

# The Right Data to the Right Place at the Right Time: A Marketplace Approach

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## 1. ABSTRACT

Data Management technology and innovation, discussed at technology conferences around the world, continue to highlight the groundbreaking advancements in research and capability development. Historically, the “valley of death” leaves end users of this technology waiting longer periods for higher readiness levels. In commercial environments, this delay creates an opportunity and a “first mover” advantage that acts as a terrific way to incentivize change. However, in a warfighting environment, this gap is harder to cross because of restrictions and cumbersome acquisition regulations. Companies like Amazon, Alibaba, eBay, and others fill the gap between provider and consumer, with real-time connections, driving out the true costs of a product and allowing supply to match demand. Without this same market in the government acquisition space, the end user remains in the dark, overpays, or incurs unnecessary risk to operations by not having access to the right data at the right time to make life-or-death decisions. This presentation intends to demonstrate a marketplace for connecting providers to consumers for the government, providing unrivaled value, shortening the time between product creation and market availability, and *putting the needed information into the right hands at the right time*. As the new Chief of Space Operations continues to push for Space to own the Surveillance, Reconnaissance, and Tracking (SRT) mission [1], the demand signal has never been stronger. By leveraging existing technologies, such as the Unified Data Library (UDL) and the existence of a fully documented Application Programming Interface (API), this presentation will show the benefits of real-time accessibility to SRT through the existence of a Marketplace.

## 2. INTRODUCTION

The on-orbit capabilities of commercial providers continue to surge, showing the ability for private companies to do things previously possible only with government sponsorship. As the capabilities have grown, so has the demand from the end user, creating an amplifying feedback cycle that increases both supply and demand. As future advancements in shared ground stations and real-time tasking continue to grow [2], the only part missing is the exchange layer between provider and consumer. The Space Domain Awareness (SDA) Marketplace is a capability that initially went into production in 2020, focused primarily on SDA data. The number of data products continues to grow and the recent addition of Surveillance, Reconnaissance, and Tracking (SRT) data through multiple providers further ramps that growth. A thorough assessment of the marketplace identified gaps and integrated providers to meet the end users' needs with a timely, taskable, and tailored approach, working to match government demand with the onboarding of commercial vendors in the Marketplace.

Although the Marketplace brings providers and consumers together for the purchase of data, this topic is not a marketing pitch. One of the key aspects that makes the Marketplace function is that it remains an independent party in all purchases, without representing itself as a provider or consumer in any context. Instead, the Marketplace acts as the translation layer between commercial capabilities and the government process, with the ability to function as an open platform using consumer funding, while also extending the same capability to government organizations. This paper proves that the Marketplace has the ability to create an order, receive proposals, and execute the order at the same speed as the rate of technology advancement; it also shows that a true market exists. This incentivizes commercial companies to provide data and satisfies the needs of operational customers who are currently starved for information. The SRT example is fitting, since it brings the capabilities of space back to the most relevant users, while lowering the barrier to entry for both parties.

Marketplaces allow for a wider range of data providers, giving users access to a larger data pool, which leads to improved data quality, since more providers means more diverse and accurate data. Additionally, marketplaces often offer data processing and analysis services, which can save users time and resources by providing pre-processed data that is ready to use.

Finally, the use of a marketplace for SRT data can benefit the end user. By providing access to more diverse and accurate data, organizations like the DoD, Federal Emergency Management Agency (FEMA), or Fire Services can make more informed decisions in the field. This data access can lead to more successful operations and fewer casualties. Additionally, the use of a marketplace can provide a more cost-effective solution for accessing data, which can free up resources for other critical operations. Consumers can avoid awarding their own contract and, instead, fund their account on the Marketplace, saving time and resources, while also making it cost effective to place smaller orders. By leveraging the Unified Data Library’s (UDL) distribution architecture, this critical data can get to users at any location, and at any classification level. This capability removes the burden from commercial data providers to work networking and integration, and focus solely on providing data. Likewise, the end user can feed existing tools and applications, without re-engineering the solution for each potential provider. Most importantly, tactical SRT is not possible without the ability to tactically acquire. The Marketplace allows for real-time acquisition of near real-time data, bringing the data within reach of the final consumer.

To complete the last step and link space collection to a tactical user, there needs to be a device capable of operating in an austere environment, potentially with intermittent communications, which can connect to the tools used by the operational customer. This circumstance is when the Tactical UDL (T-UDL) comes into play. The T-UDL is a micro-sized version of the Cloud-based Enterprise UDL, capable of synchronizing data to and from the Enterprise UDL and other T-UDLs—extending the cloud to the Tactical Edge. Since the T-UDL has an identical software architecture as the Enterprise UDL, data synchronization is seamless to the user, has identical data controls, and has the portability needed for a Tactical user. Combining T-UDL and SRT data through the Marketplace ensures a true end-to-end process for tactical operations.

