# Image Cutout Service Requirements (draft)

VO reference (for future check): IVOA SODA

> ⚠ DM-9769 - Jira project doesn't exist or you don't have permission to view it.

## A. Requirements

For a given imageID (which uniquely identifies an image), based on the cutout parameters (orientation, center position, and size), the cutout service will return a cutout image.

This document addresses the cutout services for two types of images, Processed Visit Images (PVIs) and coadded images.

For PVI cutout:

- If the requested cutout size is larger than the given PVI, the cutout service needs to stitch multiple PVIs together:
  - The cutout service should only use the PVIs from the same full field of view (FOV), in other words, they are all taken at the same time.
  - The cutout service needs to be able to cross image edges and to handle gaps in the coverage (e.g., gaps between CCDs) and set those pixels to some value (NULL?) that can be read by the visualizers and set to 'black'.
- User could request the orientation of the cutout image in the camera array coordinate system (equivalent to the pixel space coordinate system) or any world coordinate system.
- If the orientation of the cutout is in the camera array coordinate system, the cutout service should respect that and do not do re-projection. The flux value in the output image should be the same as in original image.
- If the requested orientation of the cutout is in world coordinate system, the image needs to be re-projected to generate the cutout.

For coadded image cutout:

- If the requested cutout size is larger than the given image, the cutout service needs to stitch multiple coadded images together.
  - The cutout service may not need to take care of the gaps as there are supposedly no gaps between the coadded images.
- User could request the orientation of the cutout, either in the pixel space coordinate of the given image or in any of the world coordinate systems.
- If the requested orientation of the cutout is in world coordinate system, the image needs to be re-projected to generate the cutout.

The cutout service should be able to handle many calls without performance degrading.

## B. Inputs to the cutout service

For a given image, the cutout input parameters define the orientation, the center position, and the size of the cutout image.

**(1)Orientation (string):**

This input defines the orientation of the cutout. The cutout will be done along the longitude and latitude of the coordinate system (see Notes).

The orientation could be any of the following:

- Pixel Coordinate
- Equatorial J2000
- Equatorial B1950
- Ecliptic J2000
- Ecliptic B1950
- Galactic
- Super Galactic

**(2)Center (decimal, decimal, string):**

**x, y, unit**

- The center parameter consists of a coordinate pair and an optional unit.
- Unit can be pixel (px, pix, pixels) or angular (arcsec, arcmin, deg).
- If unit is in pixel, (x,y) is interpreted as the pixel space coordinate in the input image.
- If unit is angular, (x,y) is interpreted as the right ascension(RA) and declination(Dec) in Equatorial J2000.
- Valid Dec range is [-90, 90] degrees; Valid RA range is [0, 360].

Examples:

| Center | Interpretation |
|--------|----------------|

| | |
|---|---|
| 1000, 2000, px | The cutout is centered at pixel1 = 1000, pixel2 = 2000 |
| 100, 200, arcmin | The cutout center is at (RA = 100 arcmin, Dec = 200 arcmin) in Equatorial J2000 |
| 30, 60, deg | The cutout center is at (RA = 30 deg, Dec = 60 deg) in Equatorial J2000 |

**(3)Size (decimal, decimal, string):**

**x, y, unit**

- The size parameter consists of two size values and a unit specification.
- Unit can be pixel (px, pix, pixels) or angular (arcsec, arcmin, deg).
- The (x, y) is taken to be the (full-width, full-height) in arc length of the requested cutout along the (longitude, latitude) direction or the (horizontal, vertical) pixel direction given in Orientation parameter above.
- Valid size values are positive decimal numbers.

Examples:

| Size | Orientation | Interpretation |
|---|---|---|
| 100, 200, pix | Pixel Coordinate | The width is 100 pixels and the height is 200 pixels along the Pixel Coordinate of the input image. |
| 200, 150, arcmin | Equatorial J2000 | The cutout width is 200 arcminutes (arc length) along Equatorial J2000 RA direction. The cutout height is 150 arcminutes (arc length) along Equatorial J2000 Dec direction. |
| 45, 60, deg | Ecliptic J2000 | The cutout width is 45 degrees (arc length) along Ecliptic J2000 longitude direction. The cutout height is 60 deg (arc length) along the Ecliptic J2000 latitude direction. |

## C. Notes

We require that all the cutout images shall be North Up. In other words, if the orientation is one of the world coordinates, the line of longitude through the center of the cutout must be upright and at the middle of the image. See attached images from https://skyview.gsfc.nasa.gov.
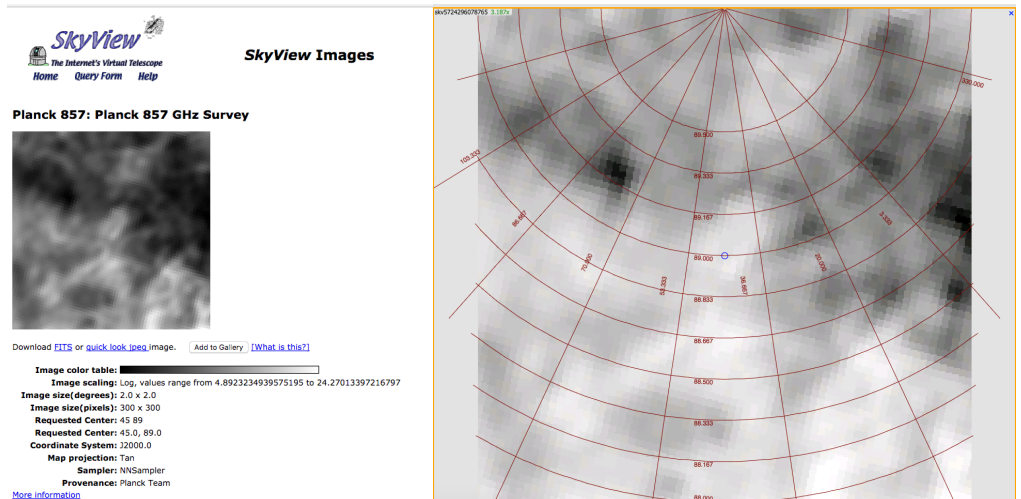


## D. Questions:

- LSST generated images:

| Type | Level | size | Availabel to user | minimum parameters to uniquely identify it | relavant provenance | required data to re-process |
|---|---|---|---|---|---|---|
| raw | L1 | | Y | | • time of observation<br>• airmass<br>• seeing | |
| PVI | L1 | | Y | | | • Calibrtion data<br>• Processing dara |
| difference image | L1 | | Y | | | |
| template image | L1 | | Y | | | |
| | | | | | | |
| raw | L2 | | Y | | | |
| PVI | L2 | | Y | | | |
| difference image | L2 | | Y | | | |
| template | L2 | | Y | | | |
| Deep coadd (ugrizy) | L2 | | Y | | | |
| 7th deeper multi-color coadd | L2 | | Y | | | |
| short-period coadds (ugrizyM) | L2 | | N | | | |
| PSF-matched coadds (ugrizyM) | L2 | | N | | | |

- Definition of Track, ...