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VHR image acquisition specifications for the CAP checks (CwRS and LPIS QA)

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VHR profile-based specifications including VHR+ profiles

Campaign 2015

Author: Pär Johan Åstrand	Status: V7.4
Co-authors: Giovanni Di Matteo, Csaba Wirnhardt, Armin Burger, Blanka Vajsova, Agnieszka Walczynska, Susanne Hain, Ansgar Kornhoff, Edith Simon	Circulation: Internal/Commission, MS Administrations and their contractors, FW contractor/s
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Document History:

Version	Date	Comment	Who
1.0	01/05/2008	1 st release includes updates of 2007 specifications (FMP 7528) incorporating exclusion of OrbView3, changes to EROSB, changes to Formosat2, inclusion of WorldView1, backup procedure changes, image return etc.	PA, ME, Image providers
1.1	30/05/2008	Final version after draft revision deadline 30/05/08	PA
1.2	12/03/2009	Updates on GeoEye-1	Image Providers
1.31	23/03/2009, 02/04/2009, 22/06/2009	Administrative routines, image return, change on EROS B, and SPOT backup; Final check, minor corrections §11.1.1 Image return, and 12.1.3 GE1 sw suites;	PA, ME, CA PA
2.0	01/05/2010	New edits 2010: WV1, WV2, copyrights	EUSI, PA
3.0 - 3.1	10/02/2011, 25/02/2011	Update of document for the 2011 Campaign: intro. of auto-backup, intro. of new backup approach, elevation angle restrictions, introduction of 2010 years edits including WV2 (ref doc JRC IPSC/G03 /C/PAR/par (2010)(11936)), introduction of the THEOS sensor, invoicing issues, other miscellaneous (e.g. sensor formats, zones: no 500/5 km rule on shapes); all edits in RED.	PA
3.2	05/03/2011	Further updates according to EG, BW (minor clarifications, and edit to 3.1.9 pricing issue), updates on LioDotNet by EG (e.g. upload with shapefile Annex 18.1, plus minor other changes); introduction of checksum by Image Providers and Contractors to be able to check correct image data delivery by FTP (§ 9.1.8) (AB)	EG, BW, SG, AB
3.3	13/03/2011	Clarifications on data return, introduction of functional email LioDotNet, ref. THEOS 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 item 4.1.4 (elevation angle), 11.2.1 (Image Data Access).	CA, PA
3.32	04/04/2011	Accept of Image Providers: EUSI (no further input); e-GEOS (Minor corrections to 2.1.15, 2.1.16 allowing PAN to be prime upon MS request with a possible additional HR(VHR) if requested). Renumbering of erroneously numbered chapters	Michaela Weber, Bruno Biagini, Ricardo Nasini, (Image Providers)
4.0	20/10/2011	New version for 2012 and future: 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 (4.1.5 elevation angle typo, 11.2.3 on copyright text, 12.1.4 GE1 specs., 12.3.3 IK2 specs), EUSI (2.2.1 recommendation is to keep shapes of simple shape but no compulsory limit, 12.3 QB may be chosen as prime, 12.4.3 QB tiling).	PA, A Oddone, E Simon

Version	Date	Comment	Who
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 (Item 11.2.3.)	EG, BV, PA
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 (see chapter 2.2.9); update of profiles (chapter 12), 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

1. **Introduction**

1.1. **VHR Image Acquisition for the CAP checks Programme**

- 1.1.1. Since 1993, DG AGRI has promoted the use of “Controls with Remote Sensing” (CwRS) as an appropriate control system suitable to checking if aids are correctly granted. On the basis of the Council Regulation (EC) 1306/2013 [ref i)] and of the Commission Implementation Regulation (EC) 908/2014 [ref i)], 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 cross delegation (sub-delegation of signature) by DG AGRI to DG JRC (JRC).
- 1.1.2. Following the real time evaluation in 2003 and the successful operational application since 2004, DG JRC, in agreement with DG AGRI, continues to supply Very High Resolution (VHR) SRS imagery, to the Member States’ (MS) Administrations for their CwRS of area-based subsidies.
- 1.1.3. Since 2010, DG AGRI calls for a yearly LPIS Quality Assurance (LPIS QA). VHR imagery acquired under the CwRS Campaign can be used for LPIS QA providing that the zones satisfy the issued technical LPIS QA recommendations (see further §2.1.2 below).
- 1.1.4. 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.
- 1.1.5. 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) At the moment European Space Imaging GmbH (EUSI) holds one contract [ref vii)], while another for the supply of VHR topographic (or VHR+) imagery is being tendered.

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 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. There is a substantial change in the roles of the stakeholders as from Campaign 2014 compared to earlier Campaigns, as mentioned above (§1.1.4, 1.1.5). The JRC has now an overarching role as responsible for 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 at the G-LIO¹ website, and will be available from the documentation page of the new NG-LIO.NET² website.
- 1.2.4. Several references are made here: to the Common Technical Specifications (CTS) for the Remote Sensing Controls of area-based subsidies [ref ii]); to the WikiCAP website [ref iii, iv] for further recommendations; to the Guidelines for Best Practice and Quality Checking of Ortho Imagery (ref v); to the HR profile-based specifications [ref vi] 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 vii].

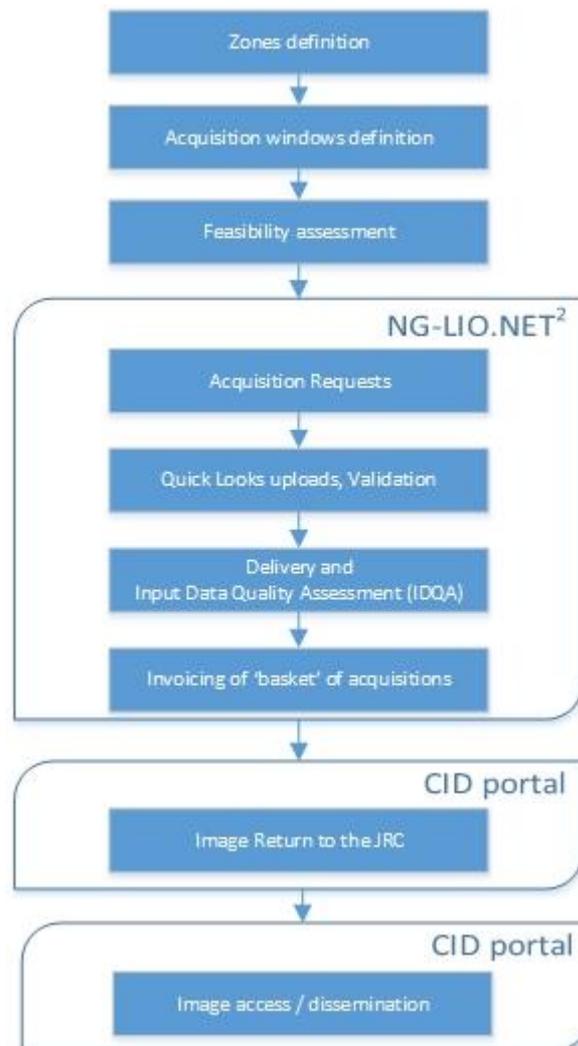


Figure 1 - Figure showing structure of this document and the SRS image acquisition process

¹ G-LIO is a Web application, implemented with Microsoft.NET technology used in 2014 Campaign and to be phased out in favour of NG-LIO.NET (New Generation LIO.NET) ; <http://g-lio.jrc.ec.europa.eu/G-LioDotNet/> ; will be <https://www.ng-lio.eu/> (see also ref. xii, xiii)

² NG-LIO.NET (New Generation LIO.NET) and the NG-QL Browser (New Generation Quick Look Browser) is a Live Image Ordering system developed within Microsoft .NET domain [ref xii]. This system will be phased in after G-LIO.NET and will compulsory be used thereafter in the 2015 Campaign.