### 3. THE PROCESS

The overall process, from end to end, is shown below in Fig. 1.

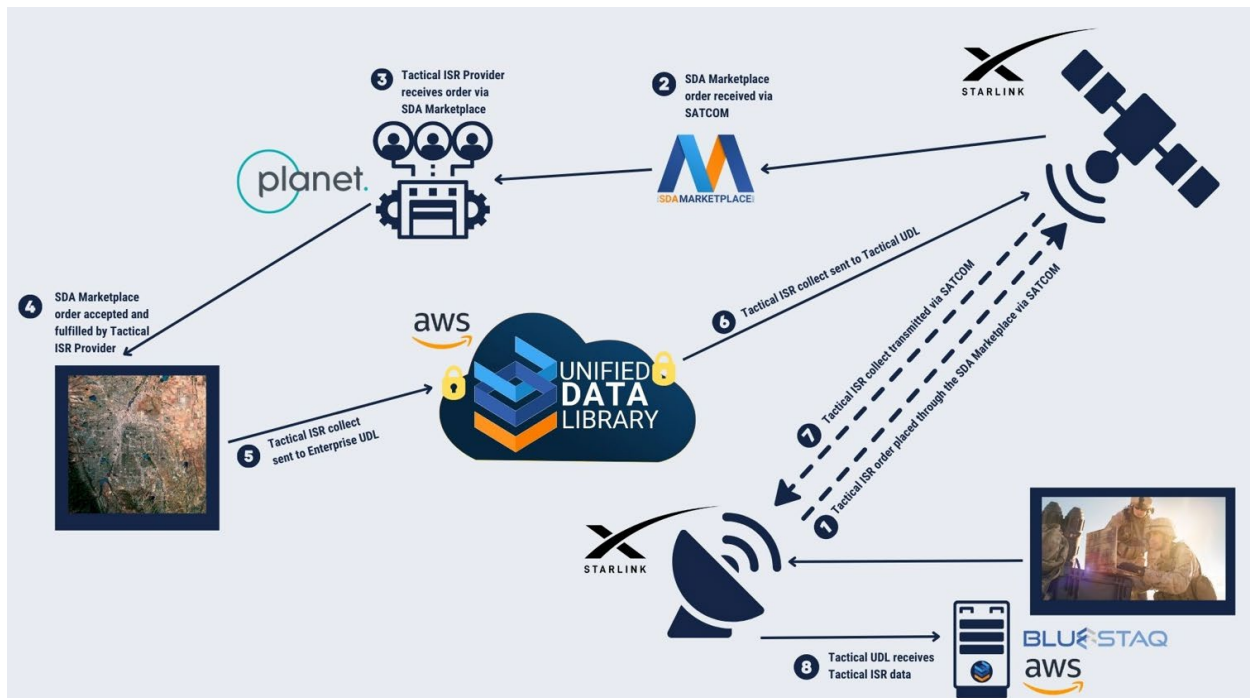


Fig. 1: Marketplace Ordering Process

This process starts with customer demand, just like any other Marketplace. A customer, after being verified through a due diligence process and funding their account to be able to purchase data, initiates the process by creating an order. That order then hits the Marketplace, where vendors can see what consumer orders are accepting proposals from data providers. The consumer will see proposals as they come in; if a proposal meets the consumer's needs at an acceptable cost, the consumer can place the order. At this point, the provider initiates the work to collect data, in this case SRT collections, and provides that data to the Unified Data Library for distribution. Using whatever internet path is available, a Tactical UDL can then consume this data from the UDL, and hold it locally even if communications drop, providing continual access to data or imagery to support an operation. To walk through each step in more detail and provide relevant examples, the scenario of a Fire Services team using the UDL to purchase satellite imagery, for locating a forest fire, acts as the motivation for purchasing commercial imagery, where the imagery can be loaded onto a Tactical UDL and moved closer to the Fire Fighters who are working to extinguish the burn.

