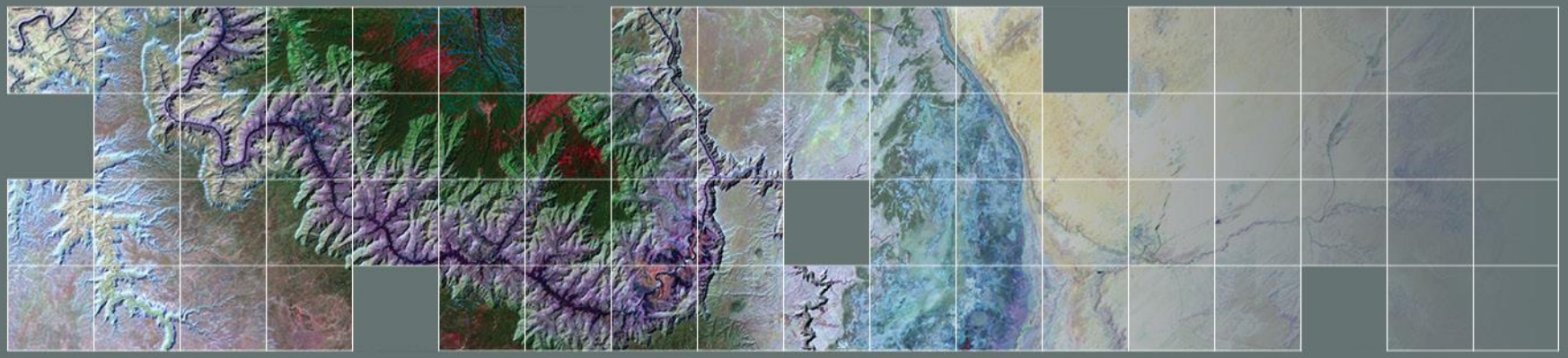
USGS
science for a changing world

Climate and Land Use Change
Earth Resources Observation and Science (EROS) Center

USGS Sentinel-2 Status



John Dwyer
January 13, 2016
Landsat Science Team

U.S. Department of the Interior
U.S. Geological Survey

USGS Plans for Sentinel-2 Data

- **Presented Investigation Summary "Sentinel-2 Augmentation to Landsat Data Record" to Land Remote Sensing Program October, 2014**
  - Scope and Ops Con assumptions used for analysis
  - Investigation Analysis & Findings
  - Architecture Recommendation & Implementation Summary
  - Risks & Considerations
  - Work packages and associated cost estimates
- **Collaborating with NASA on pre-flight calibration to data characterization to define Science data processing to ensure Landsat and Sentinel-2 data synergy**

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Implementation Tiers and Options

- **Implementation Tiers:**
  - ✓ **Tier 1: EROS will pull a copy of all L1C data from ESA, create single tile based products from ESA multi-tile based products, host a copy at EROS, generate a Full Resolution Browse (FRB) and enable basic data discover capabilities (no other processing included)**
  - **Tier 2:** In addition to Tier 1, add a minimal amount of processing necessary to increase usability of the data, including reformatting data to be more consistent with Landsat Level 1 and resampling the Level 1C data to a 30m common grid and tiling scheme (Landsat-like) for distribution as an on-demand Landsat-like product
  - **Tier 3:** This is a separate and parallel scenario to Tier 2 to render the MSI data interoperable with Landsat and significantly increase the usability/utility of the data for research/applications and makes the data as seamlessly similar as possible to Landsat data for the user (feasibility pending and therefore, not yet estimated)
- **Additional defined options:**
  - ✓ **Option 1: Increased disk cache for S2 to 360 days and added 10% each year to improve user experience**
  - **Option 2:** Generate surface reflectance products from S2 data and archive and distribute to the public (currently assuming use of NASA Ames Research Center (ARC) for processing SR data)
  - **Option 3:** Provide coincident search and discovery of both inventories (Landsat & S2) simultaneously in EarthExplorer and provide aggregated results (feasibility pending and therefore, not yet estimated)
- **Scope and Schedule remain contingent upon available funding**

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USGS Sentinel-2 Procurement Status

QTY	HW Description	Status	Comment
1	Sentinel Ingest/Distribution server	Installed	Single point of failure (pending procurement)
2	T10K-d tape drives	Installed	
1	LTO-6 tape drive	Installed	
1	SAN 96 port fibre switch	Installed	
1	1.2TB Solid State Disk to augment Inventory Database	Installed	
2	V3700 dual ctrl with SSD/SAS -- CR1MSS 1st tier disk (L1C/FRB/WMS) ~35TB	Installed	
2	V3700 exp tray with SAS disk -- CR1MSS 1st tier disk (L1C/FRB/WMS)	Installed	
2	V3700 dual ctrl with 12x4TB disk -- CR1MSS 2nd tier disk -- ~2x288TB	Installed	
12	V3700 additional disk tray with 12x4TB disk -- CR1MSS 2nd tier disk	Installed	
1	Network infrastructure -- Extreme Black Diamond 8810 core switch	Installed	
1	Juniper firewall (upgrade to existing asset)	Installed	
2	Rack for additional hardware	Installed	