2. Zones definition

2.1. General

- 2.1.1. The regulatory basis for the CwRS programme is given in Council Regulation (EC) 1306/2013 (Horizontal Issues), 1307 (Direct Payments)/2013 [ref. i)] and Delegated and Implementing Regulations 639/2014, 640/2014, 641/2014 that allow MS to use remote sensing techniques as a means of carrying out On The Spot (OTS) checks on agricultural parcels. These are further described in the document "Guidance for on the-spot checks and area measurement" [ref ii)], 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. Above mentioned Regulation also calls for a yearly LPIS Quality Assurance. VHR Imagery acquired during the CwRS Campaign can be used for LPIS quality assessment providing that the zones satisfy the technical LPIS QA recommendations issued, including minimum elevation angle requirements [ref iv]. MS Administrations not participating in the CwRS programme can request specific acquisitions for LPIS assessment through the EC Services of the JRC.

2.2. 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. < 5 km 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 a zone is 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 favours crop interpretation, i.e. "multi-temporality" should be as short as possible.
- 2.2.3. The MS Administration has to 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 NG-LIO.NET (see 2.2.10). The FW Contactor will programme accordingly to cover the control zone efficiently. The FW contractor/s/s may also propose a backup profile to the MS Administration whenever he considers it necessary to increase acquisition success during the Campaign.

- 2.2.4. The zone may be covered by multiple sensors fitting the prime profile selected by the MS Administration (multisensor and multitemporal acquisition 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 chance 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) is obliged to accept the backup profile collection (in case of partial coverage for the remaining part). In this case the extension of the prime profile window will be possible only in exceptional cases and following mutual agreement between the JRC and the FW contractor.
- 2.2.6. When completing any zone, the necessary overlap (E-W or N-S) between subsequent acquisitions or strips, should be a minimum of 0.5km. Also there shall be an overlap of a minimum of 0.5km 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 min allowable SatElevation:
- [max 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 pansharpended product, or the PAN only product. If the profile A4 (VHR Stereo) is requested, a stereo product will be delivered. Special profiles will allow elevation angle uplift [VHR+ or Topographic], or [8/16 bands and pan bundle] (see Chapter 12)
- 2.2.9. Basic zone parameters for each MS will be the task of the EC Services (JRC) to provide to the FW contractor/s/s:
- Relevant control method description
 - Number and sum area to be acquired (rounded to whole km², UTM); for each type of prime profile (see Chapter 12);
 - a.) CwRS: [std], [VHR+ or Topographic], the VHR[8]; VHR[16] variants; VHR[pan], VHR[stereo];
 - b.) LPIS [std];
 - Number and type of window/s
 - 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 finalise the remaining parameters (see §2.2.11 below) in its contacts with the MS Administrations (or their Contractors). The NG-LIO.NET³ web application shall be used for this purpose where all relevant parameters shall be inserted as Image Requests 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 (see §4). When the FW contractor/s/s has completed this task, he shall report to the JRC who will validate final results inserted in NG-LIO.NET before feasibility 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 handled to the FW contractor/s by the JRC ;
 - requested acquisition windows (from and to dates);
 - possible VHR backup [see Chapter 12];
 - product, bundle or pansharpended, or PAN only;
 - delivery, DVD or FTP.
- 2.2.12. The MS Administrations (or their Contractor/s), the FW contractor/s, and the JRC obligatorily need to name one contact person (or functional email address) to be used for interfacing with each other regarding the issues listed above and in all other communication during the Campaign.

³ or G-LIO.NET before it is phased out

3. Acquisition windows

- 3.1.1. There is one or two VHR image acquisition windows 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. Programming of the second window depends on available budget, and is determined by the JRC at the basic zone definition stage (see § 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). If an HR-1 window is open, it will close when the VHR prime window opens, also a HR+1 window may depend on the acquisition of the VHR image. Both these circumstances obligatorily need to be communicated between the VHR and HR FW contractor/s. Such communication is normally made via NG-LIO.NET.
- 3.1.3. If extraordinary weather conditions prevail in any region, a window may change (opening and closing dates move). This will be dealt with on a case-by-case basis. Such acquisition window date changes should occur in very rare cases. Notice shall be given by the MS Administration (or its Contractor) to the FW contractor/s/s at the latest 2 weeks before scheduled opening.
- 3.1.4. It is not useful to open an acquisition window too early in the season as the sun angle is generally low and the crops may not have developed sufficiently to provide a scene with adequate contrast for a good delineation of the parcels. It is suggested not to open any window when sun angle is less than 20 deg., in order to ensure sufficient contrast and to minimize the effect of shadows.
- 3.1.5. If a VHR profile sensor (see §12) 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].
- 3.1.6. 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 5 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.
- 3.1.7. 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).

4. **Feasibility assessment**

4.1.1. The basic zone parameters for the image requests (see §2.2.9) are sent by the JRC to the FW contractor/s at a minimum of 6 weeks before the first window starts. This will be done through signature of the relevant specific contract between the JRC and the VHR FW contractor/s.

At a minimum of 5 weeks (preferably 6 weeks) before the first window starts, the MS Administrations (or their contractors) are obliged to provide the following initial zone parameters via NG-LIO, that are essential for the FW contractor/s to proceed with the feasibility assessment:

- zone name
- VHR profiles
- possible VHR backup
- acquisition window(s)

The FW contractor/s are then responsible (see § 2.2.10, § 2.2.11) to finalise the feasibility parameters in NG-LIO, and perform the feasibility study. For these tasks, a timeframe of at least 3 weeks (preferably 4 weeks) should be granted to the FW contractor/s.

If necessary (e.g. zones are requested with windows starting earlier than beginning/mid of March) the FW contractor/s and the JRC can agree on a phased feasibility assessment (e.g. one first feasibility assessment for the early zones and a second one for all other zones).

4.1.2. 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 programming.

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

4.1.4. 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 §12.1.1). The allowed area for such elevation angle uplift will have been agreed between MS Administration and the JRC prior to the feasibility with the FW contractor/s as of §2.2.9.

4.1.5. MS Administrations should bear in mind that they should keep their requests for above elevation angle restriction to be < 25% of their overall control area.