#### 4. PLACING AN ORDER

The first step in acquiring data through the Marketplace is to place an order. Before this step can begin, the consumer must request an account, be validated through the due diligence process, and must fund their account (either through a swipe of a credit card, an Automated Clearing House (ACH) transfer, or a government funding action such as a Military Interdepartmental Purchase Request (MIPR) or Form 9). From there, the consumer must decide the type of commercial data product they need. Currently, the Marketplace supports orders of Conjunction reports, Electro Optical observations or imagery, Elsets, Ground imagery, Infrared, Maneuver detection, Orbital objects, RF environmental characterizations, Radar, Radio frequency, SGI, Sat-to-sat, Satellite metadata, State Vector, Synthetic aperture radar, and TDOA/FDOA. In the forest fire example, the first step is to enter the basic details of the order into the Marketplace user interface, such as an Order Name, description of what is needed, and what data type is needed. This interface is seen below in Fig. 2.

**SDA Marketplace** Day 144 2023-05-24T23:00:35Z arnim.zola Hydra

**Name \***  
AMOS Tactical ISR Order

**Description \***  
Looking to purchase an overhead EO image of the best conference of the year for all things Space!

[Attach a File](#)

**Product \***  
Imagery

**Product Type \***  
Ground Imagery

**Vendor Selection**

By default, your order will be available to all vendors on the SDA Marketplace. If you believe only certain vendors are able to fulfill your order, please choose one or more vendors to purchase from. By doing so, only those vendors will be able to see your order.

[Attach a File](#)

Will this order be a pay on fulfillment type?  
 Yes  No

Will this order be taskable?  
 Yes  No

**Next**

Fig. 2: Order Creation

The next step in the order creation process is to populate the order details. In this case, a polygon was built around Hawaii, with additional features of the maximum viewing angle, maximum solar angle, maximum ground sample distance, and maximum cloud cover. This polygon clarifies the consumer’s need, showing what final product features would satisfy the needs of the consumer. This process can be seen below in Fig. 3.

