Evaluating Commercial Contributions to Space Domain Mission Assurance

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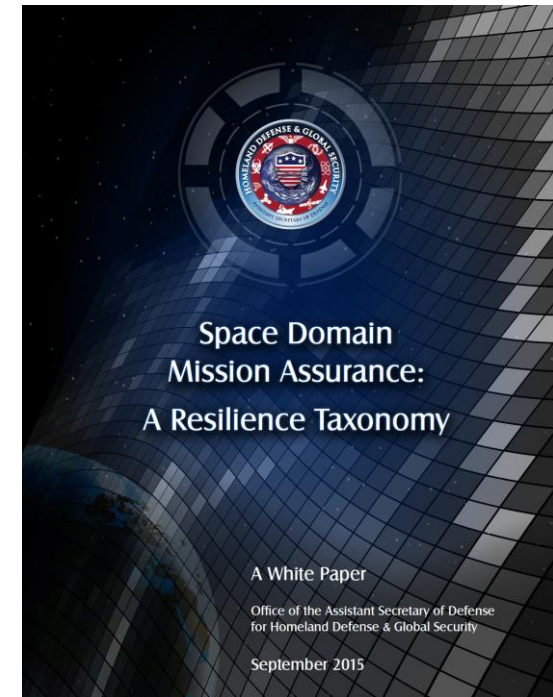
HAWKEYE 360

SPACE SYMPOSIUM, TECH TRACK SESSION 8

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BLUF

- Space Mission Assurance Taxonomy defines Space Domain Mission Assurance (SDMA) for critical National Security Space (NSS) assets

- Contribution of commercial space systems:
  - Less understood, but more than just disaggregation
  - Can contribute to each aspect of the Mission Assurance Taxonomy
  - Critical to understand in order to build to a heterogenous enterprise

- A follow-on study should propose a methodology to quantiatively assess the mission assurance of alternative future architectures
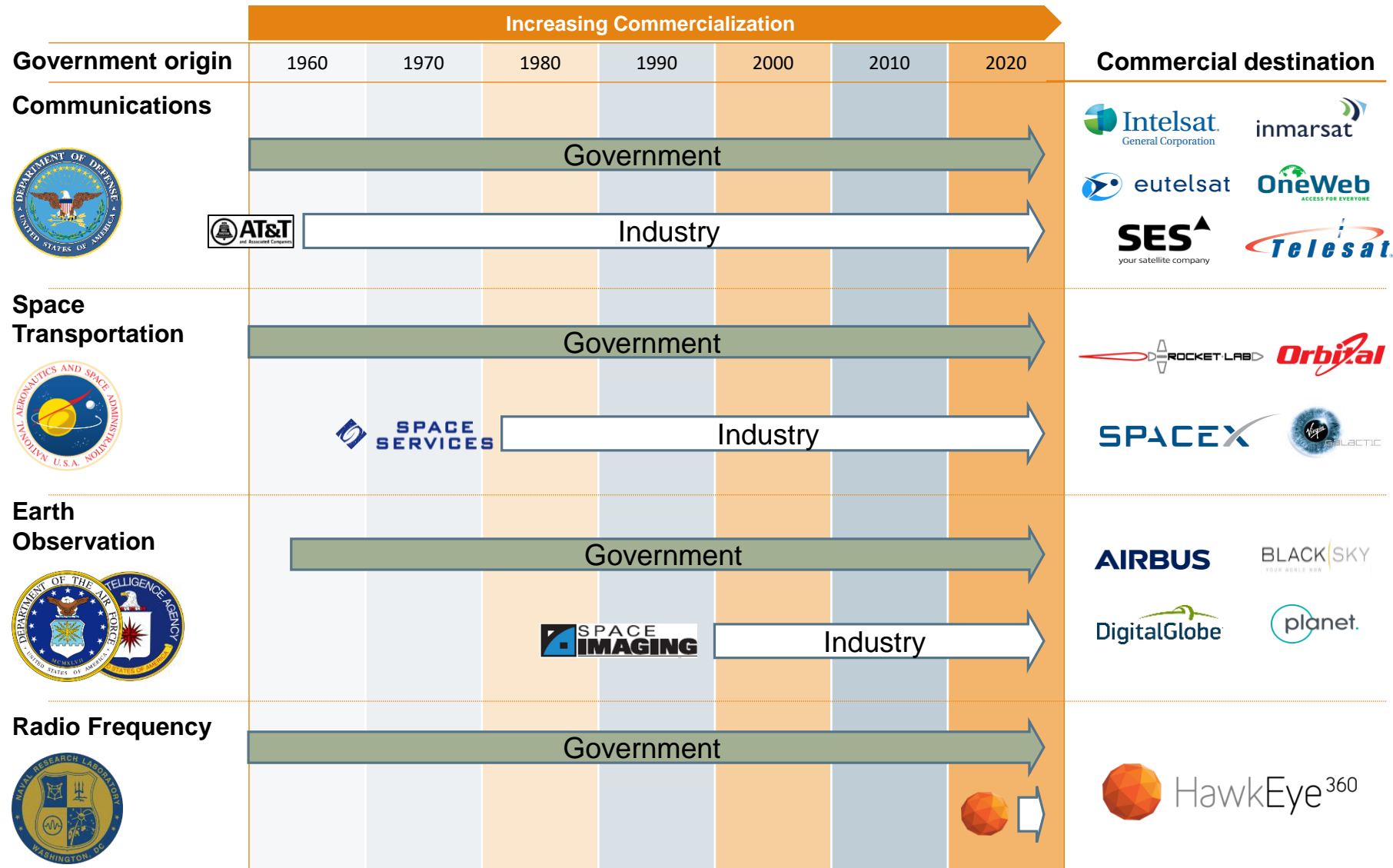