4.1.6. Special profiles such as [8/16 bands and pan bundle] will be provided depending on feasibility and EC Services budget availability

- 4.1.7. 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 NG-LIO by the MS Administration and checked by the FW contractor/s, a final accept shall be obtained from the JRC before feasibility start.
- 4.1.8. The feasibility assessment performed by the FW contractor/s shall divide the zones in 3 categories:
- 1.) FEASIBLE WITHIN WINDOW (*) - approaching 100% probability;
 - 2.) FEASIBLE WITHIN WINDOW (*) - 80% probability (may need EXTENSION);
 - 3.) NOT FEASIBLE WITHIN WINDOW - with suggestion to make feasible (extend window to..., allow elevation angle...).
- (*) +/- 3 days adjustment of window to fit satellite pass allowed
- 4.1.9. Above feasibility results will require some iteration between the MS Administrations and the FW contractor/s. This will normally be made during January and February, before the Campaign starts.
- 4.1.10. 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 NG-LIO.NET, and accepted by the MS Administrations, will be communicated to the JRC for acceptance not later than 2 weeks before the 1st VHR window opens. In case a phased feasibility assessment is performed (also see § 4.1.1), the FW contractor/s and the JRC can agree on a shorter timeframe to finalize the first feasibility assessment for the early zones (e.g. 1 week or 3 working days before the 1st VHR window of the early zones opens).

5. Acquisition Requests (ARs)

- 5.1.1. An Acquisition Request is defined as the implementation by the FW contractor/s of the image requests of the MS Administration to cover a zone in a specific window with its defined ancillary parameters. An Acquisition Request is composed of one or more image acquisitions.
- 5.1.2. After the feasibility assessment, programming is known, and an AR for the product is opened in NG-LIO.NET. 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 Mail Selection feature in NG-LIO.NET. If no request for the extension of a window is received by the FW Contractor, the window will close at planned closure (end date window)
- 5.1.4. NG-LIO.NET functionalities are described in its manual, available on-line from the NG-LIO.NET Web site [ref xii, xiii]. It is a Web-based application developed by the JRC and further enhanced by the FW Contractors in cooperation with their technical partner. It is intended to be used to manage Zones definition, MS Administrations Image Requests, ARs, browse image uploads, validation, delivery, and preparation for invoicing. NG-LIO.NET is the main communication tool between the CAP checks actors⁴ during the Campaign; its automatic e-mails exchange can be used to synchronize actions between different actors.

⁴ Stakeholders, or Actors included in the CAP checks image acquisition JRC, MS Administrations, MS Administrations contractors, FW contractor/s (two roles: operator and image provider)

- 5.1.5. Preview of uploaded QuickLooks (QLs) is made using the NG-QL Browser which is an online application for displaying and browsing QLs and shape files from the image acquisitions. It is reachable directly from within NG-LIO.NET.

6. QL (Browse Image) Upload

- 6.1.1. The FW contractor/s will notify an acquisition through its upload in the NG-LIO.NET system (or e-mail in case of temporary system unavailability) within 2 working days from the acquisition (validated/proposed, or partial/full upload).
- 6.1.2. Uploading image acquisition details into the NG-LIO.NET 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, Country (ISO name), Zone name, profile, acquisition date (dd-mm-yyyy), CC (%), haze flag, elevation angle, display order (the display order of the given layer in the NG-QL Browser), provider status (Validated/Proposed), filename, etc. are defined in the metadata XML⁵ 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 NG-LIO.NET.
- 6.1.3. Upon upload of an acquisition the NG-LIO.NET system will automatically send messages to interested actors. Users' subscriptions are managed through the NG-LIO.NET system. By default all users receive this message unless they deactivate 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 include DigitalGlobe Browse Tool⁶ for QB, WV2, GE1 WV1 and WV3; GeoEye's GeoFUSE for IK2. For Kompsat 3 the Arirang search tool can be checked⁷ etc. 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 NG-LIO.NET for acceptance by the MS Administrations (or their Contractors).

⁵ XML metadata file specification – see Annex 18.1

⁶ <http://browse.digitalglobe.com/imagefinder>

⁷ <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 always done on intersection of the upload (or acquisition) with the zone shapefile. Every upload (or acquisition) has an acquisition date, is a contiguous area, and has a regular and simple shape. It is composed of a strip or multiple strips.
- 7.1.2. For a VHR zone the validation of an upload (or acquisition) is done on the basis of CC content. 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 §7.1.8). The FW contractor/s uploads georeferenced QLs and relevant XML metadata file, including CC assessment (following established CC threshold criteria) and haze assessment (haze flag) into NG-LIO.NET.
- 7.1.3. VHR CC thresholds are defined as follows:
- a validated acquisition is defined by a maximum CC of $\leq 10\%$ 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 §9 and §13);
 - a proposed acquisition is defined by a $10\% < CC \leq 30\%$ over the AOI. Proposed images are delivered to the MS Administration (or its Contractor) only upon the MS Administration (or its Contractor) agreement in NG-LIO.NET. 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 its 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 (2 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 (see §7.1.5). 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 (haze flag), in order to prove that the re-tasking is required.

7.1.8. VHR Haze flag is validated as follows:

- validated CC upload with flag for dense haze - the flag will trigger an e-mail to the MS Administration (or its Contractor), who will assess if the dense haze prevents control of the parcels within 3 working days and provide the FW contractor/s 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 T4 coding due haze (reference CTS [ref ii]);
 - to check if any proposed image is available;
 - to assess whether the haze image can be used if an atmospheric correction 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 image⁸.

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 FW Contractor will contact the JRC who 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 flag for dense haze - treated as proposed acquisition.

⁸ The FW contractor/s, may upon request provide final images on FTP for haze evaluation

8. Delivery

- 8.1.1. 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.
- 8.1.2. The contractual delivery period that includes production, internal QC, and ex-works availability is 6 working days after acquisition for VHR data.
- 8.1.3. Images (after validation according to procedure in §7) are delivered directly to the MS Administration (or its Contractor) after having passed through the internal QC of the FW contractor/s.
- 8.1.4. The MS Administration (or its Contractor) receives a delivery notification, through NG-LIO.NET, 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 product is delivered via FTP, NG-LIO could display the FTP address, username and password to access it, else a delivery note will be uploaded in NG-LIO.NET in Portable Document Format (PDF) or Microsoft Word document format, containing the information on the shipment.
- 8.1.5. The MS Administration (or its Contractor) must download the product within 8 working days from the day it has been placed on FTP server by the FW contractor/s.
- 8.1.6. 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 §11).
- 8.1.7. 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 §11).
- The MS Administration (or its Contractor) will fill in the Input Data Quality Assessment (IDQA) on the single acquisition page within 10 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;
 - the FW contractor/s to assess initial quality of delivered imagery;
 - the JRC to set as “ready to be invoiced” the specific acquisition and moving it to a “basket” of invoiceable acquisitions;
 - the FW contractor/s to prepare invoicing procedure.
- If the MS Administration experiences a delay to nominate its Contractor, he/she must perform all necessary actions by itself.
- 8.1.8. If the required IDQA is not filled in by the MS Administration (or its Contractor) in 10 working days from delivery of the imagery, the IDQA state will automatically be set to “accepted” to allow for timely basketification

- 8.1.9. If in the above IDQA procedure the MS Administration (or its Contractor) notes that the image area delivered⁹ does not match with the area the FW contractor/s has stated, he will enter his measured area in NG-LIO. JRC will have a final validation role on non-compliances.
- 8.1.10. An Acquisition Request 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).
- 8.1.11. If IDQA is not satisfactory for any other reason, the FW contractor/s/s and the MS Administration (or its Contractor) shall solve the situation bilaterally by either an acceptance of the MS Administration (or its Contractor), 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.
- 8.1.12. Upon request from the JRC, the FW contractor/s/s will inform status of image production/QC status (production pending, production finished, and production date) at any time of the Campaign.