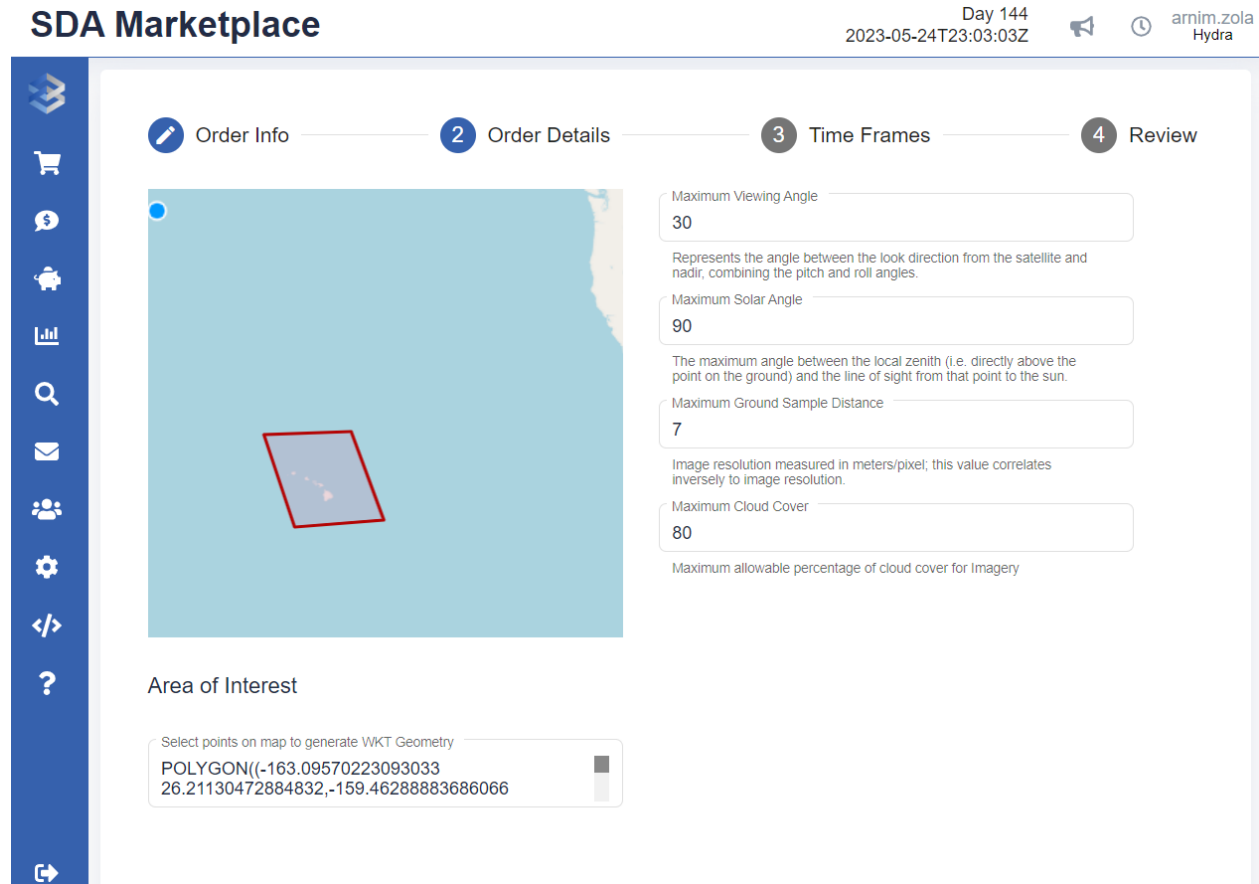


Fig. 3: Order Details

Finally, a time frame for the order is entered, allowing the consumer to indicate when this image is desired, when the opportunity to propose solutions ends, and the duration of the request if the request lasts more than a single collection. These fields are key to enabling the consumer to drive out the immediacy of the need, where a provider can understand how responsive they need to be to compete for the order. The connection for clear communication between consumer and provider are key to getting the “right” data back to the consumer. This connection also allows commercial companies to differentiate themselves, based on when they can provide the data, while meeting the quality metrics defined in the previous step. Additional information can be added here for continual collections, such as how long a provider needs to wait between collections. These inputs are shown below in Fig. 4.

Order Info — Order Details — **3 Time Frames** — 4 Review

Enter the timeframe to receive imagery

Start Time: 2023-05-25T00:00:00.000Z — End Time: 2023-05-26T23:59:59.999Z — Proposal Expiration: 2023-05-24T23:15:25.519Z

Enter the frequency for imagery collection.

Frequency: 2 time(s) every Frequency Period: 1 day(s)

Enter min/max wait between imagery

Minimum wait: 8 Hours [ ] Minutes

Maximum wait: 20 Hours [ ] Minutes

Enter your maximum projection limit in days.

1

Back Next

Fig. 4: Order Time Frame

### 5. ORDER RECEIVED

Once the order is created, it now exists on the Marketplace, giving a direct connection to providers. Details of when the order was created and what “Product” was selected automatically drives what providers would see the order and have the ability to propose to it. Only providers who support the product requested are capable of proposing, preventing a crowding of the marketplace exchange where a space company would see ground orders that they are unable to meet. In this example for Ground Imagery, over 20 companies currently have onboarded to the UDL to provide this data product, and each would see the full details of the order. Fig. 5 below shows a current list of providers of Ground Imagery.

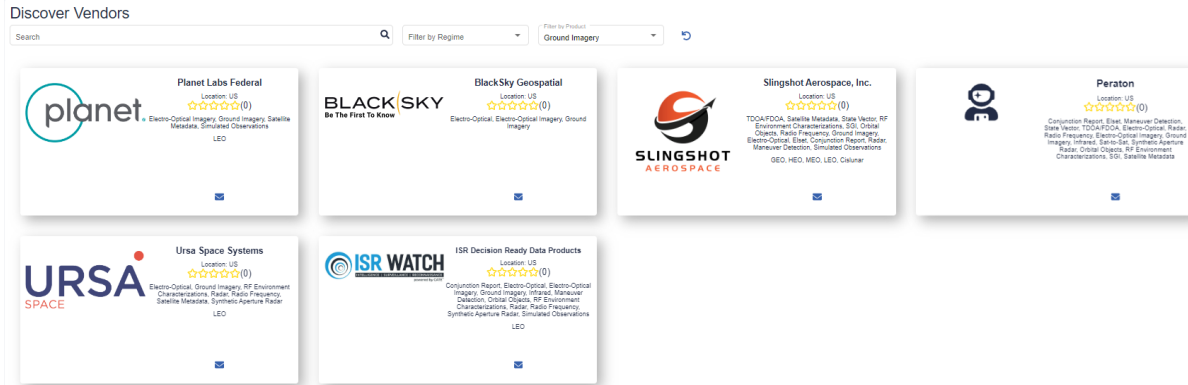


Fig. 5: Ground Imagery Providers

## 6. ORDER PROPOSAL

Once an order hits the Marketplace, providers can issue proposals for the order, up until the order expires. From a data providers Marketplace account, they can filter the available orders through their Exchange interface, seen below in Fig. 5. In this case, Stark Industries provides multiple data products, and has multiple orders they can view and submit proposals, if desired.

