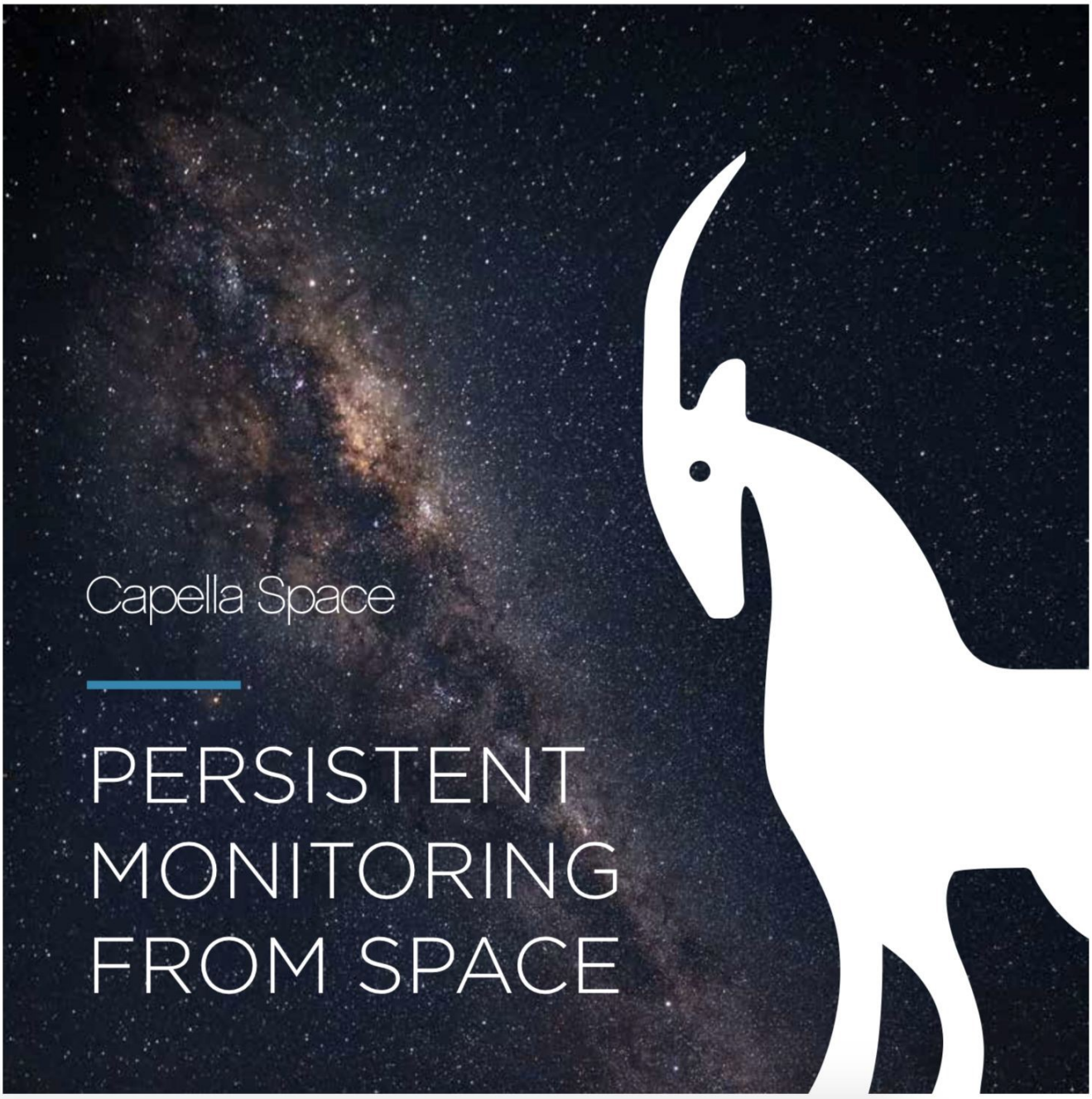
CAPELLA SPACE

SAR IMAGERY PRODUCTS GUIDE



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DISCLAIMER

This document captures the specifications, characteristics and performance of Capella Space product offerings and associated systems at the time of publication. The information presented herein is for informational purposes only and is not contractual. The products, services and systems described in this document are subject to change without prior notice. Capella Space makes no representations or warranties with respect to this document. Furthermore, Capella Space assumes no responsibility for the use of the information contained herein, and your use of the information presented in this document for any purpose whatsoever is at the sole risk of the user.

DOCUMENT CHANGE LOG

Version	Date	Change Description
2.10	10 April 2020	Change log first introduced into document
2.11	29 April 2020	"Optional New Acquisition Tasking Exclusivity" & "No Bumping Policy"
2.12	4 June 2020	Multi-Looking Figure, Ordering Section, Tasking Statuses
2.13	18 June 2020	Updated with new specification for Spot GEO imagery product
2.14	30 June 2020	Revised content to reflect initial SAR imagery product offerings
2.15	4 September 2020	Extended & Custom imagery products; Expanded tasking description
2.16	11 September 2020	Added minimum and maximum range of values for Custom parameters
3.0	22 January 2021	Refinement of product specifications based on satellite commissioning
3.1	11 February 2021	Added Spot SLC (spotlight single-look complex) image product type
3.2	5 April 2021	New satellite commissioning; New collect anomalies
3.3	25 May 2021	New GEC image product type; New SICD product delivery format
3.4	7 March 2022	Added VV polarization and more details on SICD, SIDD, & CPHD formats.
3.5	27 July 2022	Updated Extended Length imagery products
3.6	5 December 2022	Background tasking tier
3.7	28 June 2023	Updated look angle ranges and ground range resolutions.
3.8	23 August 2023	Updated accessible imaging latitudes; Updated Console image; Added Retrying task status
2.9	6 December 2023	New Tasking Tier names

THE CAPELLA ADVANTAGE

Capella Space is an information services company that provides on-demand Earth observation imagery. Through a constellation of small satellites, we provide easy access to frequent, timely, and high-quality imagery that has a positive impact on dozens of industries worldwide. Capella's very high-resolution (VHR) synthetic aperture radar (SAR) satellites are matched with unparalleled infrastructure to deliver reliable global insights that sharpen our understanding of the changing world – improving decisions about commerce, conservation, and well-being on Earth. Capella's constellation of SAR satellites and the imagery products it delivers support users at all levels of government, research, and commercial organizations.

Capella Space offers a 24-hour all-weather Earth observation imaging capability that generates SAR imagery products with the following features and benefits:

High-Quality Very high resolution and low noise leads to enhanced image quality & clarity	**Timely** Rapid, fully-automated order-to-delivery means faster speed to insight	**Frequent** Increasing high-cadence revisit timeframes as our satellite constellation grows
Accessible Intuitive web portal and API with simple catalog search, ordering and self-serve tasking	**Secure & Confidential** Secure anonymized tasking with rigorous operational security control and end-to-end encryption	**Shareable** Commercial unclassified data that can be accessed by international mission partners

Table 1: The features and benefits of Capella's SAR imagery product offerings.

Capella uses increasing availability of low orbit launch vehicles and the global availability of launch providers to maintain a reactive space infrastructure that is easily replenished and updated. The Capella satellite constellation supports the needs of the Earth observation community through a user experience that is simple, responsive, and user-friendly.

CAPELLA SENSOR FEATURES

Each Capella satellite carries an X-band, single-frequency radar capable of acquiring Spotlight, Sliding Spotlight, and Stripmap images. The main characteristics of the Capella SAR system are described in Table 2.

Frequency Band	X-band (9.4 – 9.9 GHz)
Imaging Bandwidth	Up to 500 MHz
Imaging Modes	Spotlight Sliding Spotlight Stripmap
Imaging Polarizations	Single-Pol HH & VV
Imaging Orbit Directions	Ascending & Descending
Imaging Look Directions	Left & Right
Accessible Imaging Latitudes	MIO 45° Orbital Plane: +48.9°N to -48.9°S MIO 53° Orbital Plane: +58.3°N to -58.3°S
Look Angle Ranges	25° - 50° (Standard Products) Up to 15° - 50° (Extended Products) Up to 5° - 50° (Custom Products)

Table 2: Capella SAR system characteristics.