⁹ calculated (rounded to whole km²) as the intersection between validated acquisition (using final ephemeris data) with the zone in geographic projection UTM/WGS 84.

9. Ordering

- 9.1.1. Ordering follows procedures set up in the FWC signed by the FW contractor/s/s and the JRC [ref. vii]. This is managed via signature of specific contracts within the FWC.

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/s and the JRC [ref. vii].

10.2. Invoicing - the VHR 'basket'

- 10.2.1. The FW contractor/s can invoice any single acquisition delivered 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". NG-LIO 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. vii]. The identification value for an acquisition to be invoiced is the Acquisition Unique identifier displayed in the VHR basket.
- 10.2.3. If accepted and delivered imagery turns out to be inadequate, relevant provisions of the FWC shall apply [ref. vii], where FW contractor/s image warranty applies.

11. **Image data provision to the JRC and image access**

11.1. **Image data provision to the JRC**

- 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). The detailed specifications for the orthorectified data will be 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 FTP¹⁰ 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". Alternatively 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 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

¹⁰ <http://en.wikipedia.org/wiki/Ftp>

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. 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 at KO meeting after the signature of the FWC [see ref. viii]. 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: ¹¹

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

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 NG.LIO system, and converting them into the required metadata XML file structure.

For *ortho images* 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. The information requested from the Member States and their contractors shall include: zone name, acquisition batch id's, mission (platform) name and version, coordinate reference system, band order with respect to the original sensor bands, imaging date & time. 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.

- 11.1.8. 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 tool¹², 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 for HR data replace "vhr" with "hr"

¹² <http://en.wikipedia.org/wiki/Md5sum>

11.2. Image access

- 11.2.1. MS Administrations (and their Contractors) may access imagery purchased through the FWC [ref. vii]. 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. vii]. An End User License Agreement (EULA) based on the same principles will bind the users from the moment of their registration to CIDportal [ref viii], or their registration to NG-LIO [ref. xii].
- 11.2.2. 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.
- 11.2.3. 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. viii, § 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 FWC 389.911 [ref. vii] with EUSI the first sentence above shall be substituted with:

- "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"
- "QuickBird data, © DigitalGlobe ™, year of acquisition, distributed by European Space Imaging"
- "GeoEye-1 data © DigitalGlobe ™, year of acquisition"
- "IKONOS 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"
- "WorldView3-data, © DigitalGlobe ™, provided by European Space Imaging"

12. VHR prime and backup profiles

12.1.1. Profiles

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	Elevation angle restriction	abs. 1-D rmse	Cloud Cover (CC) over AOI	Acquisition programming	Resampling	Remarks	Example of sensors
A1. VHR prime - CwRS [std]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	n/a	x,y ≤ 2m	≤10%	Priority programming	sensor dependent	standard CwRS profile	WV3**, WV2, GE1, K3
		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	n/a	x,y ≤ 2m	≤10%	Priority programming	0.50m	new profile	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	n/a	x,y ≤ 2m	≤10%	Priority programming	0.50m	new profile	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 - LPIS [std]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	see Table on off-nadir/elevation angle restrictions for the A2 profile in text	x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3**, WV2, GE1, K3
		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		x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3**, WV2, GE1, WV1, K3
A4. VHR prime - CwRS [Stereo]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN		x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3**, WV2, GE1, K3
		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	new profile	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	new profile	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	new profile	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		
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	as any of above
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	as any of above
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	as any of above
E. VHR back up	Pan+Multispectral (Bundle)	GSD≤3m	PAN		x,y ≤ 5.0m	≤10%	Priority programming	sensor dependent	backup	any of above plus IK2, EROSB, K3 etc.
		GSD≤12m	MS (at least 3 bands)							
	Panchromatic	GSD≤3m	PAN							
	Pan-sharpened	GSD≤3m	at least 3 bands							

(*) minimum 8 bits/pixel, recommended 11-12.

Table 1 - VHR profiles adopted within the CAP checks.

12.1.3. The LPIS A.2 profile will offer best quality imagery for the MS Administrations LPIS QA zones. From the 2015 Campaign an innovative acquisition approach has been implemented by EUSI (FWC 389.911) in order to provide close to nadir, very high resolution, haze free, and close to cloud free imagery. The acquisition windows will be longer (March – September). The sampling is random based for the purpose of LPIS QA, and the imagery (approx.

15x15 km) in size will be delivered by the EC Services (JRC) to the MS Administration who requires this type of imagery.

However, the profile A2. used in 2014 is maintained as backup of profiles A5, A51, A52 with the below restrictions on off-nadir/elevation angle.

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 profile

12.1.4. The VHR zone will be covered either by a bundle product (PAN and MSP as separate bands), or the pansharpened product, or the PAN only product. If the profile A4 (VHR Stereo) is requested, a stereo product will be delivered. If the zone is collected by WV2, WV3 the possibility to deliver 8 bands/16 bands is also an option.

12.1.5. The following satellite sensors will be used for the available VHR profiles

- A. A1: VHR prime - CwRS [std] - WV2, WV3¹³, GE1, K3
 - A11 VHR prime - CwRS [8] - WV2, WV3¹⁵, possibly others not benchmarked yet
 - A12 VHR prime CwRS [16] - WV3¹⁵, possibly others not benchmarked yet
- A2: VHR prime - LPIS [std] - see Chapter 12.1.2
- A3: VHR prime - CwRS [Pan only]- WV1, WV2, GE1, WV3¹⁵, K3
- A4: VHR - CwRS [Stereo] - WV2, GE01, WV3¹⁵, K3
- A5: VHR prime - CwRS [VHR+] - WV3^{**}, WV2, GE1, possibly others not benchmarked yet
- A51 VHR prime - CwRS [VHR+] [8] - WV2, WV3¹⁵, possibly others not benchmarked yet
- A52 VHR prime CwRS [VHR+] [16] - WV3¹⁵, possibly others not benchmarked yet
- B. VHR - archive - as any of above
- C. VHR - re-task - as any of above
- D. VHR - proposed - as any of above
- E. VHR - backup - as any of above plus IK, EROSB

12.1.6. Technical details of the sensors that fit above profiles are explained in the Annex 18.3.

¹³ WV3 ongoing benchmarking

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. vii]
- 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). Such 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 shadow¹⁴. Dense haze which causes consistent muting of imagery should be included.
- 13.2.2. There are different CC assessment routines, e.g.:
1. automatic or semi-automatic thresholding, with subsequent quality factor including issues of dense haze, haze, smoke, pollution, snow, shadow, etc. A visual observation after classification is required to adjust CC taking into account issues of dense haze, cloud conglomeration, etc.;
 2. manual photo interpretation and subsequent vector digitizing: if a definite boundary between affected pixels and un-affected pixels is visible it is 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.