SDA Marketplace

Day 144  
 2023-05-24T23:08:20Z

tony.stark  
 Stark Industries

SDA Exchange

7 Total Open Orders

Please choose a product type to filter by

- x Elset x Electro-Optical
- x Orbital Objects
- x Conjunction Report
- x State Vector
- x Radio Frequency
- x RF Environment Characterizations x SGI
- x TDOA/FDOA x Radar
- x Ground Imagery
- x Maneuver Detection
- x Satellite Metadata

Name	Product Types	Pay on Fulfillment	Cadence	Objects	Duration (days)	Expiration ↑	View Details & Add Proposal
AMOS Tactical ISR Order	Ground Imagery	No	2 / 1 day	8,753	2	May 24, 2023	<a href="#" style="background-color: #007bff; color: white; padding: 5px 10px; border-radius: 4px;">View Order</a>
Testing vendor country exclusion	Electro-Optical	No	1 / 1 revolution	7	44	Sep 1, 2024	<a href="#" style="background-color: #007bff; color: white; padding: 5px 10px; border-radius: 4px;">View Order</a>
Testing vendor country exclusion	Electro-Optical	No	1 / 1 revolution	7	44	Sep 1, 2024	<a href="#" style="background-color: #007bff; color: white; padding: 5px 10px; border-radius: 4px;">View Order</a>

Fig. 6: Marketplace Exchange

When the provider opens up the order, they can see the full details of the order, to better understand the consumer's need. See Fig. 6. Providers can pull up the details manually to review and communicate any clarifying questions back to the consumer, if needed.

**SDA Marketplace**
Day 144  
2023-05-24T23:08:49Z
🔊 🕒 tony.stark  
Stark Industries

AMOS Tactical ISR Order
✉️ 📅 💰

**DESCRIPTION**  
Looking to purchase an overhead EO image of the best conference of the year for all things Space!

PRODUCT TYPE	SUB-PRODUCT TYPE	REGIME	OBJECT COUNT	EST. IMAGERY	PROJECTION LIMIT DAYS	FULFILLMENT ORDER
Imagery	Ground Imagery	CUSTOM	8,753	35,012	1	false

MAXIMUM VIEWING ANGLE	MAXIMUM SOLAR ANGLE	MAXIMUM GROUND SAMPLE DISTANCE	MAXIMUM CLOUD COVER	AREA OF INTEREST
30	90	7	80	POLYGON((-163.09570223093033 26.21130472884832,-159.46288883686066 16.063409003226056,-148.91601383686066 16.850107453457923,-152.78320133686066 26.526287887643733,-163.09570223093033 26.21130472884832))

TASKABLE false	CORRECTED DATA false
EXPIRATION May 24, 2023, 11:15:25 PM	START TIME May 25, 2023, 12:00:00 AM
	END TIME May 26, 2023, 11:59:59 PM

PROPOSALS

There are no proposals on this order

Fig. 7: Order Details

Once the providers understand the request, they can provide their proposed price to satisfy the consumer's need. This price can include additional options, such as tasking ability for long term orders, or different data rights, from small groups of under 25 up to full and unlimited. Since the Marketplace has a fully published Application Programming Interface (API), a provider can also set up their account to read orders machine-to-machine and, based on a rule set, propose a cost and capability back to the order. Once the cost details are fully defined, the proposal goes back to the Marketplace where the consumer can view it. An example proposal is shown below in Fig. 7.

