Space Domain Awareness (SDA)

Lt Col Travis Blake, TTO Program Manager

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Overview

SST - provides a fundamentally new approach to optical ground based surveillance of space objects—the ability to detect an unprecedented number of objects with accuracies and sensitivities beyond that of current sensors

Ibex - demonstrates an advanced SSA data fusion based on SST data and extendable to other current and future sensors—capability to dynamically task disparate sensors and efficiently process data to provide actionable information

Space Domain Awareness (SDA) – would continue to demonstrate the potential for revolutionary SSA concepts by enabling a shift from a sensor-centric model to a cost efficient data-centric model utilizing an incentive-for-service collaborative network of users with access to data from numerous distributed sensors

More data, less cost.

Space Surveillance Telescope (SST)

Program Objectives

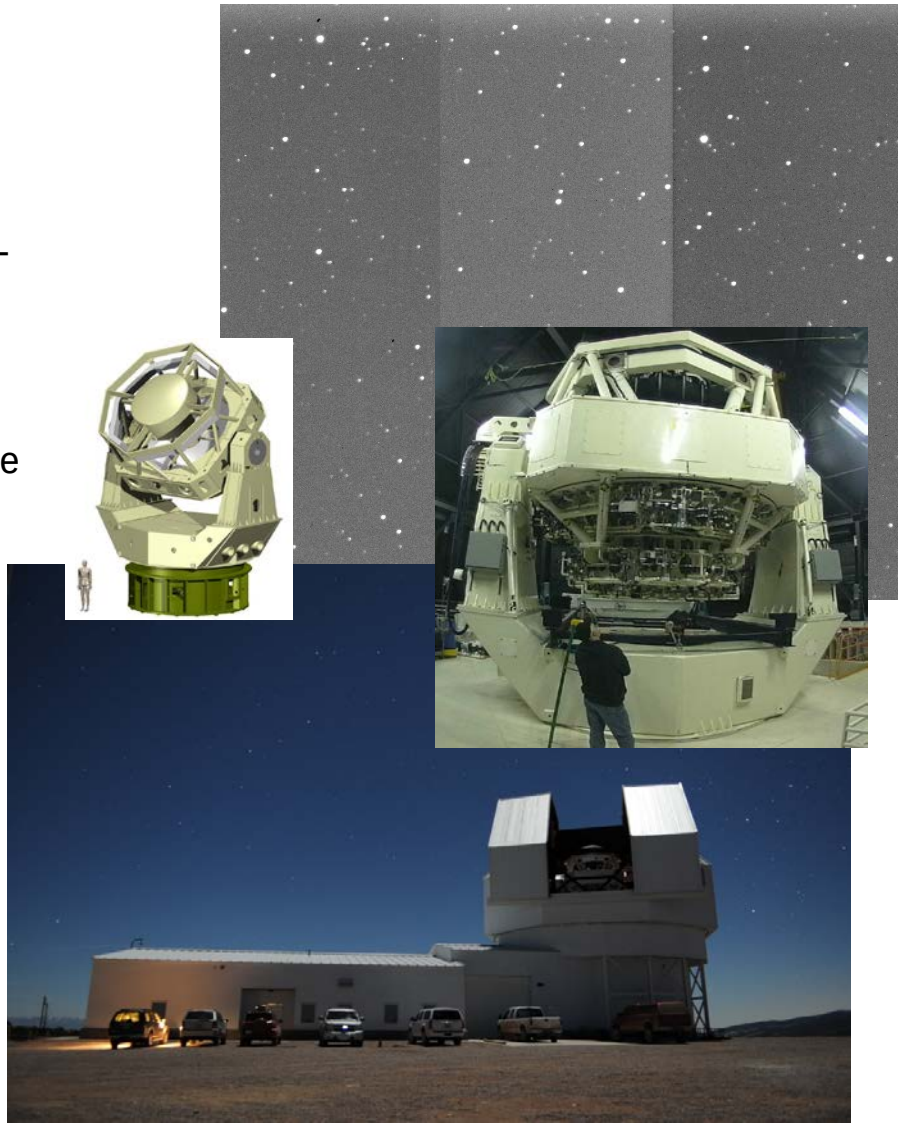
- Demonstrate a telescope system capable of rapid un-cued search, detection, and tracking of dim objects in deep space.
- Innovative 3-mirror telescope design, enabled by novel curved CCD technology providing a wide field-of-view and a large aperture.