Space Domain Mission Assurance: A Resilience Taxonomy

A White Paper
Office of the Assistant Secretary of Defense for Homeland Defense & Global Security
September 2015

This presentation is an qualitative survey of the impact of commercial space systems on the mission assurance of the NSS enterprise
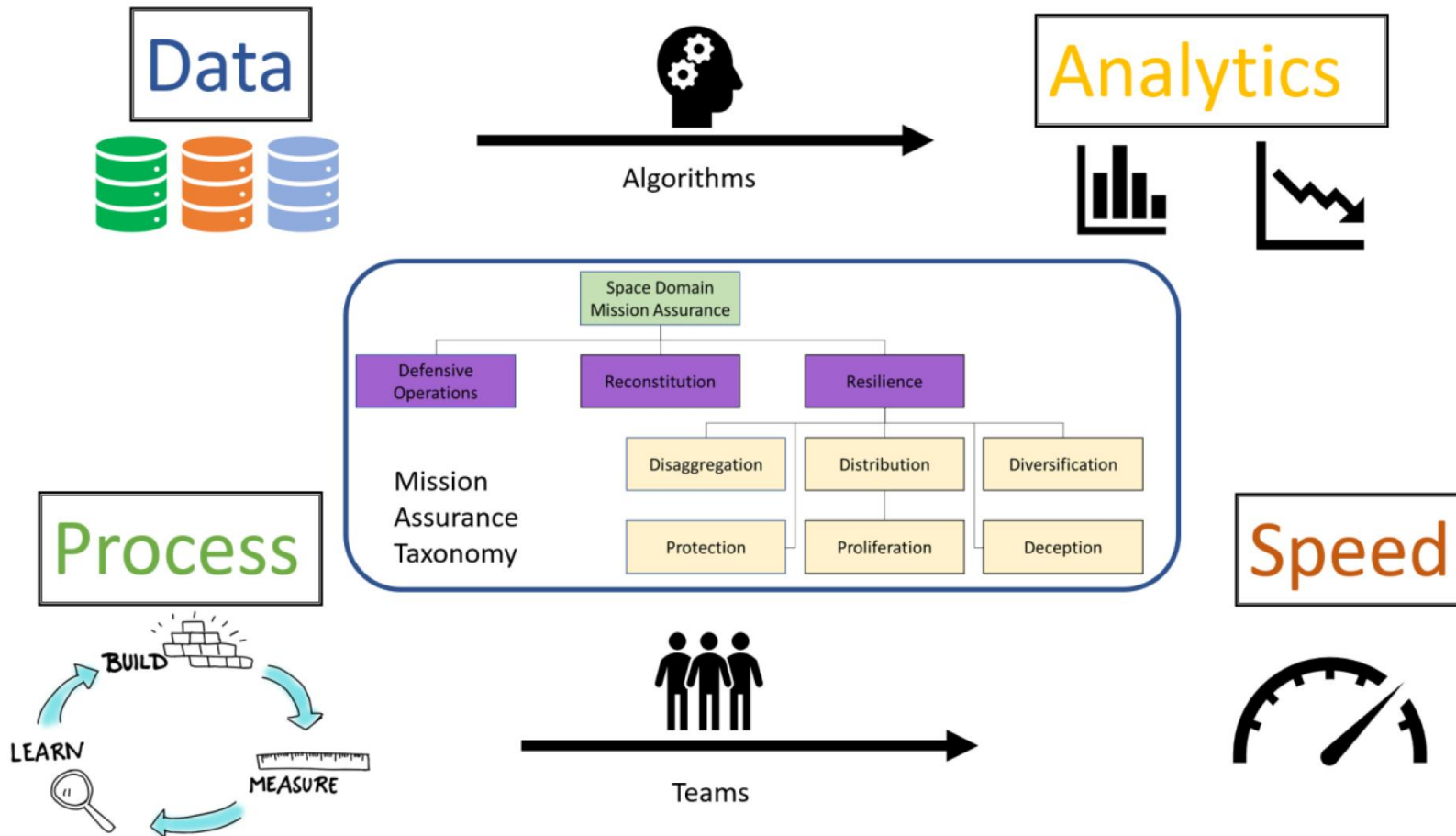
SDMA Taxonomy
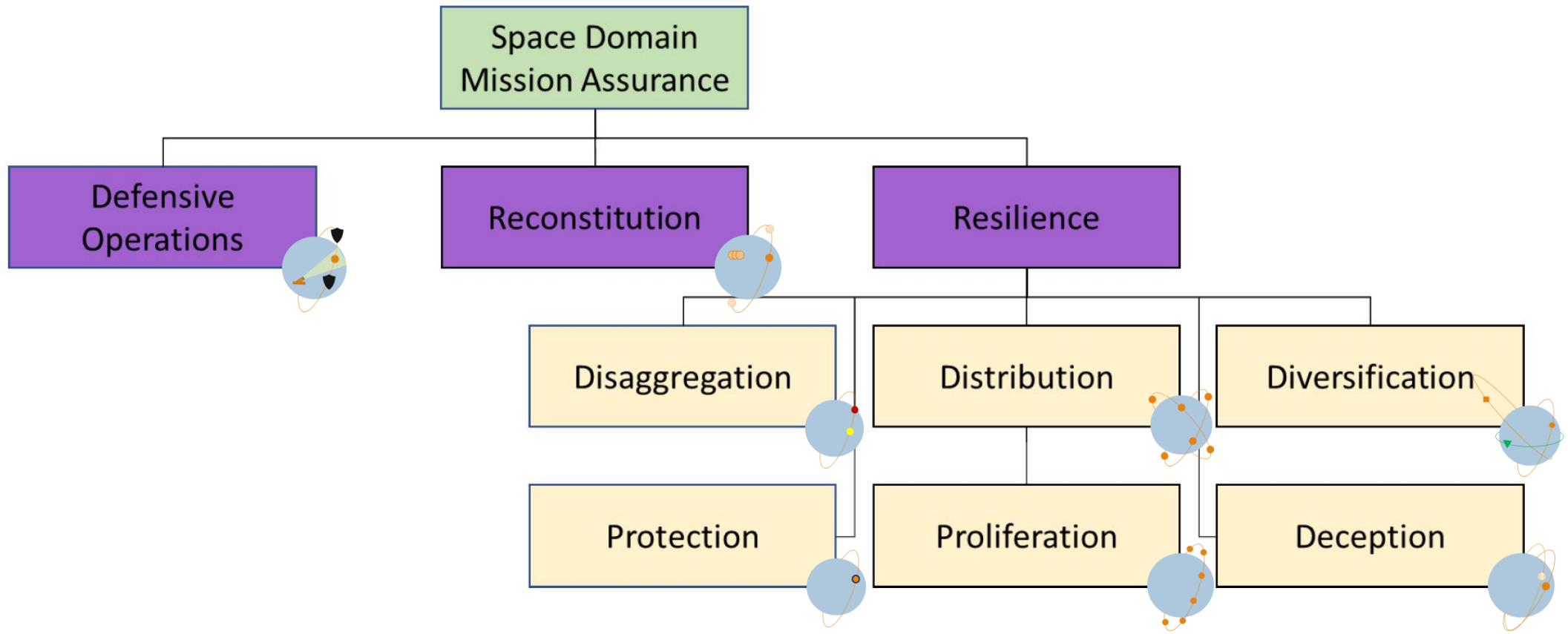