IMAGING MODES

Capella's SAR satellites support a wide range of look angles and can collect data in Spotlight (Spot), Sliding Spotlight (Site) and Stripmap (Strip) imaging modes. These imaging modes are summarized In Table 3. The SAR imaging capabilities of Capella's satellites are well suited for a variety of applications across a range of market verticals. These include traditional intelligence, surveillance and reconnaissance for defense and security, maritime domain awareness, and emerging commercial applications such as insurtech, energy and commodities trading, agriculture, and infrastructure monitoring.

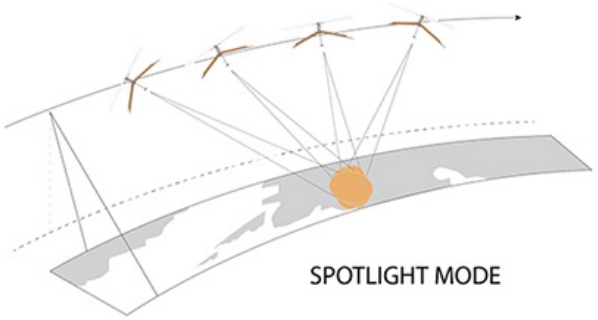
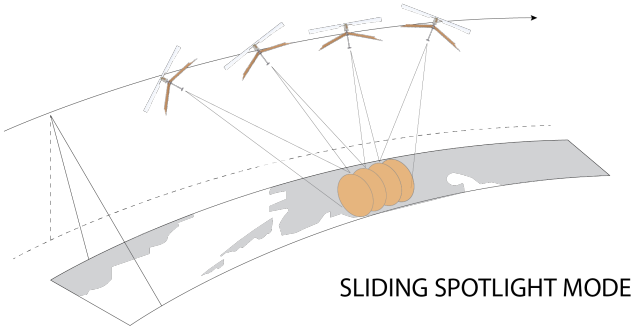
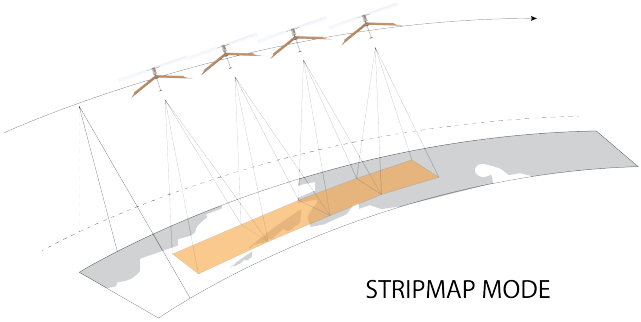
Imaging Mode Description	Illustration
Spotlight (Spot) In spotlight mode the antenna beam is focused on a point on the Earth for an extended period. Azimuth resolution increases with the dwell time of the antenna beam on the target, and range resolution increases with the bandwidth. Dwell time on a single spot is set to provide a desired azimuth resolution. The image width is determined by the antenna beam size. These longer dwell time acquisitions processed with multiple looks provide better image quality with less speckle.	
Sliding Spotlight (Site) The sliding-spotlight imaging mode increases the image length of high-resolution spotlight acquisitions. Instead of illuminating a fixed point on the ground, in sliding-spotlight mode the acquisition angle is slowly varied to slide the illumination point along the ground. Sliding spotlight provides excellent image resolution with larger area coverage than spotlight.	
Stripmap (Strip) In stripmap mode the center of the antenna beam moves in tandem with the satellite. The ground swath is illuminated with continuous sequence of pulses while the antenna beam is fixed in look angle. This results in a SAR image longer than spotlight and sliding spotlight with a continuous image quality and resolution.	

Table 3: Capella's SAR imaging modes.

STANDARD SAR IMAGERY PRODUCTS

The standard SAR imagery products are defined with predefined sets of imaging acquisition parameters that provide the optimal full performance range of the Capella radar system. Capella provides the following SAR imagery product types for each imaging mode:

Single Look Complex (SLC)

- Contains both amplitude and phase of the radar signal
- Range-compressed and focused SAR image in slant-range geometry
- Georeferenced using orbit data and Range-Doppler projected

Geocoded Ellipsoid Corrected (GEC)

- Contains amplitude information only
- Range-compressed, detected, focused and multi-looked SAR image
- Multi-look techniques applied to enhance radiometric resolution
- Resampled and projected onto WGS84 ellipsoid with average scene center height
- Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) projections

Geocoded Terrain Corrected (GEO)

- Contains amplitude information only
- Range-compressed, detected, focused and multi-looked SAR image
- Multi-look techniques applied to enhance radiometric resolution
- Terrain-height corrected using a high-resolution Digital Elevation Model (DEM)
- Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) projections

Sensor Independent Complex Data (SICD)

- Contains both amplitude and phase of the radar signal
- Range-compressed and focused SAR image in slant-range geometry
- Sensor independent format

Sensor Independent Derived Data (SIDD)

- Contains amplitude information only
- Range-compressed, detected, focused and multi-looked SAR image
- Multi-look techniques applied to enhance radiometric resolution
- Planar Gridded Display (PGD) projection
- Sensor independent format

Compensated Phase History Data (CPHD)

- Contains raw phase history data that is compensated for hardware timing & platform motion
- Sensor independent format

The Single Look Complex (SLC) image product type is a single-look dataset of the focused radar signal. SLC images contain both amplitude and phase information in slant plane range-doppler geometry. Consequently, SLC images are suitable for users with advanced SAR expertise who are working on applications that require exploitation of the phase information such as coherent analysis. The SAR data in a SLC image product type is represented as complex numbers with in-phase (I) and quadrature (Q) components.

The Geocoded Ellipsoid Corrected (GEC) image product type is a detected multi-looked dataset which has been geocoded and projected onto the WGS84 ellipsoid. The average scene center height is used to generate the GEC image product type, and no terrain correction is performed. Consequently, GEC images are ideally suited for users who wish to analyze imagery over areas with significant topographic relief without any DEM correction applied. Since the ellipsoid projection does not use height information from a DEM, the geolocation accuracy varies depending on the relief of the local topography. For relatively flat terrain excellent geolocation accuracy is still achieved, making GEC images ideally suited for visual literal image interpretation and multi-temporal analysis.

The Geocoded Terrain Corrected (GEO) image product type is a detected multi-looked dataset which has been geocoded and terrain corrected using a Digital Elevation Model (DEM). Consequently, terrain-induced location shifts and SAR-specific distortions caused by varying terrain height are corrected. The geolocation of GEO images is of higher accuracy but depends on the relief of terrain and the incidence angle of the acquisition. GEO images provide the highest level of geometric correction and geolocation accuracy, making them ideally suited for mapping applications where the SAR imagery products can be easily combined with imagery basemaps and GIS information from other geospatial data sources.

The Sensor Independent Complex Data (SICD) image product type is a single-look dataset of range and azimuth compressed radar signal. Like the SLC, SICD images contain both amplitude and phase information in slant plane range-doppler geometry. SICD data is packaged in a sensor independent format which contains standard metadata parameters as defined in the SICD v1.2.1 standard specification.

The Sensor Independent Derived Data (SIDD) image product type is a detected, multi-looked dataset like the GEC and GEO products. SIDD images are projected onto a Planar Gridded Display (PGD) coordinate system, which preserves the imaging geometry's layover. SIDD data is packaged in a sensor independent format which contains standard metadata parameters as defined in the SICD v2.0 standard specification.

The Compensated Phase History Data (CPHD) image product type contains the raw radar phase history data in a sensor independent format. CPHD data includes compensations for the motion of the spacecraft as well as the precise timing of the transmitted pulses and received echoes from the

imaged scene. CPHD data is packaged according to the CPHD v1.0.1 standard specification. This data product is only allowed to be used by United States Government customers.

The specification for standard SAR imagery products is delineated in Table 4 and Table 5 below. The spatial resolution of the SLC image product type is defined using azimuth and slant range, while the spatial resolution for GEC and GEO image product type is defined using azimuth and ground range. Both the image scene size and geocoded ground range resolution of final delivered data products vary with incidence angle, which is impacted by the combination of imaging look angle and local topography.