Performance Metrics

- Large agile telescope with a wide field-of-view; large area mosaic CCD camera; and high speed slit shutter design.
- A rapid step-and-settle telescope mount.
- Autonomous operation and real time data processing.

Military Utility

- Improved space situational awareness (SSA).
- Complete synoptic searches of the GEO belt, high-altitude orbits, and deep space with rapid updates.
- Enables detection of un-cued faint objects that are currently not possible.



Ibex

Program Objectives

- Develop and demonstrate algorithms and software to autonomously accept, organize, process and analyze space situational awareness (SSA) data in three primary areas:
  - Dynamic Sensor Tasking (DST): synergistic and cooperative cueing for systems such as Space Based Space Surveillance (SBSS) and Space Surveillance Telescope (SST).
  - Positive Object Identification (POI): reduce SSA data ambiguity through positive ID of space objects to maintain custody of all detectable objects.
  - Rapid Object Characterization (ROC): supports quicker sensor response and object of interest (OOI) identification from uncorrelated targets.

Performance Metrics

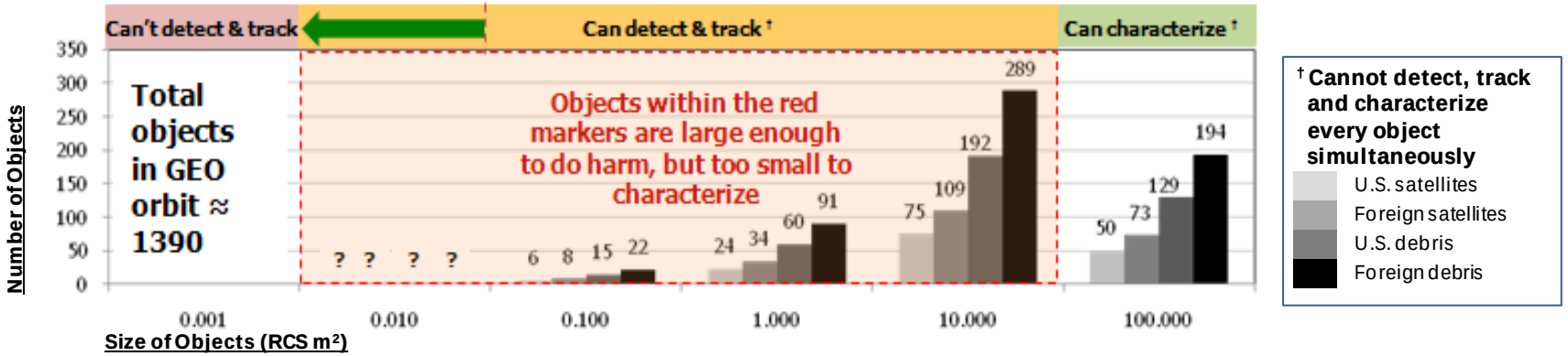
- DST: schedule more efficiently to build a complete object database, to meet accuracy requirements, and free up sensor resources to enable monitoring of high-interest resident space objects (RSOs) for indications and warnings threat mission.
- POI: maintain integrity of object catalog (seek to eliminate cross-tags and detection of lost or maneuvered objects of interest).
- ROC: identify possible objects of interest and detect changes.

Military Utility

- Provide more timely understanding of the space environment to support course of action implementation in the Joint Space Operations Center (JSpOC).
- MOA between DARPA and transition partner AFSPC signed Feb 2011.

What's the next DARPA hard challenge...

- SST – increased large optic ground-sensor capability.
- Ibex – demonstrating the level of awareness that is possible when data is available.



- Need to replicate SST's data source success to provide more data feeds for Ibex-type algorithms...

How do we make more data available for the right cost?