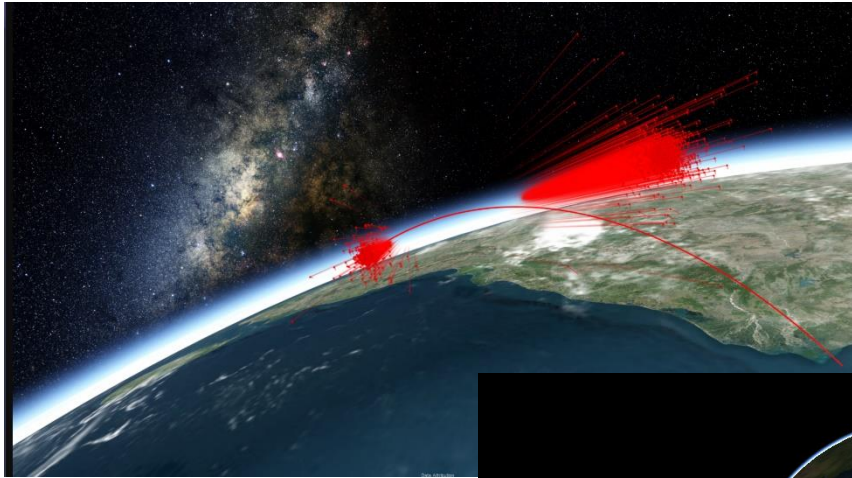
Commercial Space Actors
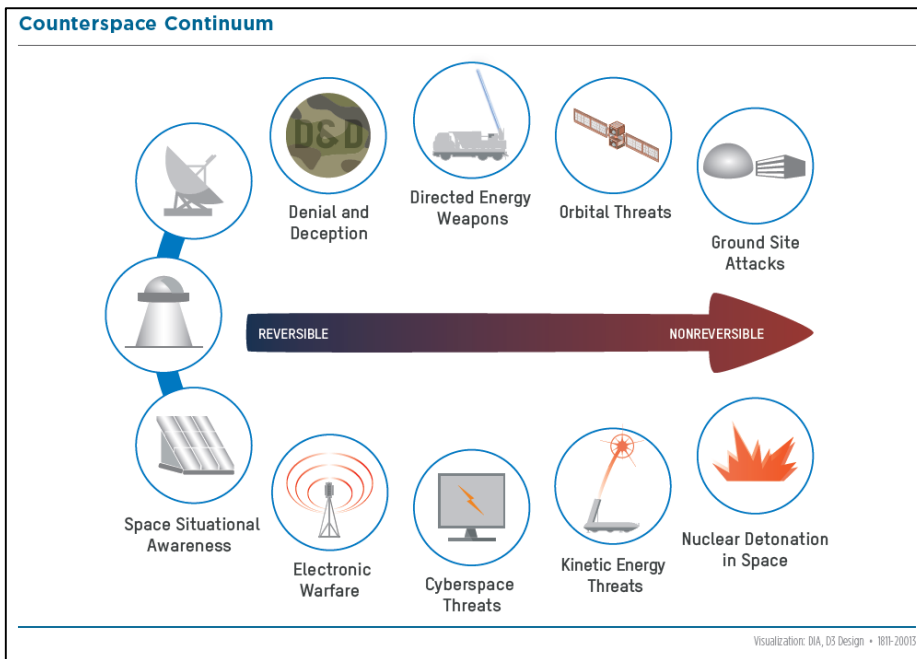
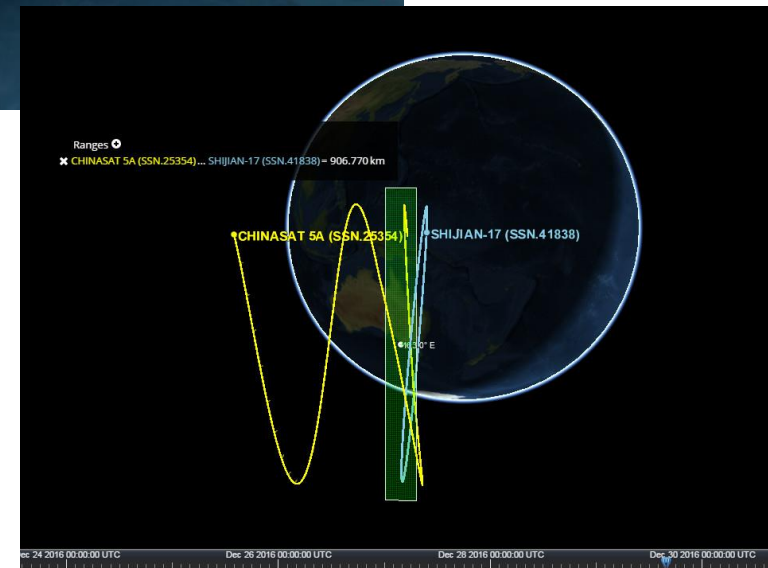# Commercial Space Systems and SDMA