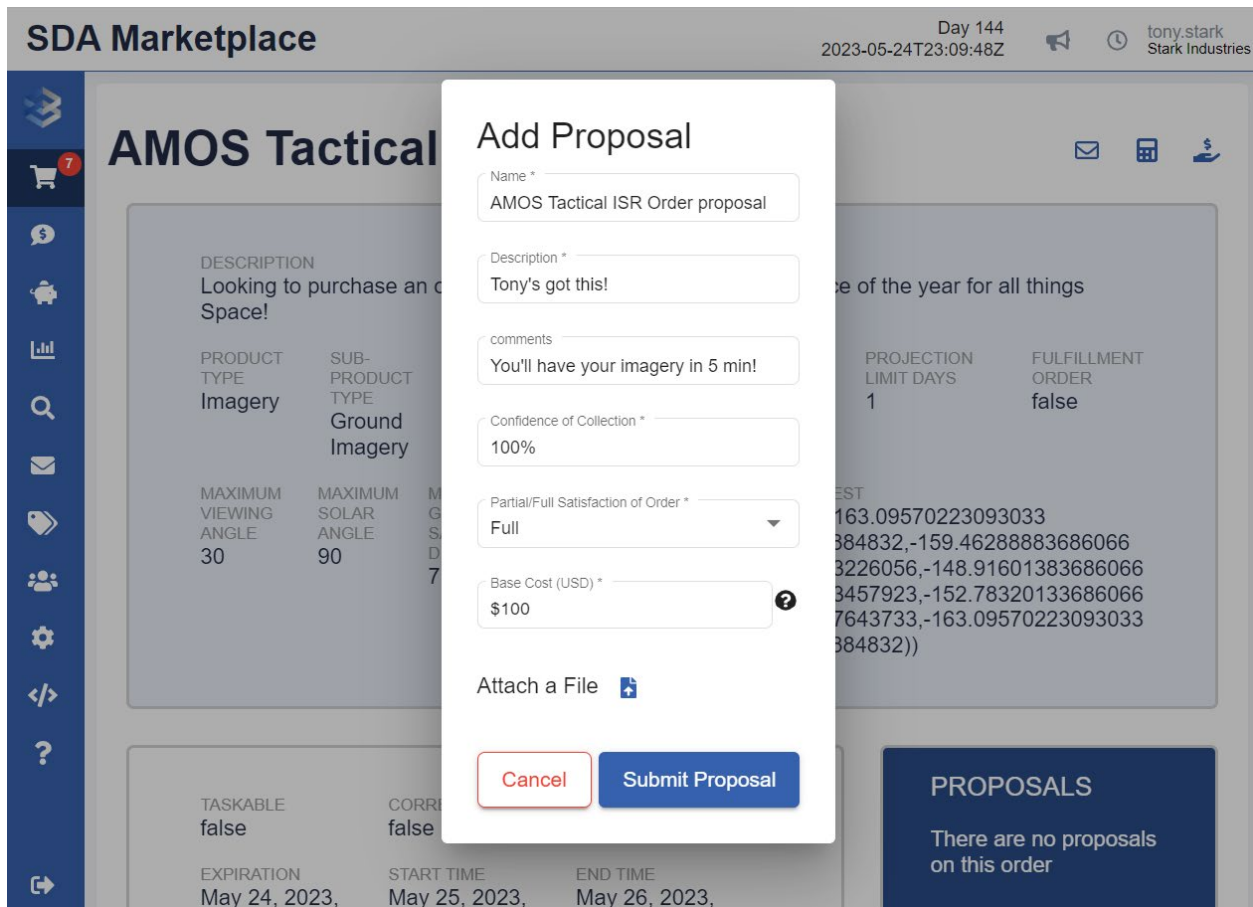


Fig. 8: Order Proposal

Now, the consumer can see this proposal in their Marketplace exchange. Below, the Stark Industries’ proposal is highlighted, showing the base price and the Actions column that allows the consumer to communicate directly with the provider.



Proposal Management 13 Open Proposals 94 Accepted Proposals

Search

Open Accepted Complete Canceled

Order	Vendor	Base Price	Actions
AMOS Tactical ISR Order	Stark Industries	\$100.00	
IT Order One	Stark Industries	\$100,000.00	
abc	Stark Industries	\$5,000.00	
Elset Pay in Full	Stark Industries	\$88,888.00	
Elset Pay in Full	Stark Industries	\$44,444.00	
Elset Pay in Full	Stark Industries	\$33,333.00	

Fig. 9: Proposal Management

If the consumer opens the proposal, the full details of the proposal are shown, including the full price based on the data rights desired by the consumer. This piece of the Marketplace is key, since current government organizations purchasing data encounter challenges matching the data rights of the purchase to their intended audience, either under or over purchasing due to the restrictions on the data rights. With the Marketplace, they can not only define exactly what data rights they want included with the data, but they can also toggle between different rights to see the cost impact that is unique to each provider and each proposal. These capabilities allow the best cost/benefit point to be reached for the order, fine tuning the needs of the consumer against the costs from providers, which is shown below in Fig. 9.

**View Proposal Details**

**NAME**  
AMOS Tactical ISR Order proposal

**DESCRIPTION**  
Tony's got this!

**COMMENTS**  
You'll have your imagery in 5 min!

**STATUS**  
Open

Base Price (USD)	\$100.00
Data Rights (200%)	\$200.00
Subtotal	\$300.00
Convenience Fee (10%)	\$30.00
Total Tax (USD)	Exempt
<b>Total (USD)</b>	<b>\$330.00</b>

After payment your new balance will be \$5,471,925.66.