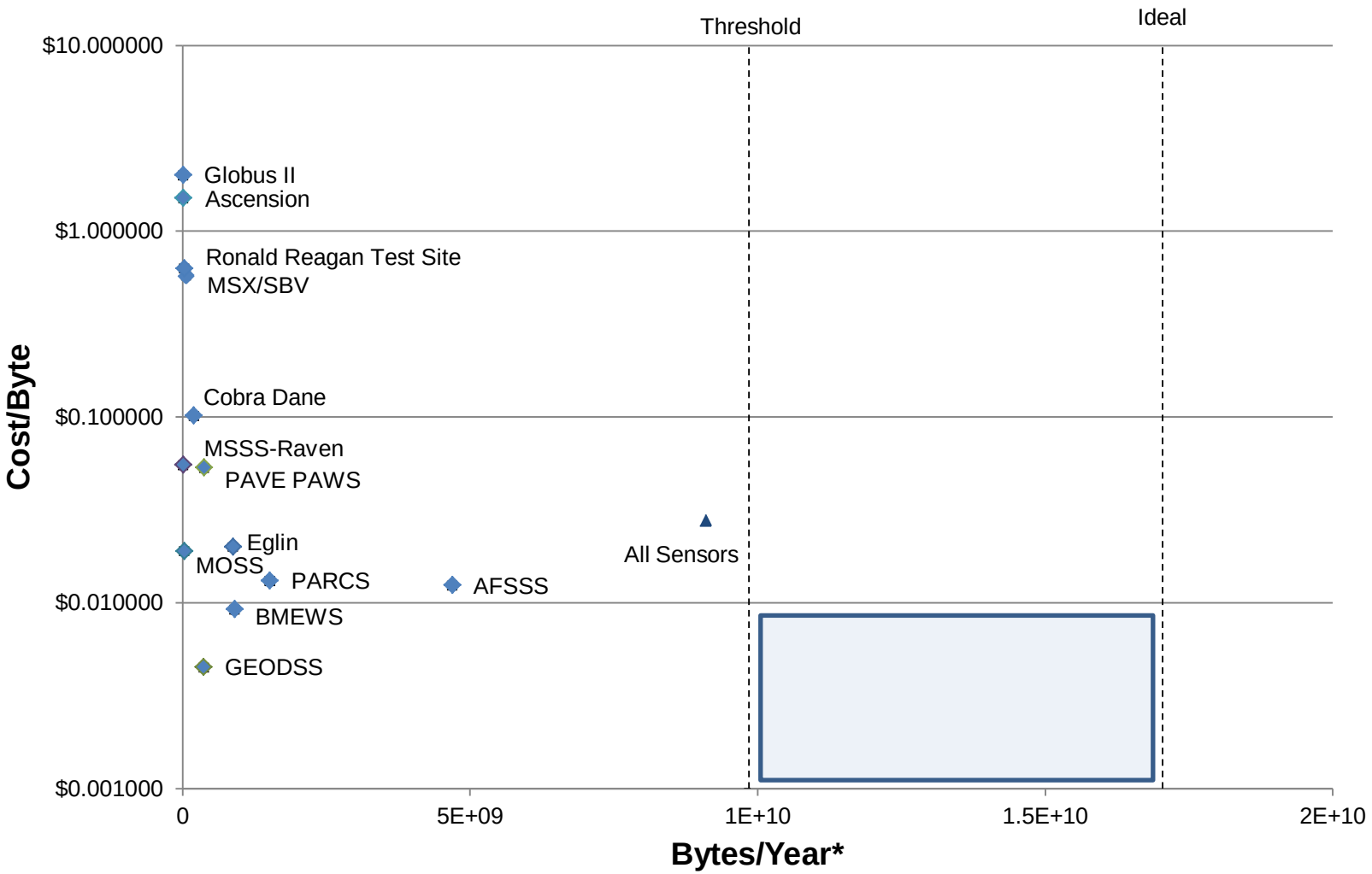
What if we looked at SSA from a purely data perspective?

Space Situational Awareness – in data space

	Current	Programmed	Threshold	Ideal
Number of Objects Tracked	20k	50-100k	100-500k	100-500k
Size Object	> 10 cm	> 5 cm	> 1 cm	> 1 cm
Orbital Vector Accuracy	~ 5 km	~1 km	250 m	10 m
Update Frequency (Active/Debris)	3 / 10 days	1.4 / 10 days	1.4 days	0.5 days
Collision Avoidance Warnings / Satellite	~10/year	~20-50/year	~1/year	~0.1/year
# Objects Characterized	1-10	1-10	10-100	100+
Threats Identified	No	No	Yes	Real-time
Change Detection	7-30 days	7-30 days	1-7 days	< 1 day
Dynamic Sensor Tasking	No	No	Yes	Yes
Rapid Object Characterization	No	No	Yes	Real-time
Positive Object Identification	Manual	Manual	Automated	Real-time
Number of Sensors	29	29	50-100	100-10,000
GB/Year of raw *usable* data	~1.5	~4.3	~9.8	~17.3