¹⁴ This is an issue of research by JRC and FW contractor/s; including optimisation of CC definition fitting CAP checks requirements, historical CC definition and CC statistics

13.2.5. CC validation and haze flagging should follow the procedure described in §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 responsables and e-mail addresses

15.1.1. IES / image acquisition

par-johan.astrand@jrc.ec.europa.eu

15.1.2. IES / CAP related issues

philippe.loudjani@jrc.ec.europa.eu

16. References

- i) EUR Lex Access to European Union law: <http://eur-lex.europa.eu/homepage.html>
- ii) GUIDANCE FOR ON-THE-SPOT CHECKS AND AREA MEASUREMENT - CLAIM YEAR 2015
http://mars.jrc.ec.europa.eu/mars/content/download/3472/17236/file/DS-2014-32_OTSC%20guidelines%202015%20.pdf –final version (REV 3) will be discussed at the Direct Payment Committee in Brussels on the 9th of December
- iii) nil
- iv) LPIS quality assessment and CwRS imagery used for this assessment (WikiCAP)
http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPISQA_2.b.ii_LPIS_control_zones
- v) Guidelines for Best Practice and Quality Checking of Ortho Imagery [Issue 3.0 available at:
<http://mars.jrc.ec.europa.eu/mars/News-Events/New-version-of-the-Guidance-for-Best-Practice-and-Quality-Checking-of-Ortho-Imagery>
- vi) HR 'profile based' Specs (ref file://S:\FMPArchive\C\17362.doc)
- vii) FWCs for satellite image purchase held at the JRC IES:
 - 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 tender FWC 389.911 with **European Space Imaging** GmbH, and (2) HR profile tender FWC 389.912 **AirBus Defence and Space** respectively
 - b. Framework contract for supply of Satellite Remote Sensing Data; broker (no award as of this document last edit)
- viii) The CID portal EULA <http://cidportal.jrc.ec.europa.eu/home/idp/licensing/eula>
- ix) Benchmarking GeoEye-1, WorldView-2, GeoEye-1, Cartosat-2, Kompsat-2, RapidEye and THEOS image [JRC Oral presentation Cat3.4 JRC60286 JRC IPSC/G03/C/JNO/jno D(2010)(12136),Int. ref.

- file://S:\FMPArchive\C\12136.ppt - Presented at the MARS Unit's GEOCAP Action's Control Methods Workshop - 2010 Campaign; 13-14 April 2010; Ispra (Italy); Authors: Nowak Da Costa J.K, Åstrand P.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/>
- x) 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/>
- xii) Benchmarking the WorldView-1 and EROS B sensors for use in the Common Agricultural Policy Control with Remote Sensing programme [PUBSY # JRC49378, Category 3.4 Oral presentation, Available at: http://mars.jrc.ec.europa.eu/mars/News-Events/MARS-Conference-2008/Agenda-and-Presentations/T2_Nowak_WV1_EROS2_JRC
- xiii) NG-LIO.NET manual (TBD); G-LIO.NET manual JRC IES/H06/C/PAR/par D(2014)(17242); (See under manuals in G-LIO.NET: <http://g-lio.ejrc.ec.europa.eu/g-liodotnet>)
- xiii) URL to NG-LIO.NET will be <https://www.ng-lio.eu/>
- xiv) Benchmarking Kompsat3; <http://mars.jrc.ec.europa.eu/mars/News-Events/20th-MARS-Conference-19-20-November-2014-Dresden-Germany/pres-10>

17. 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. vii.
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
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

Abbreviation/Term	Explanation
IDQA	Input Data Quality Assessment
IES	Institute for Environment and Sustainability, Joint Research Centre
INSPIRE	Infrastructure for Spatial Information in the European Community
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. vij;
IPR	Intellectual Property Right(s)
ITT	Invitation To Tender
JRC	Joint Research Centre of the EC
LD	Liquidated Damages
LF	Landscape Feature
G-LIO.NET	JRC Web-based software for the management of image acquisitions
LPIS	Land Parcel Information 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
NG-LIO.NET	Next-Generation LIO.NET, 2015 Campaign evolution of G-LIO.NET
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

18. Annexes

18.1. XML metadata file specification for image providers

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;
2. image file(s);
3. shape file(s);
4. other file(s) for geo referencing (if applicable).

XML Structure

```

<root>
  <Images>
    <Image>
      See nodes needed for the image
    <Image>
  </Images>
  <Shapes>
    <Shape>
      See nodes needed for the image
    </Shape>
  </Shapes>
</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-LIO.NET profile), must be inside the window defined in the Acquisition Request	DateTime	Yes
Row	Image row	?	No
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-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

Node name	Description	Data type	Compulsory
CWRS_CAMPAIGN	Campaign Year	Integer	yes
ACQUISITION_ID	NG-LIO 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	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 "QUICKBIRD" or "IKONOS" or "EROS" or "SKYBOX")	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 returned 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 returned ortho imagery (coordinate system)	Integer	yes
WKT	EPSG code description	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 "16" or "32")	yes
NBANDS	Number of returned bands		yes
CWRS_CAMPAIGN	Campaign Year	Integer	yes
ACQUISITION_ID	NG-LIO 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	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 "QUICKBIRD" or "IKONOS" or "EROS" or "SKYBOX")	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 returned 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 returned ortho imagery (coordinate system)	Integer	yes
WKT	EPSG code description	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 "16" or "32")	yes
NBANDS	Number of returned bands	Integer (enumeration value="1" or "2" or "3" or "4" or "5" or "6" "7" or "8")	yes

Table 4 XML metadata file – possible sub-nodes

Country list and abbreviation

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

Table 5 Country list and standard abbreviationsProvider state

Provider Status	Description
Proposed	This acquisition is proposed
Validated	This acquisition is validated
Not Requested	A status for this acquisition is not requested

Table 6 - Possible values for Provider state

Example of metadata XML file for QL image upload