**BASE PRICE**  
\$100.00 USD

**SATISFACTION**  
FULL

**DATA RIGHTS**  
GPR

**DISTRIBUTION GROUPS**

**PAYMENT OPTIONS**  
 Pay over time  Pay in full

Fig. 10: Proposal Costs

From here, if a consumer agrees with the details of the order, accepts the proposed cost, and has enough credits in their marketplace account, they can confirm the order to complete the ordering process and move the request out to fulfillment.

## 7. ORDER FULFILLMENT

Once a proposal has been accepted, the data provider executes the task and collects the data. The focus of this wildfire example highlights the general demand signal from the community that is currently being underserved, where mobile technology options and real-time data acquisition are limited [3]. With the Marketplace, users can rapidly connect to commercial providers who can avoid the challenges of seeking a full government contract award, and instead simply offer their services on the Marketplace. Because the government contracting process exists on the Marketplace side, vendors need only to be vetted through a due diligence process, but they do not need to have a direct contractual relationship with the consumers. A provider can collect overhead imagery without the need for a Facility Security Officer, an approved government cost accounting platform, a Cybersecurity Maturity Model Certification (CMMC) compliant company network, or even a single cleared individual on staff. Commercial companies can do what they do best, without having to lean into government processes, and at the same time can be immediately compensated through a Marketplace purchase without delay, just like other commercial marketplaces. The Marketplace process also leads to a commercial provider being rated at the order level, rather than at the contract level. Similar to a five star rating system in other markets, the Marketplace allows consumers to rate a provider for each order, holding providers accountable for meeting their side of the deal. In our wild-fire example, a provider who has received an order would use the order details to task a satellite, collect an image or series of images, and provide any additional tagging or analysis, included as part of the purchase. This final data product is what then moves back into the UDL for distribution.

## 8. ORDER POSTED TO ENTERPRISE UDL

Although there is an ability to provide data directly back to the consumer, the bulk of Marketplace purchases leverage the UDL for data distribution, since the robust security architecture, cloud storage, cross-domain data movement, and machine-to-machine opportunities allow for the easiest data distribution. In the wild-fire example, images of the wild-fire would be pushed to the UDL Ground Imagery service, following the data schema outlined on the OpenAPI documentation page within the UDL, as shown in Figure 11. A provider would mark the data source, time, and other fields, as required in the “POST” instructions, to allow the imagery to be distributed through the UDL based on the data releasability agreed to during the purchase. These actions happen automatically, with the consumer receiving a unique marketplace key that “unlocks” access to this data once posted to the UDL.

```
{
  "id": "GROUNDIMAGERY-ID",
  "idSensor": "SENSOR-ID",
  "classificationMarking": "U",
  "imageTime": "2021-01-01T01:01:123456Z",
  "filename": "Example file name",
  "region": "POLYGON((26.156175339112 67.3291113966927,26.0910220642717 67.2580009640721,26.6637992964562 67.1795862381682,26.730115808233 67.2501237475598,26.156175339112 67.3291113966927))",
  "regionText": "POLYGON((67.3291113966927 26.156175339112,67.2580009640721 26.0910220642717,67.1795862381682 26.6637992964562,67.2501237475598 26.730115808233,67.3291113966927 26.156175339112))",
  "regionGeoJSON": "{\"type\":\"Polygon\",\"coordinates\":[[[100,0],[101,0],[101,1],[100,1],[100,0]]]]",
  "regionType": "Polygon",
  "regionWdms": 2,
  "regionSRId": 0,
  "origSensorId": "ORIGSENSOR-ID",
  "subjectId": "SUBJECT-ID",
  "name": "Example name",
  "source": "Bluestaq",
  "origin": "THIRD_PARTY_DATASOURCE",
  "dataNode": "TEST",
  "transactionId": "37bdef1f-5a4f-4776-bee4-7a1e9ec7d35a",
  "tags": [
    "PROVIDER_TAG1",
    "PROVIDER_TAG2"
  ]
}
```