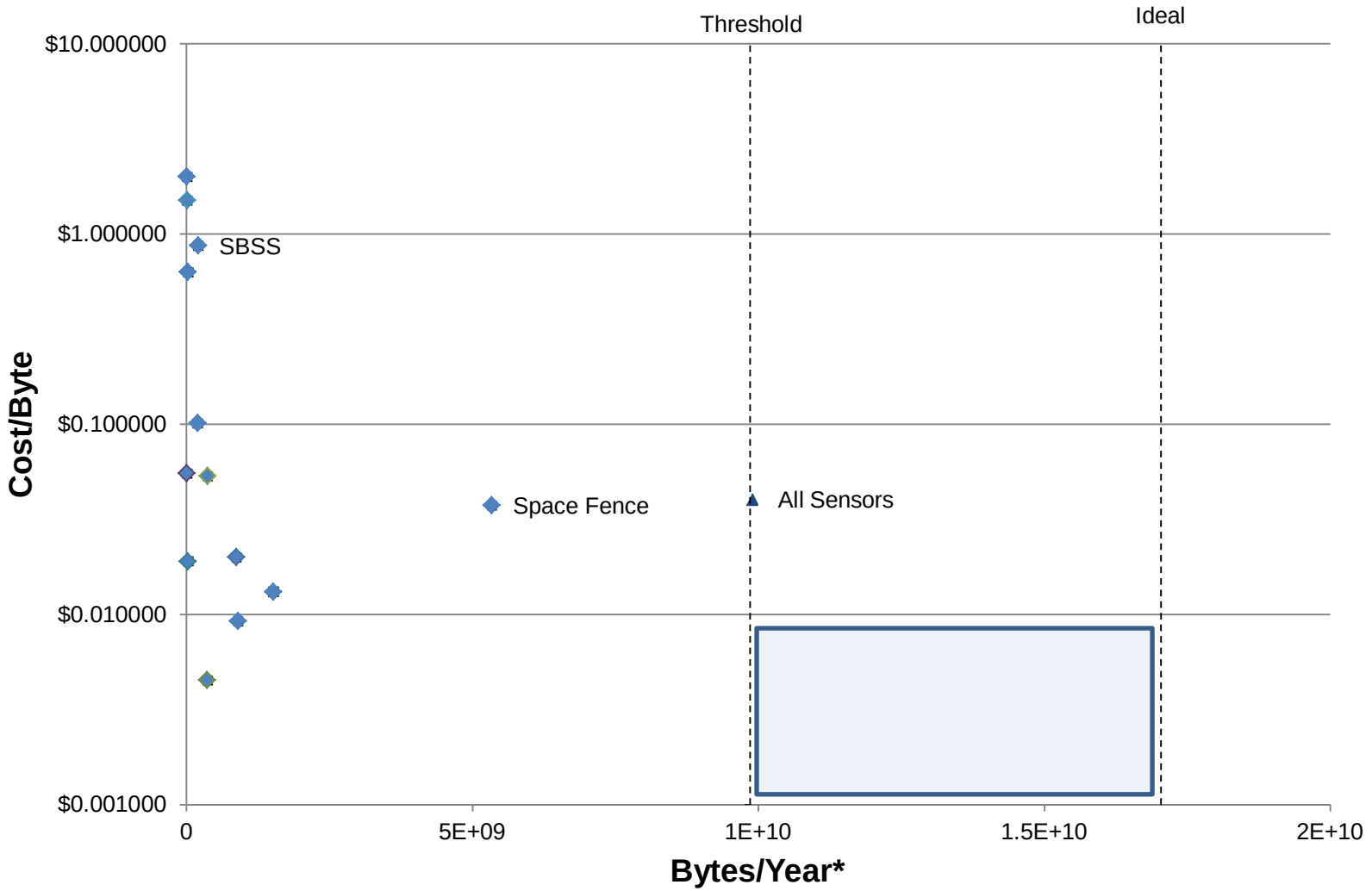
Threshold – Maintain awareness to identify potential threats to space capabilities.
Ideal – Provide real-time awareness of all threats to space capabilities.