The analytical slant range resolution of Capella SAR systems is 0.3 m, based on a pulse bandwidth of 500 MHz. Spectral weighting used in every SAR system to control range sidelobes degrades this value slightly which can impact the resulting slant range and ground range resolutions in the final data products. The azimuth resolution depends on the Doppler bandwidth. In the case of Stripmap imaging, Doppler bandwidth is set by the physical length of the antenna, and azimuth resolution achieved is half of the antenna length. For spotlight mode, larger Doppler bandwidth is achieved by dwelling on the target as the satellite moves. In this case, the resolution is proportional to the integration time over the same target scene.

Image Product	Imaging Mode	Nominal Scene Size	Azimuth Resolution	Slant Range Resolution	Look Angle Range
Spot SLC	Spotlight	5 km x 5 km	0.5 m	0.3 m	25° to 50°
Site SLC	Sliding Spotlight	5 km x 10 km	1.0 m	0.5 m	25° to 50°
Strip SLC	Stripmap	5 km x 20 km	1.2 m	0.75 m	25° to 50°

Table 4: Specification of the standard single look complex (SLC) image product type.

Image Product	Imaging Mode	Nominal Scene Size	# Of Looks	Azimuth Resolution	Ground Range Resolution	Pixel Spacing	Look Angle Range
Spot GEC/GEO	Spotlight	5 km x 5 km	9	0.5 m	0.4 m to 0.7 m	0.35 m	25° to 50°
Site GEC/GEO	Sliding Spotlight	5 km x 10 km	5	1.0 m	0.7 m to 1.2 m	0.6 m	25° to 50°
Strip GEC/GEO	Stripmap	5 km x 20 km	1	1.2 m	1.1 m to 1.6 m	0.8 m	25° to 50°

Table 5: Specification of the standard geocoded ellipsoid corrected (GEC) and geocoded terrain corrected (GEO) image product types.

Capella delivers SAR data in a 3-file bundle package known as the Capella TIFF+JSON format for SLC, GEC, and GEO product types. The Capella TIFF+JSON format bundle includes one cloud-optimized GeoTIFF format image along with JSON metadata sidecar files (STAC & Extended). SICD, & SIDD are single NITF format files that include the embedded metadata in XML format. CPHD is a custom binary format detailed in the CPHD v1.0.1 standard specification. For more detailed SAR data formatting and metadata descriptions, please refer to the Capella's separate "SAR Products Format Specification" document.

In Table 5, the pixel spacing for geocoded products (GEC and GEO) are also specified. The image formation process produces a sampled version of the image on a grid in the spatial (image) domain. To avoid aliasing, the pixel spacing must be finer than the impulse response defined resolution of the sensor. For example, in the Spot GEC and GEO image product types a pixel spacing (0.35 m) finer than the ground resolution (0.4 m – 0.7 m) is used to sample the image in a manner that maintains full resolution performance. Changing the sample spacing does not change the range and azimuth resolution of the sensor.

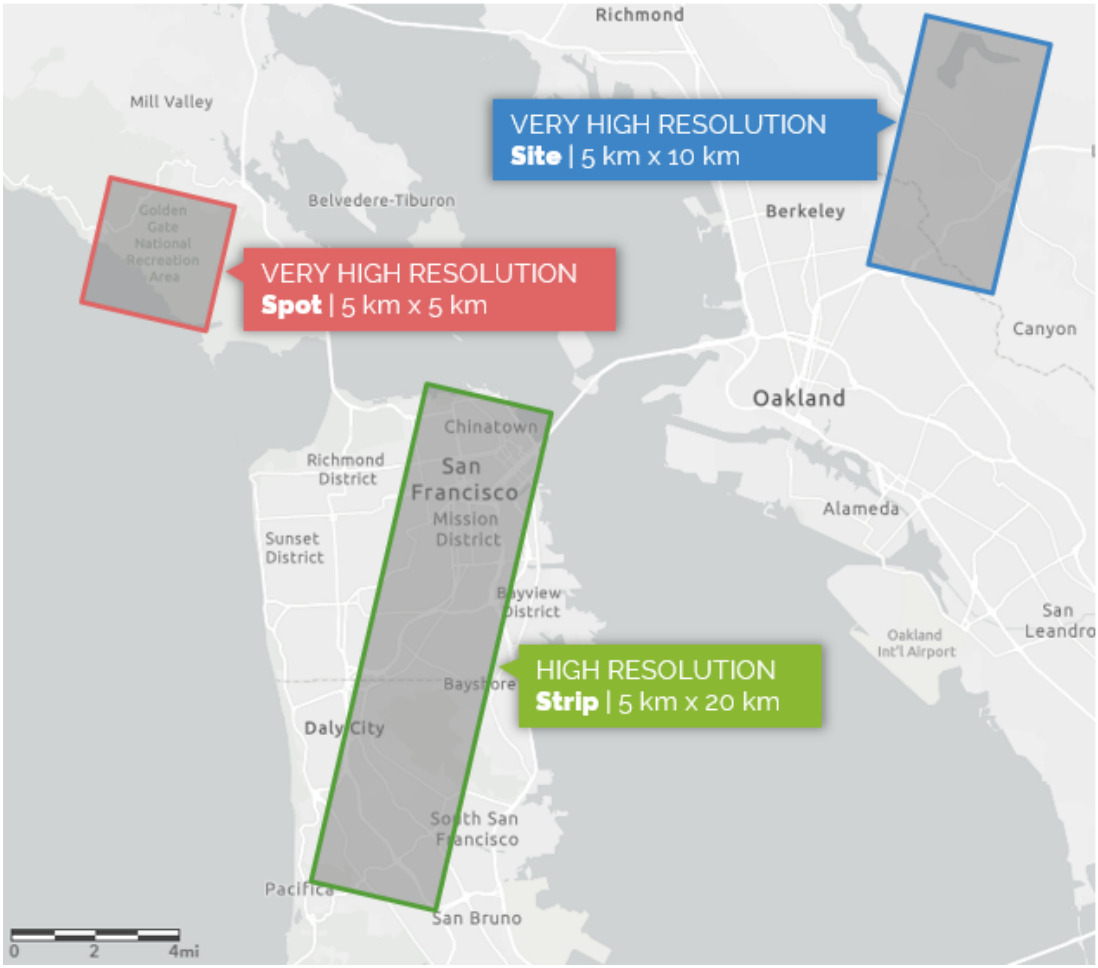


Figure 1: Nominal scene size of SAR imagery products for each imaging mode.

MULTI-LOOK PROCESSING

Multi-looking is a technique that generates images with lower speckle and increased image quality. The agile design of the Capella satellite provides much longer dwell times in spotlight imaging mode. Capella's SAR sensors generate high-quality image products with greatly reduced speckle because they are capable of imaging the same location on the ground for tens of seconds in spotlight mode. The Capella system can provide a maximum ground range resolution of 0.5 m with 9 looks which provides substantial improvement in the image quality. The Capella multi-looked imagery is obtained by splitting a long synthetic aperture into a set of sub-apertures and then combining them to generate the GEC and GEO image product types. For this purpose, nine 0.5m resolution SLC images are generated with multiple squint angles each time that a Spot product is collected and processed.

Figure 2 presents a comparison of 0.5m resolution SAR imagery that have been generated with a single look (left) and nine multiple looks (right). Multi-look processing produces enhanced radiometric resolution with higher sensitivity to brightness changes and less noise. The single look image on the left has significant speckle noise but the multi-look version on the right has much improved image clarity and target detectability. The aircraft emerge clearly in the multi-looked image and are easier to distinguish than in the single-look image. The scene also contains backscatter variations over the grassy areas which are clearly discernable.