Counterspace Threat Environment

- Space domain is no longer a sanctuary

- Unclassified reports describe growing threats based on a continuum of effects

Source: AGI

Counterspace Continuum

Denial and Deception

Directed Energy Weapons

Orbital Threats

Ground Site Attacks

REVERSIBLE → NONREVERSIBLE

Space Situational Awareness

Electronic Warfare

Cyberspace Threats

Kinetic Energy Threats

Nuclear Detonation in Space

Visualization: DIA, D3 Design • 1811-20013
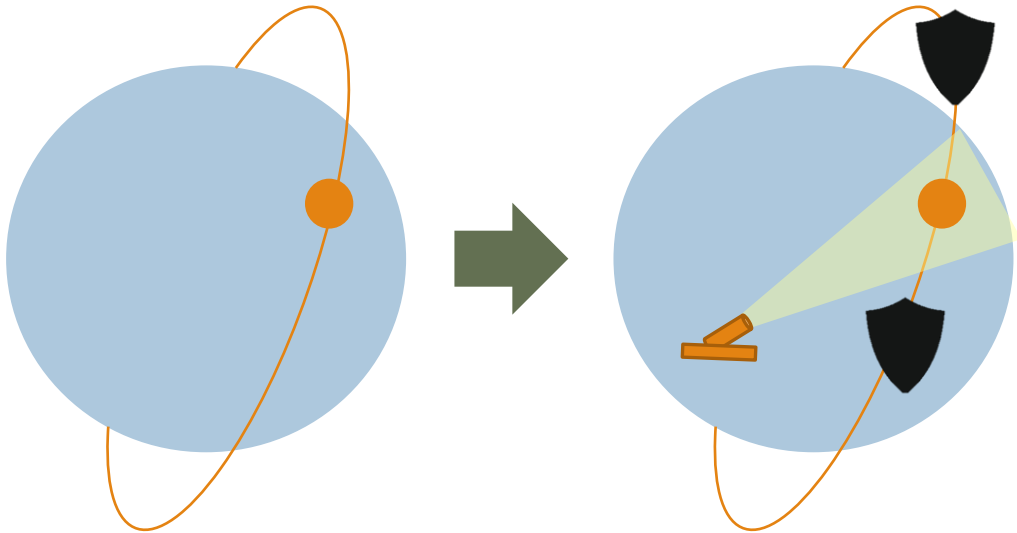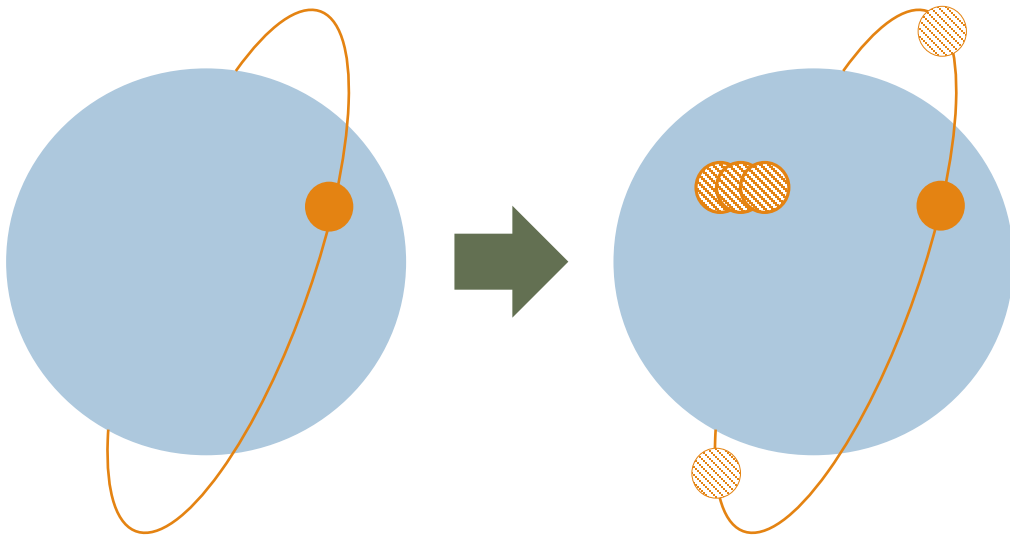
Source: DIA

Defensive Operations

"Activities or operations undertaken to interrupt an adversary kill chain, or provide warning or insight to the targeted mission system in support of defensive actions"

- Commercial does not perform defensive operations, however plays a critical mission-enabling/support role

- SSA contributes to critical I&W

- Sensors and systems can support attribution and post-conflict assessments

- Potential commercial support
  - Indications and Warnings (I&W) of Adversary Activity
  - Space Situational Awareness (SSA)
  - Pattern-of-Life Analysis
  - Monitoring Human Activity
 - Post-Enagagement: Battle Damage Assessment (BDA)

Reconstitution

- Responsive launch is key to Reconstitution
  - SmallSat dedicated launchers
- Maintaining spare inventory and rapid tech insertion capability
  - Mass production/economies of scale
  - Interoperable bus/payload/launch/communication segments
 - "Hot spare" capability in orbit or on the ground

"[L]aunching additional satellites or bringing additional ground stations, new signals and spectrum into play to bolster the ability to provide the capabilities and capacity required for mission success."