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FY15 Milestones and Deliverables

Executive Milestones	Status	Start	End	Notes/Deliverable
FY15a Hardware Procurement Submission (2 months IT approval, 1 month TSSC award, 2 months to purchase and delivery)	Done	Nov 2014	May 2015	Hardware procurement completed
Sentinel-2A Software Requirements definition	Done	Jan 2015	Dec 2015	Inventory, EE change requests
Sentinel-2A Launch	Done	Jun 2015	Jun 2015	Launch of first Sentinel-2 satellite
FY15a Hardware Integration	Done	May 2015	Nov 2015	Integrated hardware into existing architecture – Network switch, SAN switch, tape drives, ingest server, 1st and 2nd tier disk
Sentinel-2A SW Dev	In Process	Feb 2015	Feb 2016	Ingest, Inventory, EE, GloVis, TRAM
Document Sentinel-2 data characterization	In Process	Apr 2015	Dec 2016	Perform and document data characterization studies from which to document differences between standard ESA products and USGS product packaging.
Sentinel-2A System testing	In Process	Aug 2015	Feb 2016	System Testing Ingest, Inventory, EE, GloVis, TRAM
Receive L1C 'ramp up' data from ESA	In Process	Jul 2015	Feb 2016	No S2 available on International Data Hub, using Science Hub data to validate SW Dev
Sentinel-2 ORR	Future	Sep 2015	TBD	Operation Readiness Review for production release to support Sentinel-2 archive and distribution
FY16 Hardware Procurement initiation	Future	Oct 2015	TBD	Hardware procurement outline in FY16 budget
Sentinel-2A L1C data available for download	Future	Jan 2016	TBD	Pending Sentinel-2 data availability on International Data hub and ORR

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USGS suggestions for ESA consideration

- **Populate the International Data Hub with L1C products**
- **Provide USGS Internet 2/GEANT access to International Data Hub L1C products**
- **Provide automated access to L1C products for the International Data Hub**
  - Similar to API that is available on the Science Data Hub
  - Increase number of concurrent connections allowed per user id
- **Provide Database reconciliation tools for the International Data Hub**
- **Provide tile based rather than bundled tile L1C products**
- **Shorten file naming convention for L1C products**
- **Provide Network and other Technical POC's in support of Inter-Agency agreements**

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Feedback topics for LST consideration

- **Examples: http://edcftp.cr.usgs.gov/edcuser/cgacke/Sentinel2/**
  - **ESA_Sample folder – original ESA zip file in SAFE format**
    - **Contains 12 Granule (Tile) folders**
  - **Tiles_Samples folder – 12 separated tiled products**
  - **FRB_Samples folder – 12 FRB representing the tiled products**
- **Comments and/or suggestions on sample L1C tile based products**
- Please look at the sample S2 products. USGS plans to provide a different download format for the Sentinel-2 product. The ESA product is a SAFE (Standard Archive Format for Europe) format with multiple tiles of S2 products in a JPEG2000 format contained within it. This download format can result in a very large file size. The USGS will provide single tiles in the same JPEG2000 format along with the necessary XML metadata files in a .zip file.
- **Comments and/or suggestions on the sample Full Resolution Browse products**
- **Examples: http://edcftp.cr.usgs.gov/edcuser/cgacke/Sentinel2/**
- Please look at Full Resolution Browse Sample products. This product mimics the Landsat FRB. USGS is considering implementing a tool similar to LandsatLook (https://landsatlook.usgs.gov) for the Sentinel-2 products.