Awareness today



* - Bytes of *useful* data

Programmed awareness



* - Bytes of *useful* data

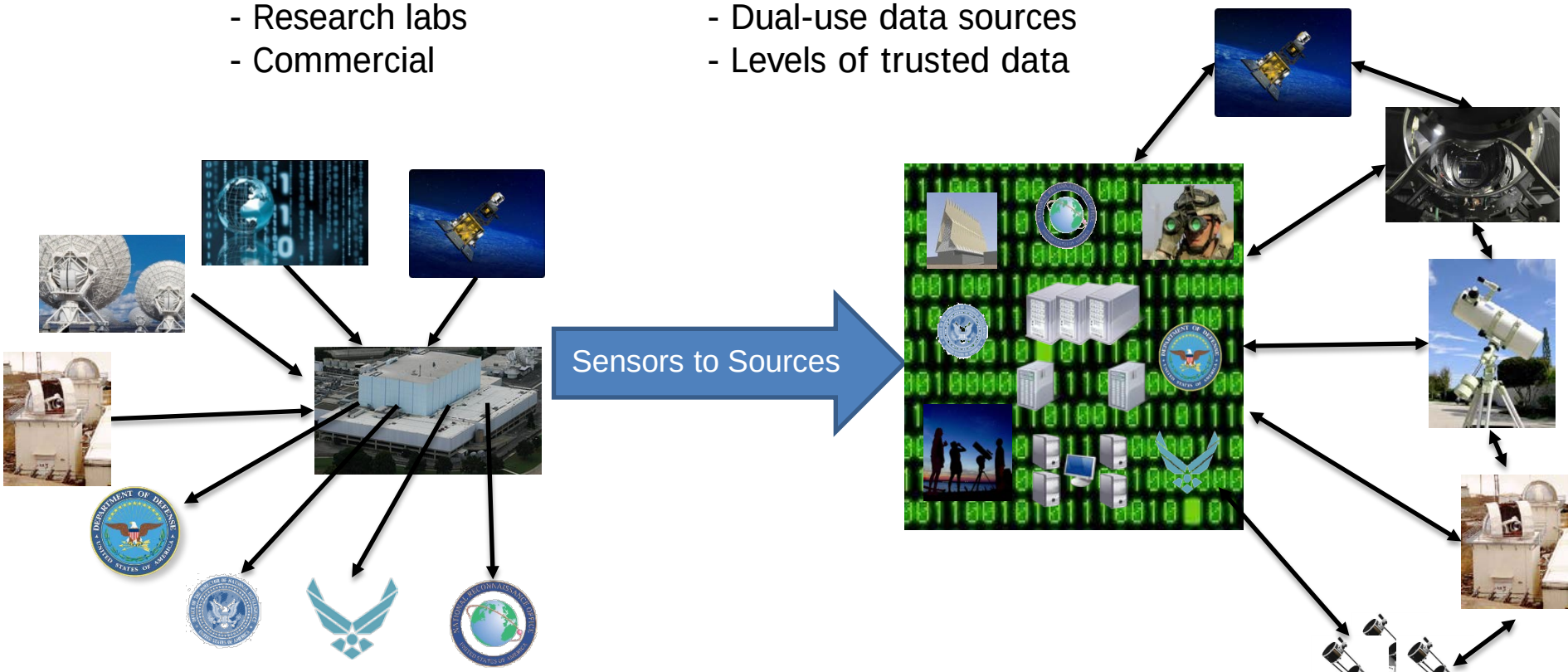
Space Domain Awareness concept

Proposed goal: Efficient use of motivated/low-cost data sources in a high volume service oriented environment.