Disaggregation
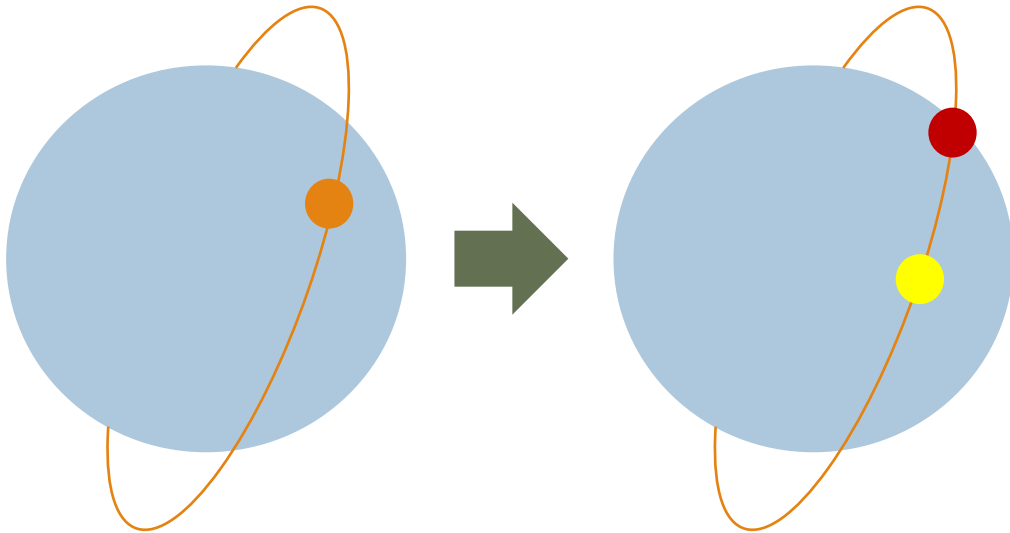
"[S]eparation of dissimilar capabilities into separate platforms or payloads."

- Default approach taken by NewSpace actors
- Smaller satellites only have sufficient SWaP and lifetime for dedicated missions
- Heterogenous architecture enabled by experts who specialize in the area relevant to their business
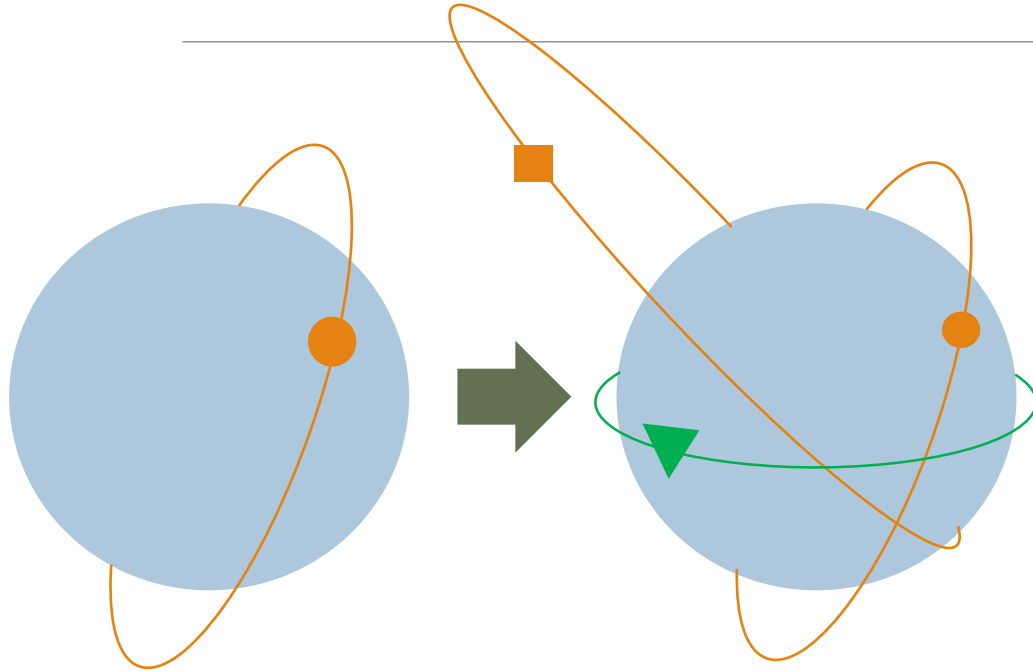 - Phenomenology
  - Target(s)
  - Orbits