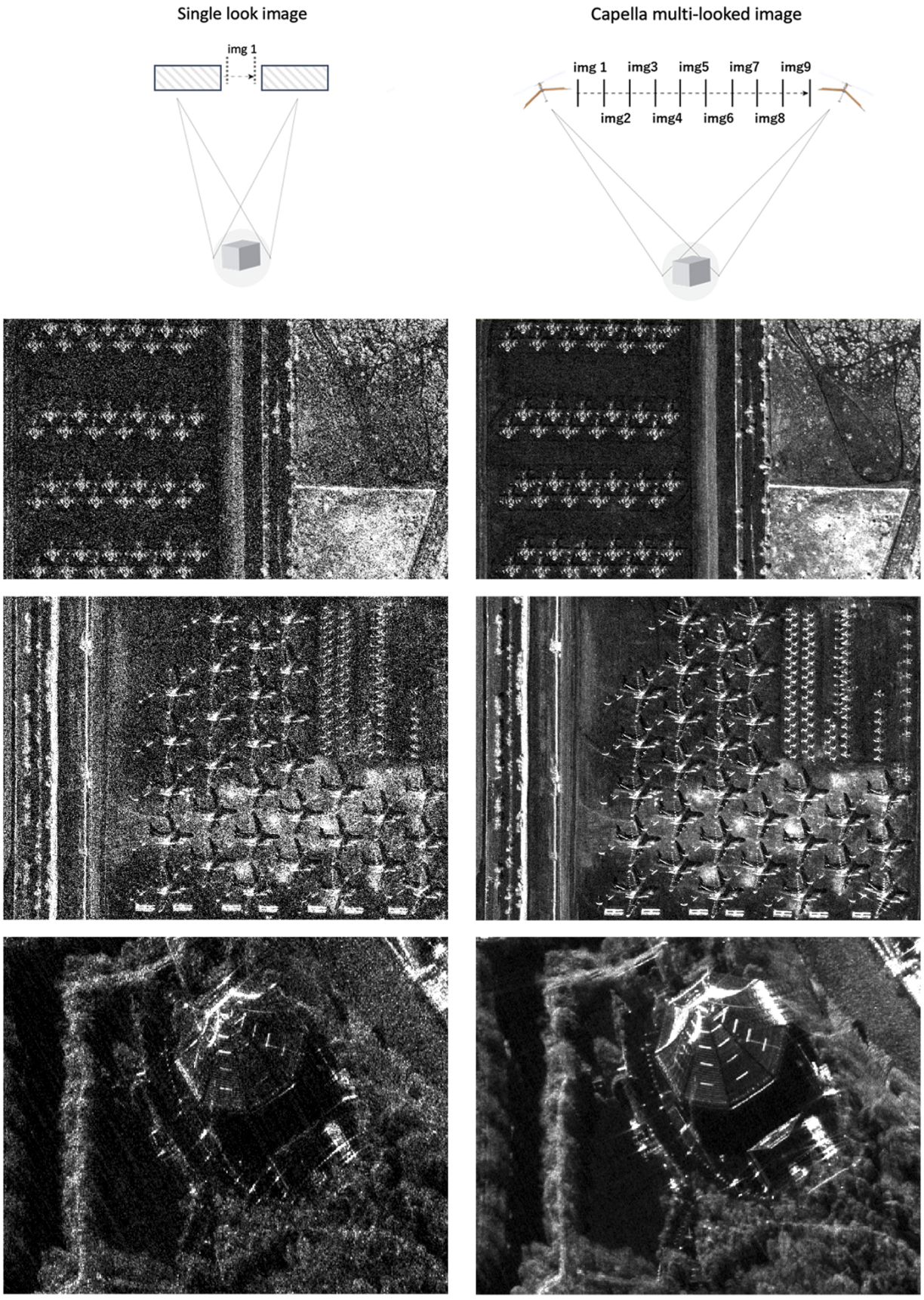


Figure 2: Image quality improvement via the multi-look process. A short integration time is needed to generate single-look SAR images (left) and longer integration times generate Capella's 9-look imagery (right). Single-look and multi-look images have the same resolution, equal to 0.5 meter.

EXTENDED SAR IMAGERY PRODUCTS

The extended SAR imagery products provide increased acquisition opportunities and shorter revisit time periods via imaging acquisitions in broader look angle ranges than the standard products. All other imaging acquisition parameters use the same settings as standard products. The specification for extended SAR imagery products is delineated in Table 6 and Table 7 below.

Image Product	Imaging Mode	Nominal Scene Size	Azimuth Resolution	Slant Range Resolution	Look Angle Range
Spot SLC (Extended)	Spotlight	5 km x 5 km	0.5 m	0.3 m	15° to 50°
Strip SLC (Extended)	Stripmap	5 km x 20 km	1.2 m	0.75 m	15° to 50°

Table 6: Specification of the extended single look complex (SLC) image product type.

Image Product	Imaging Mode	Nominal Scene Size	# Of Looks	Azimuth Resolution	Ground Range Resolution	Pixel Spacing	Look Angle Range
Spot GEC/GEO (Extended)	Spotlight	5 km x 5 km	9	0.5 m	0.4 m to 1.2 m	0.35 m	15° to 50°
Strip GEC/GEO (Extended)	Stripmap	5 km x 20 km	1	1.2 m	1.1 m to 2.7 m	0.8 m	15° to 50°

Table 7: Specification of the extended geocoded ellipsoid corrected (GEC) and geocoded terrain corrected (GEO) image product types. The number of looks is adaptively selected to bring the azimuth resolution near to the ground range resolution.

CUSTOM SAR IMAGERY PRODUCTS

The custom SAR imagery products provide advanced control of imaging acquisition parameters. By leveraging the custom imagery products category, expert users have the power to submit new acquisition tasking requests with very specific SAR imaging characteristics to collect bespoke data products that satisfy their application requirements. Capella's custom SAR imagery acquisition is a unique capability that unlocks new use cases, fosters innovation, facilitates proof of concept development, and provides optimal utilization of satellite capacity by allowing imaging across the full 5°-50° accessible look angle range of the Capella radar system (varies slightly by imaging mode).

The power of custom SAR imagery products is available to users by submitting new acquisition tasking requests using the Capella Console or Capella API with the ability to control the imaging parameters described in the table below.

Imaging Parameter	Description	Units	Minimum	Maximum
Window Open	The earliest user-defined time when acquisition can occur. Image acquisition can begin any time after the Window Open time up to the Window Close time.	Date Time	n/a	n/a
Window Close	The latest user-defined time when acquisition can occur. Image acquisition must occur no later than the Window Close time which effectively sets the tasking request expiration date.	Date Time	n/a	n/a
Collection Time	The user-defined time of day when acquisition can occur. Image acquisition can be set to occur only at night (6pm to 6am local time), during the day (6am to 6pm local time), anytime, or a unique time window specified by the user.	Integer	n/a	n/a
Tasking Tier	The scheduling importance of the new acquisition request (e.g. Routine, Urgent, Priority, Standard, or Flexible).	String	n/a	n/a
Observation Direction	Whether spacecraft is looking Left or Right with respect to its velocity vector during image acquisition. Also available for Standard and Extended products tasking.	String	n/a	n/a
Orbit State	Whether the spacecraft is on the Ascending (South to North) or Descending (North to South) orbit during image acquisition. Also available for Standard and Extended products tasking.	String	n/a	n/a
Look Angle Minimum	Minimum angle between the sub-satellite point and image center point. Based on the full accessible look angle range of the Capella radar the smallest possible look angle is 5°.	Degrees	5	50
Look Angle Maximum	Maximum angle between the sub-satellite point and image center point. Based on the full accessible look angle range of the Capella radar the largest possible look angle is 50°.	Degrees	5	50

Imaging Mode	The radar system imaging mode (e.g. spotlight, sliding spotlight, stripmap).	String	n/a	n/a
Scene Length	Desired image scene length. This parameter is only customizable for sliding spotlight and stripmap imaging modes.	Kilometers	5	5 for Spot 50 for Site 200 for Strip
Scene Width	Desired image scene width. This parameter is only customizable for stripmap imaging modes.	Kilometers	5	10 for Strip
Ground Range Resolution Minimum	Minimum ground range resolution of the resulting image. Modification of this parameter only impacts the resolution of the GEC & GEO image product types. The bandwidth used will be adaptively selected to match the requested resolution.	Meters	0.4 for Spot 0.7 for Site 1.1 for Strip	3.1 for Spot 5.0 for Site 11.5 for Strip
Ground Range Resolution Maximum	Maximum ground range resolution of the resulting image. Modification of this parameter only impacts the resolution of the GEC & GEO image product types. The bandwidth used will be adaptively selected to match the requested resolution.	Meters	0.4 for Spot 0.7 for Site 1.1 for Strip	3.1 for Spot 5.0 for Site 11.5 for Strip
Azimuth Resolution Minimum	Minimum azimuth resolution of the resulting image. Modification of this parameter impacts the resolution of all image product types.	Meters	0.5 for Spot 1.0 for Site 1.2 for Strip	3.1 for Spot 5.0 for Site 11.5 for Strip
Azimuth Resolution Maximum	Maximum azimuth resolution of the resulting image. Modification of this parameter impacts the resolution of all image product types.	Meters	0.5 for Spot 1.0 for Site 1.2 for Strip	3.1 for Spot 5.0 for Site 11.5 for Strip
Number Of Looks	Number of looks used for multi-look processing in geocoded products. Users can select a number of looks smaller than Standard and Extended products.	Integer	1 for Spot 1 for Site 1 for Strip	9 for Spot 5 for Site 1 for Strip

Table 8: Imaging acquisition parameters for custom SAR imagery products. In GEC and GEO image product types, the number of looks in azimuth is fixed to 9, 5 and 1 for Spot, Site and Strip, respectively. When custom collects are requested, SLC image product type is recommended in order to optimize multi-looking and geocoding to match user needs.