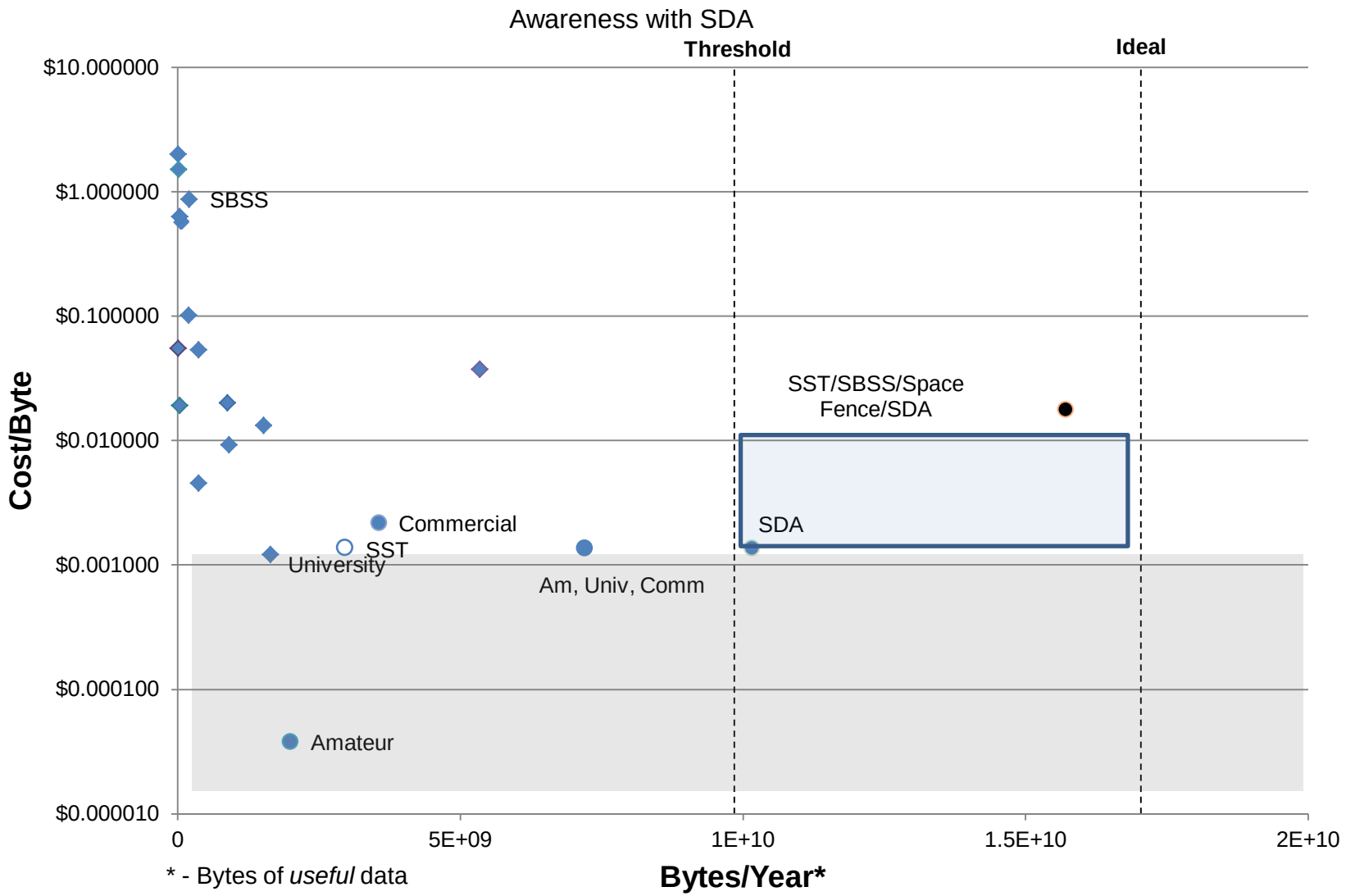
Network and standards development seamlessly integrating space awareness data services including:

- Amateur astronomers
- Universities
- Research labs
- Commercial

- Location agnostic ... Air, land, sea or space
- Secondary payloads
- Dual-use data sources
- Levels of trusted data



SDA impact on the data space



So what does being in box get us?

- Allows early identification of possible conjunction issues.
- Unbroken chain of custody.
- Fewer collision false alarms.
- Believable collision warnings.
- Enables prediction versus forensics.
- Focus on the information about what's happening in space and less on the sensors that are providing the data.

Affordable total awareness of the space domain.

Space Domain Awareness

Proposed goal: Efficient use of motivated/low-cost data sources in a high volume service oriented environment.

Possible Tasks:

- Develop network protocols and standards to enable the integration of an unknown set of diverse space awareness data services.
- Create trusted source levels for data provided.
- Create a monitoring center to provide centralized structure to the network.
- Determine the right set of incentives and requirements for data providers.

Potential demonstration:

- Utilizing a small, representative group of data providers with the right incentive structure, demonstrate the ability of the prototype network to task, collect, analyze and re-task for continual SSA data. The date from this network will be utilized by Ibex-related analysis applications to provide derived information and feedback for the re-tasking.

SDA – Potential Low-cost SSA data source demonstration

Provide a lower cost of entry into implementation of new data sources:

- Cost minimized – a sensor doesn't have to be everything to everybody.

Technological innovation incentivized:

- Greater acquisition flexibility and competition increases technical advances.

Reduced timelines:

- New technology integrated into a data-centric SOA.

Greater confidence and "right-size" awareness.

Fills the data gap – does not become the sole source of information:

- Nation continues to own, operate and maintain thin blue line of sensors.

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