```

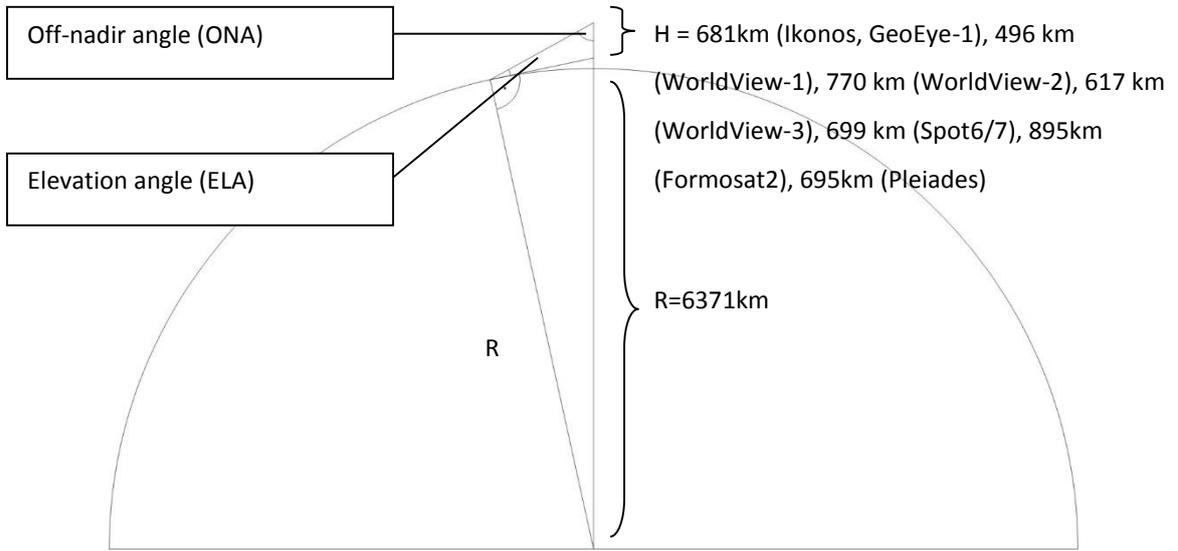
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<NewDataSet xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="http://g-lio.jrc.ec.europa.eu/G-
  LioDotNet/Portals/0/Upload_metadata_file.xsd">
  <root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <Images>
      <Image>
        <ARId>53040</ARId>
        <Country>DEMO_ITALY</Country>
        <Site>GAMMA</Site>
        <AcquisitionDate>15.06.2014</AcquisitionDate>
        <CloudCover>2.6</CloudCover>
        <Elevation>65.4</Elevation>
        <DisplayOrder>1</DisplayOrder>
        <ProviderStatus>Validated</ProviderStatus>
        <Filename>DS_PHR1B_201306130959365_FR1_PX_02694_ql.jpg</Filename>
        <AcquiredArea>200</AcquiredArea>
        <Sensor>Some type of sensor</Sensor>
        <Profile>A1 - VHR</Profile>
      </Image>
      <Image>
        <ARId>53040</ARId>
        <Country>DEMO_ITALY</Country>
        <Site>GAMMA</Site>
        <AcquisitionDate>15.06.2014</AcquisitionDate>
        <CloudCover>2.6</CloudCover>
        <Elevation>68.4</Elevation>
        <DisplayOrder>2</DisplayOrder>
        <ProviderStatus>Validated</ProviderStatus>
        <Filename>DS_PHR1B_201306130959253_FR1_PX_02710_ql.jpg</Filename>
        <AcquiredArea>200</AcquiredArea>
        <Sensor>Some type of sensor</Sensor>
        <Profile>A1 - VHR</Profile>
      </Image>
    </Images>
    <Shapes>

```