Custom SAR imagery products allow acquisitions in the full accessible look angle range for Capella's commercial data products (5^0 to 50^0). The ground range resolution for the resulting geocoded (GEC

and GEO) image product will vary according only to the user selection and will be constant for variable look angles. The bandwidth required to form the image is adaptively selected to optimize image quality. The azimuth resolution is not impacted by the look angle. For spotlight and sliding spotlight imaging modes, different azimuth resolutions are achieved by physically varying the dwell time of the satellite over the target location. For stripmap imaging mode, the azimuth resolution is constant.

SECURITY & CONFIDENTIALITY

Capella Space has built a highly secure and confidential system for access to Earth observation imagery products for the most sensitive missions. Capella's operational system protects ground, space and mission infrastructure from cyber threats to ensure continuity of operations. All transmissions of satellite command & control and mission information between space vehicles and ground networks use secure encrypted communication channels to ensure that Capella always retains positive control of space vehicles. Furthermore, Capella's order-to-delivery is fully automated, provides secure anonymized constellation tasking, obfuscates user identity via randomly generated universally unique identifiers (UUIDs), and has end-to-end encryption.

SECURITY

Capella has implemented a comprehensive operational security program that is closely aligned with the stringent U.S. NIST 800-171 requirements. As part of this program, Capella has implemented rigorous security controls for its online platform, enterprise computing, ground segments, space communications network, cloud infrastructure, personnel, and facilities. All system access requires standards-based authentication which is ISO 27001, ISO 27017, ISO 27018 and ISO 9001 compliant. Furthermore, all data is encrypted at rest and in transit per U.S. NIST AES-256 standards or better, and encryption keys are maintained in U.S. FIPS 140-3 (Revision 1) compliant storage.

The operational security program also includes a robust incident response plan for detection, analysis, containment, eradication, and recovery. The endpoint intrusion detection and prevention system is monitored 24/7/365 by our security operations center. Finally, independent penetration testing (PenTest) of all systems is performed on a regular basis to ensure the highest levels of security are constantly maintained.

CONFIDENTIALITY

Capella's confidential constellation tasking provides anonymized new imaging acquisition request submission and full end-to-end automation (i.e. no humans in the loop). This fully automated ordering system maximizes throughput and minimizes tasking-to-delivery timeframes. All organization and user identifying information is stored in a separated system with encryptions at rest and in transit. Every organization and user are assigned a randomly generated, anonymous and

universally unique identifier (UUID) that is associated with their archive catalog queries, new acquisition tasking requests and ordered SAR imagery products. All interactions with Capella systems (platform, archive catalog, tasking database, etc.) are performed using the anonymized UUIDs for organizations and users. No identifying details of any archive imagery product order or new acquisition tasking request are visible to any other users in the Capella system.

For more information on our commitment to security and confidentiality, please request a copy of the separate whitepaper document available from Capella Space.

ORDERING & DELIVERY

ORDERING

The Capella platform can be used to order archive data, task satellite acquisition, and manage your order as an end user or data reseller. The platform is made of two tools: the Capella Console (see figure below), a web portal with simple visual interface to access archive collects and task satellites, and the Capella Application Programming Interface (API), a powerful solution for archive access and tasking that allows the development of automated workflows.

The Capella Console and API both leverage the spatio-temporal asset catalog (STAC) specification. The STAC metadata and catalog search API is designed for ease of use. Queries with simple metadata filters return links to product assets based on a user's project needs. Capella Space standard data products (Spot, Site and Strip) can be ordered and delivered with a minimum purchase of a single scene.

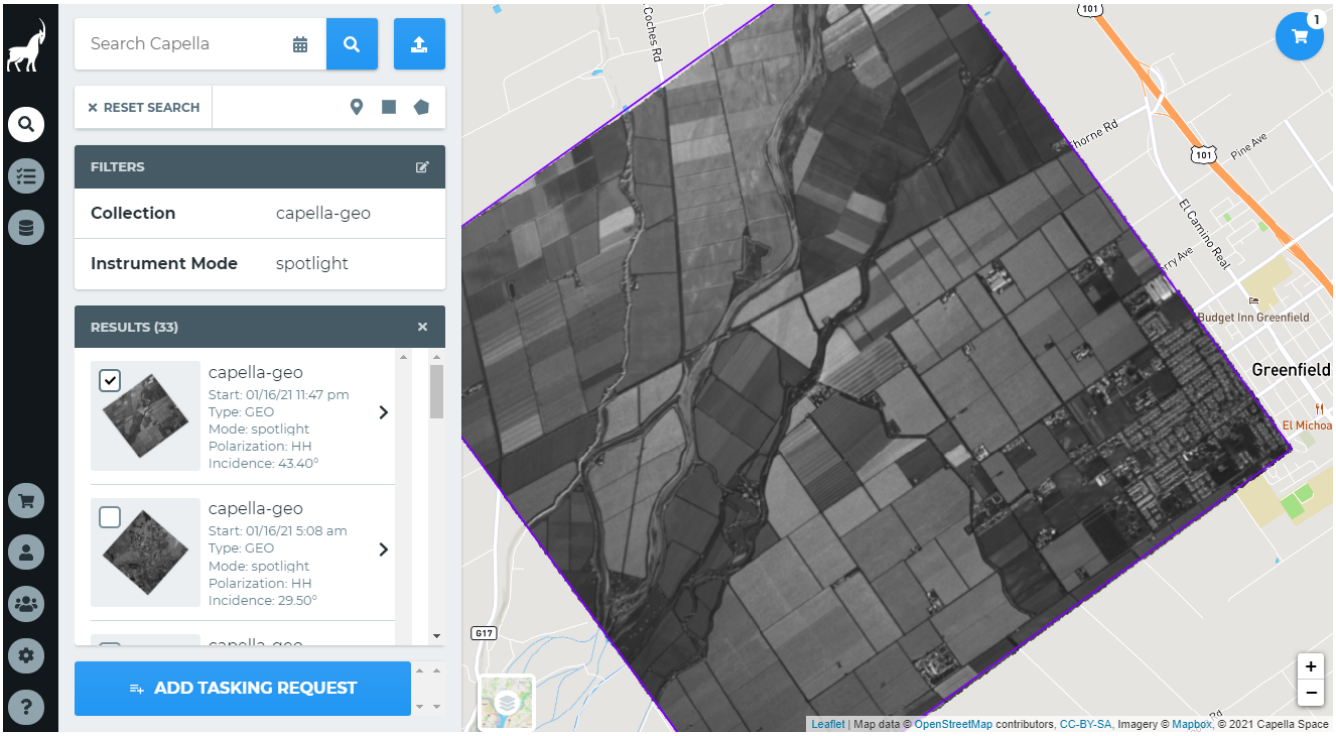


Figure 3: The Capella Console web application.

CONSTELLATION TASKING SYSTEM

Capella provides an on-demand, self-serve constellation tasking system that enables users to request timely, high-quality image acquisitions to meet their analytics and operational needs. The constellation tasking system allows users to submit imagery tasking requests, monitor status of those requests, and download the resulting imagery in a streamlined workflow.

Figure 4: Constellation tasking to SAR imagery product delivery workflow.

Submitting a tasking request is simple and user-friendly. First, a user will decide on their point-target location or polygon AOI and desired configuration of imaging acquisition parameters. Next, using the Capella Console or Capella API, the user specifies their desired imaging parameters and submits their tasking request as either a single request or a repeat request. After submitting the tasking request, users will be notified when their tasking request is ready for review. The review contains an estimated cost of the collect requested and the detailed tasking request configuration. While submitting a new tasking request, the user can select an optional pre-approval, which allows the user to skip the review of the tasking configuration and cost estimation.