Distribution
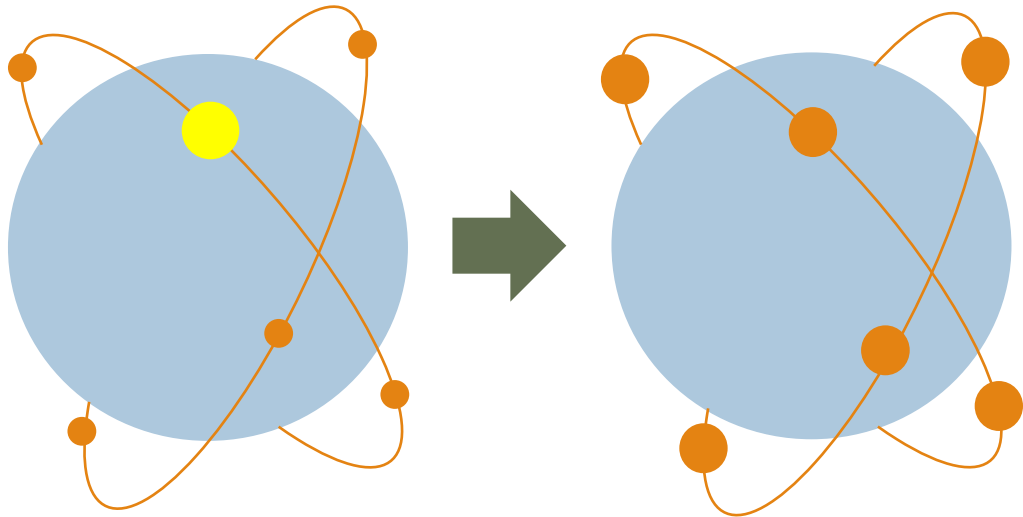
- Satellite communications undergoing a LEO-focused, distributed revolution
- Megaconstellations enabling military missions

"[U]tilizing a number of nodes, working together, to perform the same mission or functions as a single node."
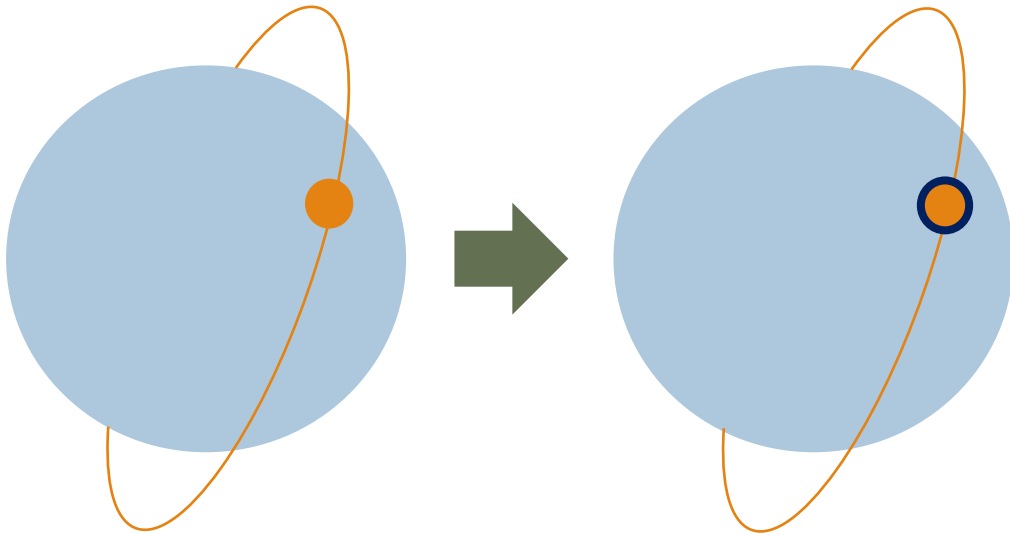
Diversification

- Including commercial and international assets in a heterogenous architecture inherently increases diversification of the enterprise

"[C]ontributing to the same mission in multiple ways, using different platforms, different orbits, or systems and capabilities of commercial, civil, or international partners."
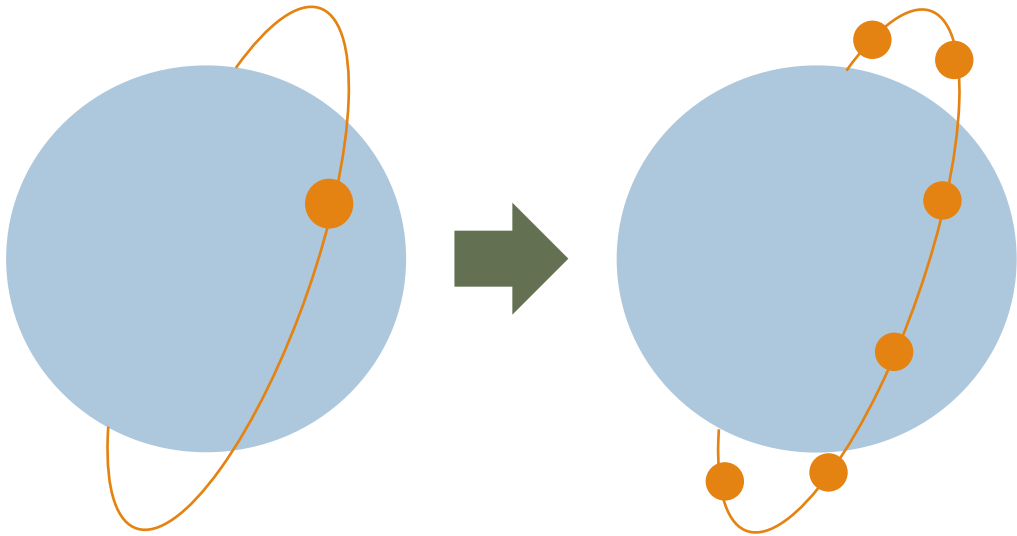
Protection