GroundImagery\_Ingest {

- description: Imagery of terrestrial regions from on-orbit, air, and other sensors
- id: string  
maxLength: 36  
minLength: 1  
example: GROUNDIMAGERY-ID  
Unique identifier of the record, auto-generated by the system
- idSensor: string  
maxLength: 36  
minLength: 0  
example: SENSOR-ID  
Optional ID of the sensor that produced this ground image.
- classificationMarking\* string  
maxLength: 128  
minLength: 1  
example: U  
Classification marking of the data in IC/CAPCO Portion-marked format
- imageTime\* string(\$date-time)  
example: 2021-01-01T01:01:123456Z  
Timestamp the image was captured/produced
- filename\* string  
maxLength: 512  
minLength: 1  
example: Example file name  
Name of the image file
- region: string  
example: POLYGON((26.156175339112 67.3291113966927,26.0910220642717 67.2580009640721,26.6637992964562 67.1795862381682,26.730115808233 67.2501237475598,26.156175339112 67.3291113966927))  
Geographical region or polygon (lon/lat pairs) of the image as projected on the ground in geoJSON or geoText format. This is an optional convenience field only used for create operations. The system will auto-detect the format (Well Known Text or GeoJSON) and populate both regionText and regionGeoJSON fields appropriately. When omitted, regionText or regionGeoJSON is expected.
- regionText: string  
example: POLYGON((67.3291113966927 26.156175339112,67.2580009640721 26.0910220642717,67.1795862381682 26.6637992964562,67.2501237475598

Figure 11: Ground Imagery example and schema

## **9. ORDER MOVED TO TACTICAL UDL**

With the UDL now holding the purchased SRT imagery, the last step is to move this data to the tactical edge onto the TUDL. A network connection is required for this step and, depending on where the end user is located, this connection could be through a commercial terrestrial network, or through a more remote connection, such as Satellite Communication (SATCOM) or 5G, with multiple service provider options that exist today. With TUDL, the owner of the TUDL has a management interface where they are able to prioritize what data to consume from the enterprise UDL. If the TUDL, in this case, is being used for wild-fire services, the top priority data feed would likely be Ground Imagery. Other data types from the UDL may also be purchased/consumed, such as air tracks of water drop aircraft or personnel location. The image below shows an example of the subscriptions from a TUDL interface, based on a user's need, which will update in real time, based on the additional filters provided (such as data type, specific data providers, timeframes, or even physical location boundaries). This prioritization allows the consumer to make the most of their storage within the TUDL, while optimizing for potential network limitations.

## **10. TACTICAL UDL EXPOSES DATA TO APPLICATION**

In the final step, the end user exposes this data to their tool, visualization, or application of choice. Since the Marketplace is focused on the connection between provider and consumer, it does not limit or dictate how the end consumer exposes data. Instead, it fully defines the data structure, how it is stored, and how it is accessed, so that the end consumer can feed it to their preferred tool or application. In this example, it could be a common operating picture across relevant fire services teams, a shared drive for imagery, or a 3D globe updated with the latest information, overlaid with response plans. In any case, the data in the TUDL, once synced with the enterprise UDL, can persist even beyond losing connectivity, maintaining the data necessary to feed the tools in use, even in an austere environment. For a TUDL, there is also the ability for data to sync from one TUDL to another, allowing one TUDL to push updates to other units in the field, using radio connectivity when other options are not available.

## **11. CONCLUSION**

In conclusion, the use of a marketplace for SRT data can provide numerous benefits to both data providers and end users. These benefits are especially relevant in the connection between space capabilities and operational end users, where current capabilities are far separated from the people who need them most. By leveraging the Marketplace, this gap can be closed, providing future incentives for the commercial market to grow, and supplying current operational users with the information they need.

## 12. REFERENCES

- [1] G. Hadley, "Air and Space Forces," 24 May 2023. [Online]. Available: <https://www.airandspaceforces.com/space-force-isr-satellites-nro/>. [Accessed 16 June 2023].
  
- [2] "SatNews," 13 April 2023. [Online]. Available: <https://news.satnews.com/2023/04/13/aws-ground-station-now-supports-wideband-digital-intermediate-frequency/>. [Accessed 16 June 2023].
  
- [3] "CONNECT," Panasonic, 23 September 2020. [Online]. Available: <https://www.ruggedmobilityforbusiness.com/2020/09/8-reasons-firefighters-and-emts-need-mobile-technology-in-the-field/>. [Accessed 16 June 2023].
  
- [4] "Defense something article about Space Force owning Tactical ISR or recent one about Commercial Space Office," [Online].

## 13. ACRONYMNS

Application Programming Interface (API).....	7
Automated Clearing House (ACH).....	3
Cybersecurity Maturity Model Certification (CMMC).....	10
Federal Emergency Management Agency (FEMA).....	2
Intelligence, Surveillance, and Reconnaissance (ISR).....	1
Military Interdepartmental Purchase Request (MIPR).....	3
Satellite Communication (SATCOM).....	12
Space Domain Awareness (SDA).....	1
Surveillance, Reconnaissance, and Tracking (SRT).....	1
Tactical UDL (T-UDL).....	2
Unified Data Library's (UDL).....	2