Once the estimated cost is reviewed and approved by the user, the tasking request enters a queue until the window open start date is within the rolling one-week-out scheduling window at which point it is evaluated for Scheduling by the Capella constellation tasking system. Capella's scheduler runs every 15 minutes, and new acquisition tasking requests are processed for a rolling one-week-out scheduling window (i.e. the upcoming next 7 days are evaluated for any given scheduler run). A new acquisition tasking request can be submitted to the scheduler queue at any time prior to the user's desired window open start time and will be evaluated once the rolling one-week-out scheduling window horizon is reached. Tasking requests remain in the Submitted status until the Window Open date of the request is within the scheduling window.

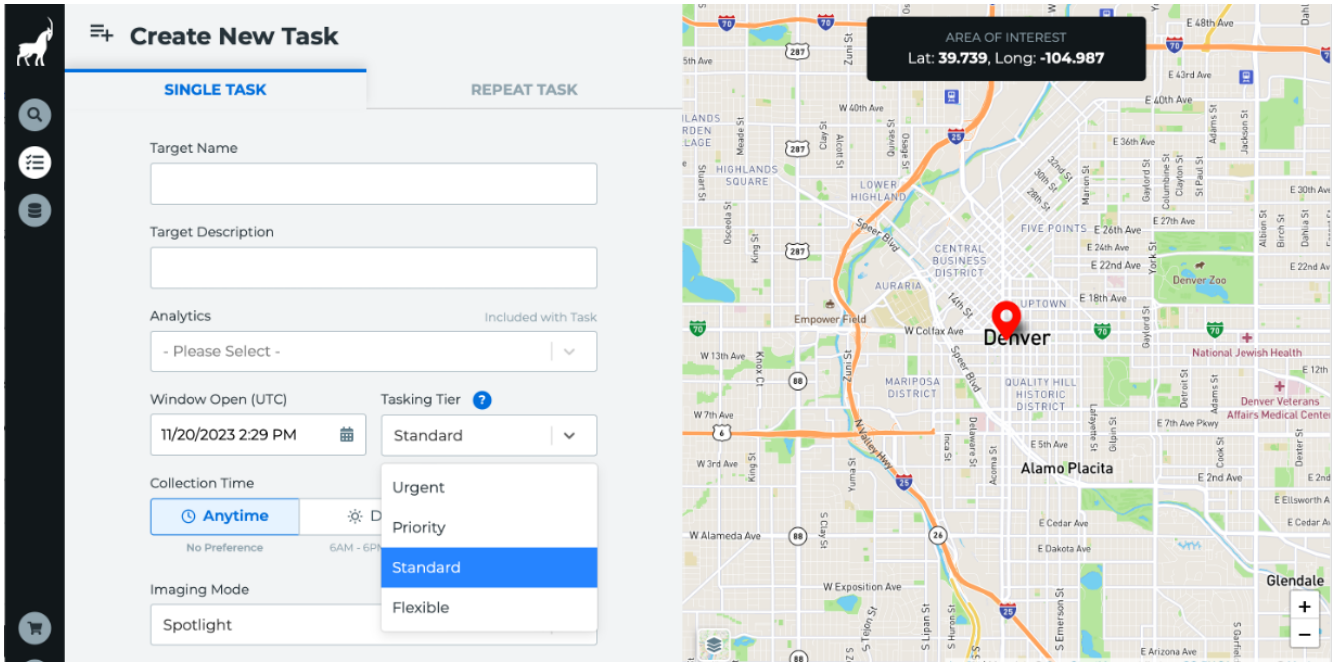


Figure 5: Tasking configuration and potential satellite access times on the Capella Console web application.

The constellation tasking system will determine if the new acquisition can be accommodated given the current capacity of the constellation, prior imaging commitments, and the parameters of the new tasking request, including the tasking tier. Once scheduling of the constellation is complete, the user will be informed whether the tasking request has been accepted or rejected/expired, and a new schedule will be uplinked to the satellite constellation at the next available contact opportunity. At any point the user can request the status of the submitted tasking request via the Capella Console or using the Capella API.

Term	Description
Tasking Request	A tasking request made by the user, which can be a single point target or a polygon AOI, as well as the imaging mode and collect constraints.
Collect	A Collect is a potential or fulfilled imagery acquisition opportunity for a tasking request. For point targets, there will typically be one collect per tasking request. For polygon tasking requests, there may be many collects to complete the coverage of the area of interest.
Tasking Tier	The tasking tier allows users to denote the importance of an individual tasking request for scheduling and sets a minimum acquisition window. A user may choose a Window Duration longer than the predefined timeframe for a tasking tier to maximize acquisition opportunities. This will change the timeframe in which the request can be collected to be beyond the minimum of the tier.
Window Open	The earliest user-defined time when acquisition can occur. Image acquisition can begin any time after the Window Open time. Window Open signifies the start of the Window Duration.

Window Close	The latest user-defined time when acquisition can occur. Image acquisition must occur no later than the Window Close time. Window Close signifies the end of the Window Duration and effectively sets the tasking request expiration date.

Table 9: Definition of the constellation tasking system terminology.

In the event another user submits a new tasking request that is rejected due to consumption of imaging capacity by an existing accepted tasking order, the system will only show any details related to the existing acquisition order to users if both the existing and new tasking request are from the same organization. Users can then choose to resubmit the rejected tasking request with different parameters or cancel one or more of the Accepted conflicting tasks and resubmit the rejected tasking request with the same parameters using the Retask functionality.

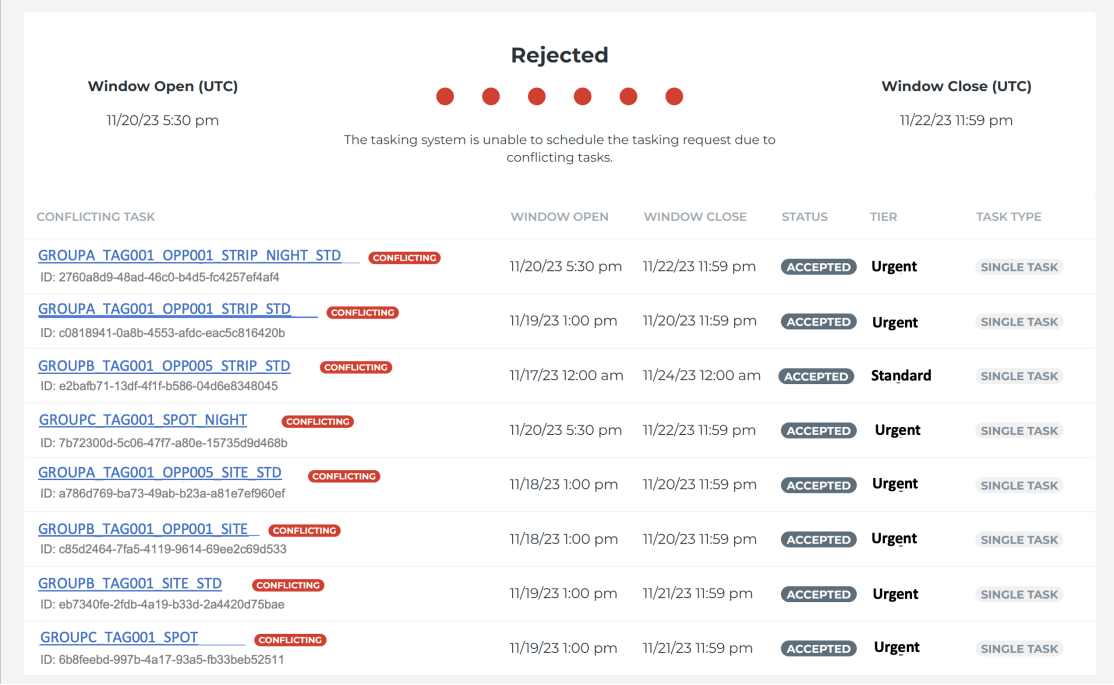


Figure 6: Intra-org conflicting tasks shown for a rejected tasking request.