```
<Shape>
  <ARId>53040</ARId>
  <Country>DEMO_ITALY</Country>
  <Site>GAMMA</Site>
  < AcquisitionDate >15.06.2014</ AcquisitionDate >
  <CloudCover>2.6</CloudCover>
  <Elevation>56.9</Elevation>
  <DisplayOrder>3</DisplayOrder>
  <ProviderStatus>Validated</ProviderStatus>
  <Filename>CSAB1_5.shp</Filename>
  <AcquiredArea>200</AcquiredArea>
  <Sensor>Some type of sensor</Sensor>
  <Profile>A1 - VHR</Profile>
</Shape>
</Shapes>
</root>
</NewDataSet>
```

Figure 2 - Sample XML metadata file structure (including shape file)

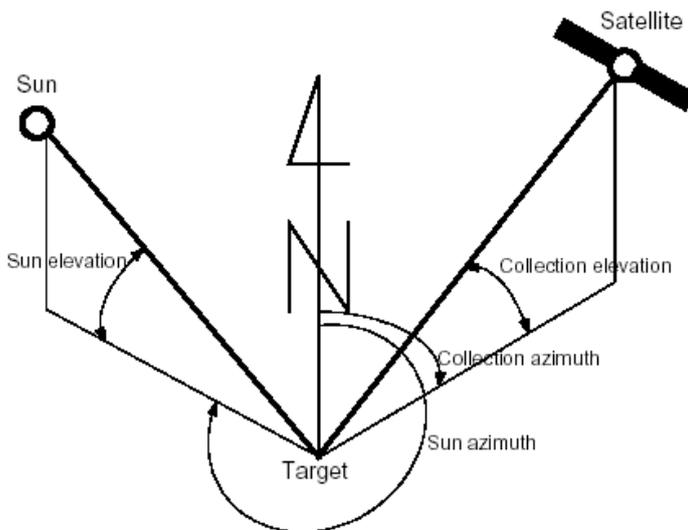
18.2. Relation elevation angle vs. off-nadir angle, and some satellite angles of importance



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

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

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



18.3. Sensors

18.3.1. Prime WorldView-2 (WV2)

The WV2 system is built to acquire large areas - typically more than 100x100km in a single pass, as well as multiple single shot (point) targets. However, an efficient collection scheme is achieved with zones of approx. 40x40km which will provide a moderate to high area yield per pass. Due to the extreme agility of the satellite another efficient collection scenario is multiple single shots of 15x15km. A mix of both scenarios is also acceptable.

WV2 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 16.4km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between.

For benchmark tests see [ref. x].

For WV2 the products ordered will be /km²:

- Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1));
- Ortho Ready Standard Pansharpened 4 Bands (BGRNIR);
- Ortho Ready 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 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 0.46m PAN (resampled to 0.5m), 1.84m MSP (resampled to 2.0m); for the VHR+ profile resampling will change to 0.4m for the PAN, and 1.6 m for MSP.
- Swath width at nadir 16.4km;
- Cloud cover "validated" 0 - ≤ 10%, "proposed" 10% < CC ≤ 30%;
- Resampling Cubic convolution;
- Format GeoTIFF;
- DRA (dynamic range adjustment) off;
- bit depth 16bit (image 11bit);
- UTM Datum WGS84;
- Special Priority Tasking;
- DVD delivery or FTP delivery;
- UTM Datum WGS84;
- Image tiling:

4 Band Bundle (32k x 32k tiling): MUL files have a max of 537MB/tile, PAN files have a max of 2,140 GB /tile,

8 Band Bundle (32k x 32k tiling): MUL files have a max of 1,073GB/tile, PAN files have a max of 2,140GB/tile,

4 bands PSH (22k x 22k tiling): files have a max of 3,872GB/tile.

18.3.2. Prime GeoEye-1 (GE1)

The GE1 system is built to acquire large areas in a single pass (up to 100x100km or 300x50km), anyway the best efficiency (meaning the capacity to acquire as many zones per pass as possible) is achieved with zones up to 40x40km. At launch the GE1 system could acquire forwards and backwards (bi-directional scan) giving a very high collection rate. Today it acquires only in one scan direction but is still capable of acquiring at a sufficient rate (thanks also to the introduced Enhanced Line Rate scanning mode, which allows to scan at 20,000lps also for colour acquisitions), and can still acquire large zones in one orbit path. The satellite is designed to work in a preferred East-West scanning direction (but it works also North-South), therefore it is especially recommended for zones having an E-W orientation. For benchmark tests see [ref. ix].

For GE1 the products ordered will be /km²:

- Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1));
- Ortho Ready Standard Pansharpened 4 Bands (BGRNIR);
- Ortho Ready 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 Stereo panchromatic only;
- resolution at nadir 0.41m PAN (resampled to 0.5m), 1.65m MSP (resampled to 2.0m), could potentially be changed to 0.4m (for A2 profile; tiling would be 8k in this case);
- Swath width at nadir is 15.2km;
- Cloud cover validated 0 - ≤ 10%, proposed 10% < CC ≤ 30%;
- resampling CC;
- format GeoTIFF;
- DRA (dynamic range adjustment) off;
- bit depth 16 bit (image 11bit);
- UTM Datum WGS84;
- Commercial Priority Tasking;
- DVD delivery or FTP delivery;
- Image tiling:

4 Band Bundle (32k x 32k tiling): MUL files have a max of 537MB/tile, PAN files have a max of 2,140 GB /tile,

4 bands PSH (22k x 22k tiling): files have a max of 3,872GB/tile.

The JRC have reached very good orthorectification results using: PCI 10.1 Geomatica OrthoEngine (RPC IK2 model, degree 1 polynomial), ERDAS LPS 9.2. (RPC IK2 model, degree 1 polynomial).

18.3.3. Prime / Backup WorldView-1 (WV1)

WV1 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 17.6km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between. Because of the extreme agility of the satellite the individual orientation of each AOI is of less importance.

WV1 features a very high resolution, high geolocation accuracy, and extreme agility.

The quality and efficiency of the WV1 data has been assessed by the JRC (ref xi)

WV1 data will normally be used as a speculative backup at the MS Administration's (or its Contractors) request and most often in difficult climatic zones (e.g. above 45° Lat.), or of zones which present difficulties in the feasibility assessment. For zones where no multispectral data are required it may also be requested as a prime sensor with the VHR-Pan profile.

For WV1 the products ordered will be /km²:

- Standard Ortho-Ready - the data is panchromatic (PAN);
- resolution 0.50m;
- cloud cover "validated" ≤ 10%, "proposed" 10% < CC ≤ 30%;

resampling Cubic Convolution;

- format GeoTIFF 1.0;
- bit depth 16 bit (image 11bit);
- UTM Datum WGS84;

Special Priority Tasking;

- DVD delivery or FTP delivery;
- image tiling: 32k x 32k, PAN files have a max of 2,140GB /tile.

recommended minimum versions of software suites that can ortho correct WV1 data are e.g. ERDAS Imagine 9.2 (Basic format using rigorous modelling, Std. Ortho-Ready format using QB RPC model), ERDAS Imagine 9.1 (Std. ortho ready format using QB RPC model), PCI 10.1.2., Keystone;

18.3.4. Backup Ikonos-2 (IK2)

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

For IK2 the products ordered will be /km²

- geo products (which include RPCs);
- Bundle (Panchromatic and 4 Multispectral bands as a single 4-layers file), or
- Pansharpened (4 multispectral bands at PAN resolution, provided as a single 4-layers file); resolution at nadir 0.82m PAN (products can be provided at full resolution or resampled to 1m), 3.28m MSP (products can be provided at full resolution or resampled to 4m);

- swath width at nadir is 11.3 km;
- cloud cover “validated” $\leq 10\%$, “proposed” $10\% < CC \leq 30\%$;

resampling Cubic convolution;

- format GeoTIFF 1.0;
- DRA (dynamic range adjustment) off;
- bit depth 16 bit (image 11bit);
- UTM Datum WGS84;

Commercial Priority Tasking;

- DVD delivery or FTP delivery;
- IK2 maximum component size 4GB.

18.3.5. Backup EROS B

The swath width of the EROS B satellite is 7km, but a mosaic of multiples of this can be acquired in the same pass. The most efficient EROS B zone is 26kmx28km.

EROS B data only exists as PAN.

Such data will normally be used as as backup at the MS Administration’s (or its Contractors) request and most often in difficult climatic zones (e.g. above 45° Lat.), or in zones that present difficulties in the feasibility assessment.

MS Administrations need to ensure that their Contractors can handle EROS B data ortho-correction and indicate this via email to the FW contractor/s; otherwise such backup will not be programmed by the FW contractor/s.

Zones programmed with EROS B shall be imaged starting half a second earlier and finishing half a second later in order to ensure correct telemetry at start/end of scene, as this will allow usage of GCPs close to the boarder of the zones (a problem which was noted in 2008 Campaign).

The quality and efficiency of the EROS B data has been assessed by the JRC (ref xi).

For EROS B the products ordered will be /km²

- EROS B level 1A (plus pass file); panchromatic;
- resolution 0.7m;
- swath width at nadir is 7km;
- cloud cover “validated” $\leq 10\%$, “proposed” $10\% < CC \leq 30\%$;
- format tiff (1A);
- bit depth 16 bit (image 11 bit);
- UTM Datum WGS84;

Commercial Rush Service;

- DVD delivery or FTP delivery;