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Feedback topics for LST consideration

- **Examples: http://edcftp.cr.usgs.gov/edcuser/cgacke/Sentinel2/**
  - Sample is from October 21, 2015 and crosses the Oregon and California border.
  - **ESA_Sample folder – original ESA zip file in SAFE format**
    - Contains 12 Granule (Tile) folders
    - Sample is ~700 mb in size, many of ESA products are 3 to 7 gb in size.
  - **Tiles_Samples folder – 12 tiled products**
    - Includes ESA's metadata such as the product and data strip xmls along with terms and condition link within a text file.
    - The AUX_DATA folder contains a binary European Centre for Medium-Range Weather Forecasts (ECMWF) file, ~800 bytes.
  - **FRB_Samples folder – 12 FRB representing tiled products**
    - **Bands 11, 8a and 4 as RGB**
    - TOA scaled to 8-bit at 20-m resolution
    - 75% compression
    - Gamma value of 2 (following Landsat FRB documented requirements)

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Feedback topics for LST consideration

- **Path name too long for Windows to unzip (Linux no issue)**
  - Limit of 260 characters
  - Requires Winzip, 7-zip or similar software
- **File Names too long**
  - Unnecessary info
  - Proposed example – could be S2A_L1C_TTTTTT_YYYYMMDD_YYYYMMDD_VV.zip
    - TTTTTT is MGRS UTM tile grid system
    - 1st YYYYMMDD is acquisition date
    - 2nd YYYYMMDD is production date
    - VV is a version number
- Tiled product not in the SAFE format
- Changing the file naming convention at USGS complicates file structure convention and impacts internal metadata within all xml files.
- ESA has expressed changes to Sentinel-2 products in 2016 per customer feedback.

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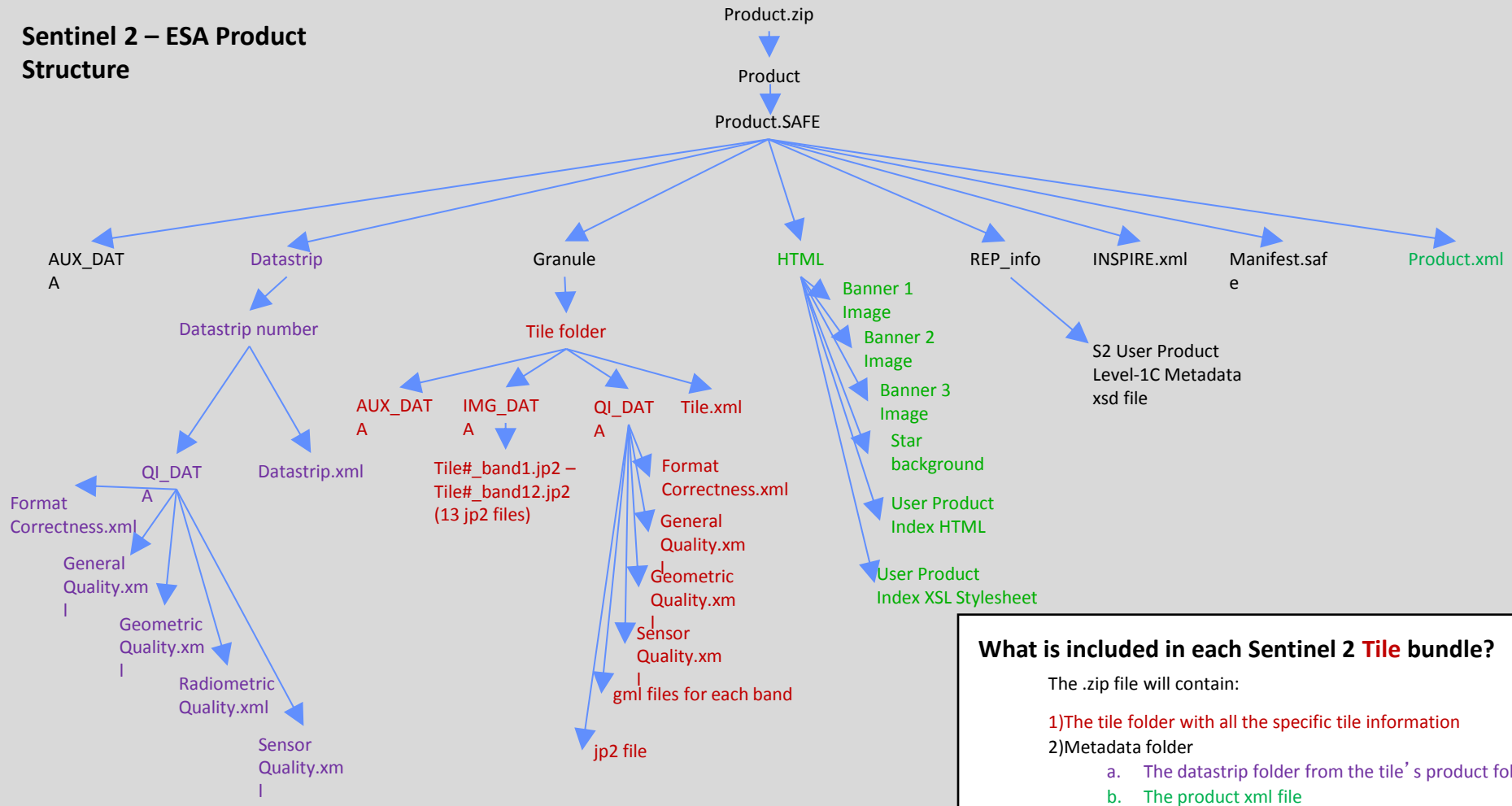
Sentinel 2 – ESA Product Structure



What is included in each Sentinel 2 Tile bundle?