ACQUISITION TASKING TIERS

The constellation tasking system supports a variety of tasking types – Repeat, Single, and Area -- with dedicated tasking tiers to give the user control over the cadence and collection importance of the tasking request. Single tasking requests are for one-time collections over a point target while area tasking requests are for a polygon location requiring multiple, one-time collections to cover the entire AOI. Repeat tasking ensures regular collections over a point target at a user-defined cadence and can also be used to ensure geometrically similar collections over time.

When a new acquisition tasking request of any type is submitted, the user is required to select a

Window Open and a Tasking Tier. The Window Open denotes the first possible date and time the collection should be acquired while tasking tiers are used to denote tasking request importance for the scheduler.

NO BUMPING POLICY

Once a new tasking request has been accepted, it is integrated into the scheduler, and it will be acquired and delivered barring any anomalies or errors occurring. There is no "bumping" of accepted tasking requests by new tasking requests submitted with higher tasking tiers, meaning the Capella system will never cancel an accepted tasking request to accommodate another imaging request unless the request was submitted at the Flexible tasking tier. For all tasking tiers, tasking requests can be automatically moved by the Capella system within the scope of the requested acquisition window duration or cancelled if an imaging restriction is imposed.

SINGLE AND AREA TASKING

Single (point) and area (polygon) tasking requests can be submitted with a variety of tasking tiers. Three of these tiers – Urgent, Priority, and Standard – include Capella's "No Bumping" assurance and can be used to:

- Submit a tasking request for an acquisition at the next possible collection opportunity
- Target a precise imaging geometry or a specific date window within the scheduling horizon
- Differentiate the importance of individual tasking requests within a customer's submissions

A tasking request submitted at the Priority tier takes greater importance for the scheduler than a Standard task while tasks submitted at the Urgent tier take the highest importance.

Single and area tasking requests can also be submitted at the Flexible tier, which is geared towards opportunistic collection and does not come with "No Bumping" assurance. It is possible that a Flexible task will get added to the schedule and more frequently shuffled, or fully removed, if a tasking request with higher importance needs the imaging slot.

Submitting tasking requests with a variety of tasking tiers helps the scheduler discern the importance of an individual request within the larger deck. It is critical to leverage the full range of tasking tiers when submitting a large tasking deck as a single batch. Submitting all tasking requests from a deck with the same tier instructs the scheduler to optimize the total number of tasking requests accepted, regardless of submission order.

Another mechanism to help denote importance of an individual tasking request within a deck is setting the Window Close to a period longer than the minimum acquisition window set by the chosen Tasking Tier. This is useful for instances where a user considers the tasking request to be of higher importance but would accept data collected outside the default acquisition window or where the

user would like to receive very precise imaging geometries. Extending the acquisition window helps the scheduler consider more collection opportunities for an individual tasking request while emphasizing collection importance of the task for the scheduler.

Extending the Window Close well beyond the default set by the chosen tasking tier is especially important for area tasking as this increases the changes of acceptance and completion. An area tasking request submitted with a Priority tasking tier and an acquisition window of 30 days will have a higher importance over a new single tasking request submitted with an Urgent tier as the scheduling horizon gets closer to the Window Close date in order to ensure imagery is collected over the entire polygon.

Each tasking tier has a minimum collection window, which sets the timeframe during which the image can be collected. This window does not include the time from collection to delivery to the end user. Tasks submitted with a Window Open and a Window Close date longer than the minimum collection acquisition window for the selected Tasking Tier will be delivered anytime between that user-defined acquisition window, not the minimum. It is not possible to set the Window Close for a shorter period than the selected Tasking Tier, although users can constraint the collection time to night, day, or a specific time period to further refine the collection opportunities.

Tasking Tier	Description
Urgent	Designed for time-sensitive situations where rapid collection speed is mission critical. Urgent tasks are considered for scheduling first. Minimum acquisition window is 24 hours.
Priority	Optimal minimum acquisition window for situations when precise imaging geometries matter. Priority tasks are considered for scheduling after Urgent tasks. Minimum acquisition window is 72 hours.
Standard	Provides assured data collection upon acceptance. Standard tasks are considered for scheduling after the Urgent and Priority tasks. Minimum acquisition window is 7 days.
Flexible	Ideal for leveraging variations in capacity without the risk of interfering with tasks of higher importance. Flexible tasks can be added, shuffled, and removed from the schedule to accommodate tasks with higher importance. Minimum acquisition window is 24 hours.

Table 10: Definition of the tasking tiers for single and area tasking.

REPEAT TASKING

A repeat tasking request will automatically spawn 10+ sub-tasking requests with the total number generated depending on the Repeat Cycle selected. The creation of these tasks beyond the scheduling horizon ensures requests generated as part of a repeat series are first in the queue for scheduling once the horizon opens so specified repetition intervals are met. Tasks associated with a

repeat request will move from Submitted to Active when they reach the scheduling horizon and will remain Active until they are Accepted or go to Expired because no imaging capacity is available. The collection acquisition window for single, sub-tasks created from a repeat request are set by the Repeat Start Date and the Repeat Task Cycle.

The Routine tasking tier is exclusive to Repeat Tasking. Users should leverage this tier when a regular collection cadence and/or geometrically similar collects over time are a key requirement because Routine tasking requests receive the highest importance for the scheduler. Sub-tasks generated by a repeat request at the Routine tier are evaluated for scheduling before any other requests, including new tasking requests, when the Window Start Date for the sub-task enters the scheduling horizon.

Repeat tasking requests can also be submitted with the Flexible tasking tier. As with single tasking, requests created by repeat tasking at the Flexible tier do not have Capella's "No Bumping" assurance. Any tasking request submitted with a tasking tier of higher importance can bump a Flexible repeat request from the schedule, even if the task has moved to Accepted, should the capacity be required to fulfil the new, more important request. Users will not be notified that this is why the task has been removed from the schedule – only that the task has moved to Expired.

Tasking Tier	Description
Routine	Get coverage on a regular basis. Offers premium importance for data collection when regularity and consistent imaging geometry are crucial. Customers set their own acquisition windows. Minimum repeat cycle is 24 hours.
Flexible	Ideal for leveraging variations in capacity without the risk of interfering with tasks of higher importance. Flexible tasks can be added, shuffled, and removed from the schedule to accommodate tasks with higher importance. Customers set their own acquisition windows. Minimum repeat cycle is 24 hours.

Table 11: Definition of the tasking tiers for repeat tasking.

TASKING & COLLECT STATUS

Users can monitor the status of new acquisition tasking requests and data delivery in real-time using the Capella Console or Capella API.

Tasking Status	Description
Received	A tasking request is received from our system and the processing of cost estimation started. AOI tasking requires tessellation algorithms to estimate number of acquisitions required. At this stage, the tasking request is not submitted scheduling.
Review	The user has the opportunity review the estimated cost for the tasking request.
Submitted	The tasking request has been cost-approved and submitted to the constellation tasking system processing queue.

Active	The tasking request is in the processing queue and acquisition is being attempted. Tasking requests enter the Active state when the window close expiration date extends beyond the one-week-out scheduling horizon and the entire new acquisition cannot yet be fully scheduled. Active tasking requests will repeatedly have collection attempts scheduled until the one-week-out scheduling horizon is reached at which point a definitive Accepted or Rejected/Expired status will be assigned.
Accepted	The tasking request has been accepted by the constellation tasking system and is scheduled for full acquisition (barring any anomalies or errors occur).
Rejected	The tasking request is rejected because there is no capacity available in the acquisition window.
Expired	The constellation tasking system has determined that it will not be able to fully collect the new acquisition by the window close expiration date.
Completed	The tasking request has been completed and all required collects have been acquired.
Canceled	The tasking request has been canceled and will not be collected.
Retrying	The tasking request is being reattempted following an anomaly.
Error	The tasking request cannot be submitted due to a scheduling error or problems during new acquisition feasibility processing. User should resubmit the tasking request.
Tasking Anomaly	An anomaly occurred during collect that prevents full completion of the tasking request before the end of the acquisition window duration.

Table 12: Definition of the tasking statuses.

For every individual collect in a new acquisition, users will be informed of the status of their SAR imagery products as described in the following table.