SW recommended - Socet Set (EROS B model), ERDAS Imagine 9.2 and PCI Geomatica 10.1.1.

18.3.6. Prime WorldView 3 (WV3)

WorldView-3 sensor has been launch in August 2014 from the Vandenberg Air Force Base located in California, US.

The resolution of 0.31m makes WorldView-3 the highest resolution commercial satellite in the world. Satellite sensor characteristics (design and specifications) are given in the **Error! Reference source not found.**

Orbit	Altitude	617km
	Type	SunSync, 10:30am descending Node
	Period	97min
	Inclination	98°
	Revisit Frequency (at 40° lat)	< 1 days (1-m GSD) 4.5 days (< 20° off-nadir)
Sensor Bands		
Imaging System	Panchromatic	400-450nm
	8 Multispectral	
	Coastal: 400-450nm Blue: 450-510nm Green: 510-580nm Yellow: 585-625nm	Red: 630-690nm Red Edge: 705-745nm Near-IR1: 770-895nm Near-IR2: 860-1040nm
	8 SWIR Bands	
	SWIR-1: 1195-1225nm SWIR-2: 1550-1590nm SWIR-3: 1640-1680nm SWIR-4: 1710-1750nm	SWIR-5: 2145-2185nm SWIR-6: 2185-2225nm SWIR-7: 2235-2285nm SWIR-8: 2295-2365nm
	12 CAVIS Bands	
	Desert Clouds: 405-420nm Aerosol-1: 459-509nm Green: 525-585nm Aerosol-2: 635-685nm Water-1: 845-885nm Water-2: 897-927nm	Water-3: 930-965nm NDVI-SWIR: 1220-1252nm Cirrus: 1365-1405nm Snow: 1620-1680nm Aerosol-3: 2105-2245nm Aerosol-3: 2105-2245nm
	Dynamic Range	11-bits per pixel Pan and MS; 14-bits per pixel SWIR
	Sensor Resolution (GSD)	Panchromatic: nadir: 0.31m 20deg off nadir angle: 0.34m Multispectral: nadir: 1.24m 20deg off nadir angle:1.38m SWIR: nadir: 3.70m 20deg off nadir angle:4.10m
	Collection Capabilities	
Collection Capabilities	Swath Width	At nadir: 13.1 km
	Capacity	680,000 km ² per day
	Geolocation Accuracy (CE90)	Predicted <3.5 m CE90 without ground control

Satellite sensor characteristics – design and specifications

WorldView-3 image products

Worldview-3 imagery will be processed and delivered as Ortho Ready Standard Imagery (2A or OR2A). A brief description of mentioned image products is given below.

Ortho Ready Standard Imagery (OR2A) has no topographic relief applies with respect to the reference ellipsoid (making it suitable for orthorectification), is projected to a constant base elevation calculated on the average terrain elevation per order polygon.

Benefits and Applications**Benefits:**

- Simultaneous, high resolution, super-spectral imagery
- Large area mono and stereoscopic collection eliminates temporal variations
- Precision geo-location possible without ground control points
- Global capacity of 680,000 km² per day
- Superior Haze Penetration
- **New and enhanced applications**, including:
 - Mapping
 - Land Classifications
 - Disaster Preparedness/Response
 - Feature Extraction/Change Detection
 - Soil/Vegetative Analysis
 - Geology: Oil & Gas, Mining
 - Environmental Monitoring
 - Bathymetry/Coastal Applications
 - Identification of Man-made Materials.

Commissioning status of WorlView-3

WorldView-3 Commercial Operations began on October 1st, 2014. Spacecraft commissioning was completed on August 19th, 6 days after launch. VNIR Instrument commissioning and VNIR product validation completed on September 30th. Commissioning activities included complete activation of the satellite (all operational capabilities verified), VNIR instrument camera calibration, VNIR radiometric calibration, Geo-location accuracy determination and integration into the complete DigitalGlobe Ground System (order entry, collection tasking, product generation, product delivery).

Benchmarking tests of WorldView-3 imagery will be performed by EUSI and after final acceptance form JRC the sensor can be used for the 2015 CwRS Campaign.

18.3.7. Prime or backup Kompsat 3 (K3)

Launched in May 2012, KOMPSAT-3 is a Korean remote sensing satellite, operated by the Korea Aerospace Research Institute (KARI) in cooperation with Satrec Initiative (SI), which provides 0.7 m GSD panchromatic image and 2.8 m GSD multi-spectral image data. The Mission orbit of the KOMPSAT-3 is a sun-synchronous near-circular orbit with an

altitude of 685.12 km. The orbit inclination is 98.13 degrees and the satellite operates with a nominal local time of ascending nodes of 13:30 PM. KOMPSAT-3 provides the highest bit per pixels (14 bits/pixel) among commercial satellites. Additionally, due to its enhanced radiometric depth, more detailed classification results can be acquired.

1.1. Satellite sensor characteristics- design and specifications

Launch information	Date: 18.05.2012 Launch Vehicle: H-IIA launch system Launch Location: Tanegashima Space Center of JAXA, Japan
Satellite weight/size/power	approx. 980 kg; 3.5 m height, 2.0 m diameter; 1.3 kW
Orbit	Altitude: 685 km Type: sun-synchronous near-circular Period: 98.58 min
Inclination/Equator Crossing Time	98.13 deg/ 13:30pm (ascending node)
Orbits per day	409R28D : 409 orbits per 28 days. 14.6 orbits per day
Revisit rate	3.5 days average revisit time at +/- 30 deg tilt angle over equator area

Satellite sensor characteristics

Sensor bands (spectral range)	Pan & 4 MS: <ul style="list-style-type: none"> • Panchromatic: 450 – 900 • Blue: 450 – 520 • Green: 520 – 600 • Red: 630 – 690 NIR: 760 – 900
Sensor Resolution	At nadir: <ul style="list-style-type: none"> • 0.70 m panchromatic • 2.80 m multispectral
Dynamic Range	14 bits/pixel
Swath Widths	16 km at nadir
Geolocation Accuracy (CE90)	< 48.5 meter (CE90) : measured < 70 meter (CE90) : system specification Planimetric Accuracy : < 2 pixel(CE90)
Capacity	Global:
Ability to collect imagery	<ul style="list-style-type: none"> • 300,000 km² per day • 109,500,000 km² per year KOMPSAT-3 can be tilted up to +/-56 degree from LVLH about roll axis (nominal operation range is +/-30 degree) and up to +/-30 degree about pitch axis Imaging Modes: <ul style="list-style-type: none"> • Strip Imaging • Multi Point Imaging • Single Pass Stereo Imaging Wide Area Along Imaging

Expected End of Operational Life	Expected life time > 7 years
Product baseline	
Product level	1R (Option)
Horizontal Accuracy* (m, CE90) Specification (Expectation)	70,0 (50,0)
Maximum off-nadir angle (degree) for data delivered under prime profile	15
Nominal GSD at nadir (m)	0,7
Products/band combination	bundle (pan + 4 multispectral) pan-sharpened (4 pan-sharpened bands).
Processing:	-without GCP -using POD/PAD -Radiometric correction -sensor correction -MTF compensation -Geo-information included

Kompsat-3 parameters

Applications and benefits

Applications:

- Provision of continuous very high-resolution (VHR) earth observation (EO) images
- DEM generation
- Location-based services
- Land and vegetation observation
- Resource management
- Environmental, agricultural and oceanographic analysis
- Intelligence
- Public safety
- Disaster and crisis Monitoring
- Mapping and rapid response

Benefits:

- Native dynamic range of 14 bits/pixel provides more details for any spectral analysis including NDVI, classification, etc. It also provides better color balancing during mosaic processing.
- Afternoon imaging capability increases the chance of acquiring cloud-free images over specific targets/areas

- Satellite agility permits event monitoring as well as single-pass stereoscopic observations. Acquisition of multi-targets in one (1) pass is also available which is good for monitoring of several targets during short period.

Commissioning status

KOMPSAT-3 was launched as a “co-payload” on 18 May 2012 from the JAXA Tanegashima Space Center in Japan. The launch vehicle was H-IIA system.

On June 15, 2012, KARI released the first image obtained by KOMPSAT-3 (Jeodong Port on Ulleungdo Island, Korea). A check-up of the condition, attitude control systems, and on-board equipment has confirmed that the KOMPSAT-3 is functioning normally.

On April 8, 2013, KARI announced the start of commercial services of KOMPSAT-3 after in-orbit validation on 29 March, 2013. Satrec Initiative distributes KOMPSAT-3 imagery on a world-wide basis.

Mission Status and periodic tests:

The KOMPSAT-3 spacecraft and its payload are operating nominally in 2014.

Geometric and radiometric performances are measured every month. If those values are not within specification, the update of system parameters is performed to keep quality parameters within the specification. The result will be reported on Satrec Initiative’s web page as required. (<http://kompsat.satreci.com>)

(end document)