The .zip file will contain:

1)The tile folder with all the specific tile information
2)Metadata folder
   a. The datastrip folder from the tile's product folder
   b. The product xml file
   c. The HTML folder from the tile's product folder
3)Citation – The Sentinel Data Terms and Conditions txt file

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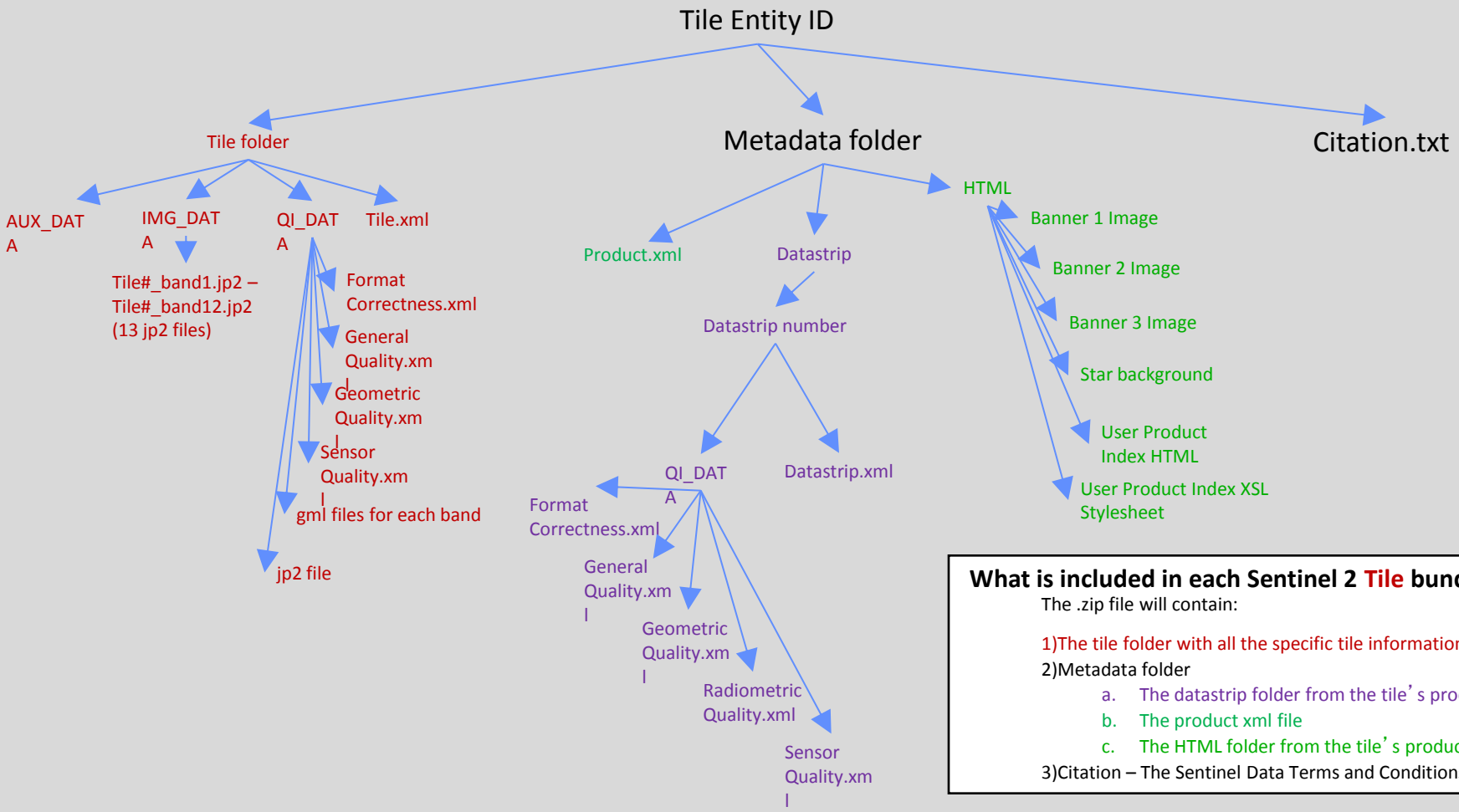
Sentinel 2 – USGS Tile Product Structure



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EarthExplorer – earthexplorer.usgs.gov