Collect Status	Description
Predicted	A collection opportunity has been predicted by the constellation tasking system.
Tasked	Acquisition of the SAR images has been incorporated into a schedule and uplinked to spacecraft.
Collected	The SAR image has been collected by the Capella SAR system on the spacecraft.
Processing	Data has been downlinked and is being processed to generate the SAR imagery products.
QA	SAR imagery products are being reviewed by an automated quality assurance system.
Delivered	SAR imagery products are ready and available for user to download from either the Capella Console web application or Capella API.
Collect Anomaly	An anomaly has occurred which prohibits acquisition or delivery of the collect. If an imaging collect anomaly occurs the constellation tasking system will automatically

	attempt to reschedule the collect for a future time within the user's specified acquisition window duration in an effort to complete the entire tasking request.
Processing Anomaly	An anomaly has occurred which prevents the collect from being properly processed and delivered. In this case the collect has reached a terminal state and the scheduler will not automatically attempt to re-collect. If the new acquisition is still important, the user must leverage the Retask functionality and resubmit the acquisition as a new tasking request.

Table 13: Definition of the collect statuses.

ACQUISITION TASKING CANCELLATION POLICY

Tasking requests that have Accepted or Active status can be cancelled by the user that submitted the request using either the Capella Console or Capella API. If an order is cancelled the following cancellation policy applies:

- Cancellation > 72 hours before first collect of order = cancellation available at no charge
- Cancellation 12 - 72 hours before first collect of order = cancellation available at 25% charge of full order value
- < 12 hours before first collect of order = no cancellation allowed with 100% charge of full order value

This cancellation policy applies to individual new acquisition tasking orders on a tasking-request-by-tasking-request basis. If multiple separate tasking requests are submitted to cover a very large area or repeatedly collect an area-of-interest (AOI) to build a multi-temporal series the cancellation policy applies to each individual tasking request separately. Once a tasking request is scheduled users can access the collect times and determine the acquisition time for the first collect of order using either the Capella Console or REST API.

Furthermore, for individual tasking requests which require multiple collects to cover the area-of-interest (AOI) the cancellation deadline is determined by the very first collect. Consequently, once the 12-hour deadline is passed for individual multi-scene tasking orders the new acquisition tasking order can no longer be cancelled, all data products will be acquired & delivered, and full order value will be charged. Finally, if a tasking request is automatically rescheduled by the constellation tasking system within the scope of the designated acquisition window duration the cancellation deadlines reset and are moved in timeframe along with the rescheduled tasking request.

OPTIONAL ACQUISITION TASKING EXCLUSIVITY

An extra-cost option for time-limited acquisition exclusivity is provided via holdback delays before new acquisition tasking datasets are cataloged into our historical archive for other users to discover

and purchase. The archive catalog holdback delay options for any given new acquisition order are the following:

- None (default behavior; all datasets immediately added to archive catalog)
- 30-Day Archive Catalog Holdback Delay = +10% uplift surcharge of full order value
- 1-Year Archive Catalog Holdback Delay = +25% uplift surcharge of full order value
- Permanent Archive Holdback = +100% uplift surcharge of full order value

After the holdback period expires, the SAR imagery products are cataloged for other users to discover and purchase. However, all dataset holdings in the Capella archive are anonymized, so no identifying details are visible to other users which connect these SAR imagery products back to user or organization who originally requested their acquisition.

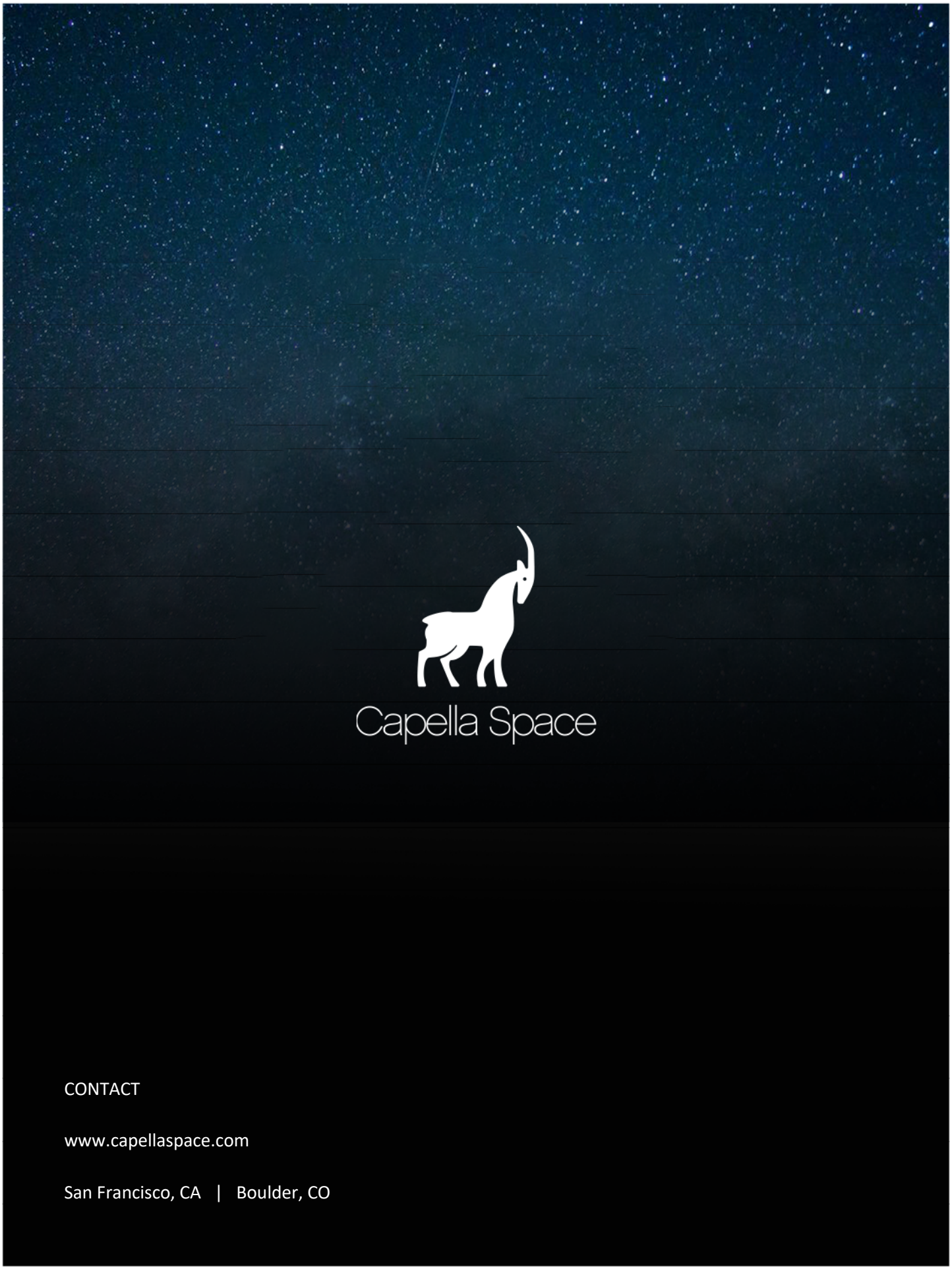
DELIVERY

All delivery of SAR imagery products is via the Capella online platform consisting of the Capella Console web application and the Capella API. Once SAR imagery products have been made available for users to download the datasets from the Capella Console the products are deemed delivered and corresponding updates will be made in the accounting system. Guaranteed delivery within a set timeframe is available through an optional Service Level Agreement.

THE CAPELLA REVOLUTION

Capella Space blends SAR imaging with the most innovative technology and tools such as commercial micro-electronics, automated command and control, worldwide downlink services, cloud-based operations, and user-friendly interfaces. We offer intuitive self-serve online ordering, very high resolution imagery with enhanced quality, secure anonymized new acquisition tasking, timely product delivery and fair prices.

We are building a large constellation of small SAR satellites that provide very high-resolution images, anywhere on the planet, at volumes and temporal resolution rates that are unparalleled. Capella can support users who need an image rapidly, as well as those who need to persistently monitor AOIs, using a coherent image stack, and receive notification when changes are detected. Until now, SAR imaging has been used as a specialized and expensive remote sensing tool, but at Capella, we are transforming SAR into an easily accessible, global information source. Our revolution is to make SAR affordable and ubiquitous across the globe—democratizing access to an expanding and essential remote sensing resource.



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