- Protection of commercial systems is critical for their inclusion in the NSS enterprise
- Commercial protection has traditionally been focused on data protection
- End-to-end protection strategies must ensure data that is feeding the NSS enterprise is:
  - Accurate
  - Reliable
  - Auditable
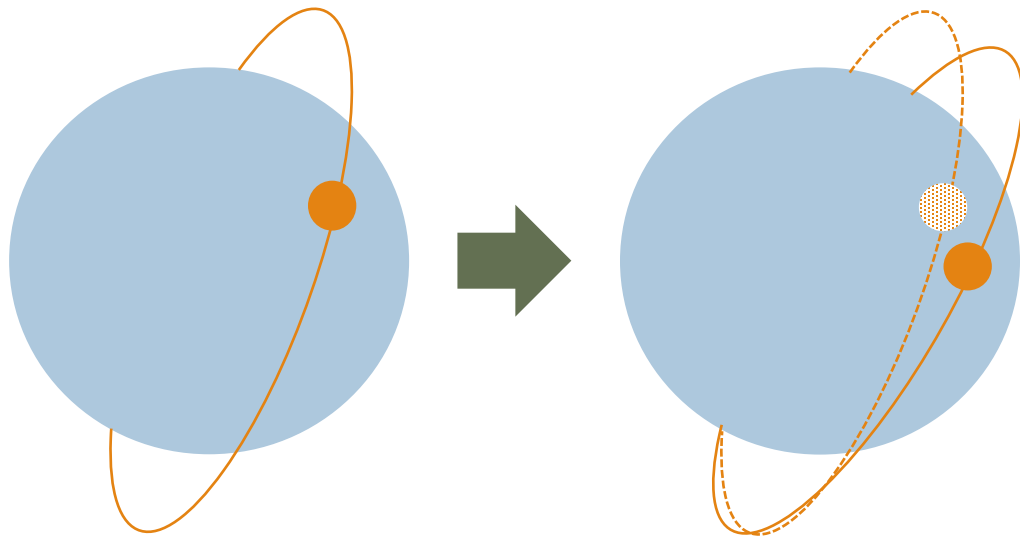- A dual tunnel approach eliminates the transition "seams" for both the uplink and downlink

"[A]ctive and passive measures to ensure [systems]…provide the required quantity and quality of mission support in any operating environment or condition."

Proliferation

- Many commercial systems are proliferated by nature
- Satellites can be incrementally improved between launches and generations to provide additional capability
- Increased adoption of software-defined architectures allows for proliferated systems to be regularly updated
  - Proves continuously-increasing capability to a large number of nodes
  - Allows for critical "bug fixes" to be implemented, increasing protection simultaneously

"[D]eploying larger numbers of the same platforms, payloads or systems of the same types to perform the same mission."

Deception

- Similar to defensive operations, limited role for commercial actors to directly deceive adversary
- Overall trends inherent in the NewSpace arena can increase the uncertainty inherent in the enterprise by increasing the tracking/custody burden on adversary SOSI networks:
  - SmallSat propulsion
  - Migration to LEO
  - Trend towards proliferation and distribution

"[M]easures taken to confuse or mislead an adversary with respect to the location, capability, operational status, mission type, and/or robustness of a national security system or payload."

Towards a Quantitative Assessment

- In order to evaluate competing options for investment in increasing the overall mission assurance of the NSS enterprise, a quantitative assessment of the options is needed

- A quantitative assessment must include the following characteristics:
  - A performance metric based on "Warfighter Mission Assurance" (mission delivery)
  - An evaluation of threats based on their impact to mission, rather than physical method of impact
  - Impacted mission performance level relative to:
    - Initial (un-impacted) performance
    - A required threshold level of performance
    - A complete loss of mission performance
  - An understanding of the way that unimpacted and impacted (pre/post-conflict) mission assurance is contributed by disparate components of the NSS enterprise, including commercial actors
  - An assessment of the relative costs of alternative investments

Conclusion and Recommended Follow-On

- Space Mission Assurance Taxonomy provides a useful framework for evaluating disparate elements

- Recent wave of "Space 2.0" or "NewSpace" companies are contributing to NSS missions in a different way

- Contributing data analytic products, software as a service, and even full architectures as a service

- As these commercial partners increase in size and scope, any analysis of NSS enterprise mission assurance must, by necessity, incorporate the contribution of these systems to a truly a heterogeneous architecture

Recommend a follow-on study that proposes a quantitative methodology for evaluating enterprise mission assurance and applies it to the contribution of both traditional NSS and nontraditional commercial assets

Questions?

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