



# **SPACE DEVELOPMENT AGENCY**

## **DELIVERING CAPABILITIES**

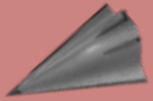
*SEMPER CITIUS*

DISTRIBUTION A: Approved for public release. Distribution unlimited.





**Beyond-Line-Of-Sight (BLOS) targeting for time-sensitive ground and maritime targets**



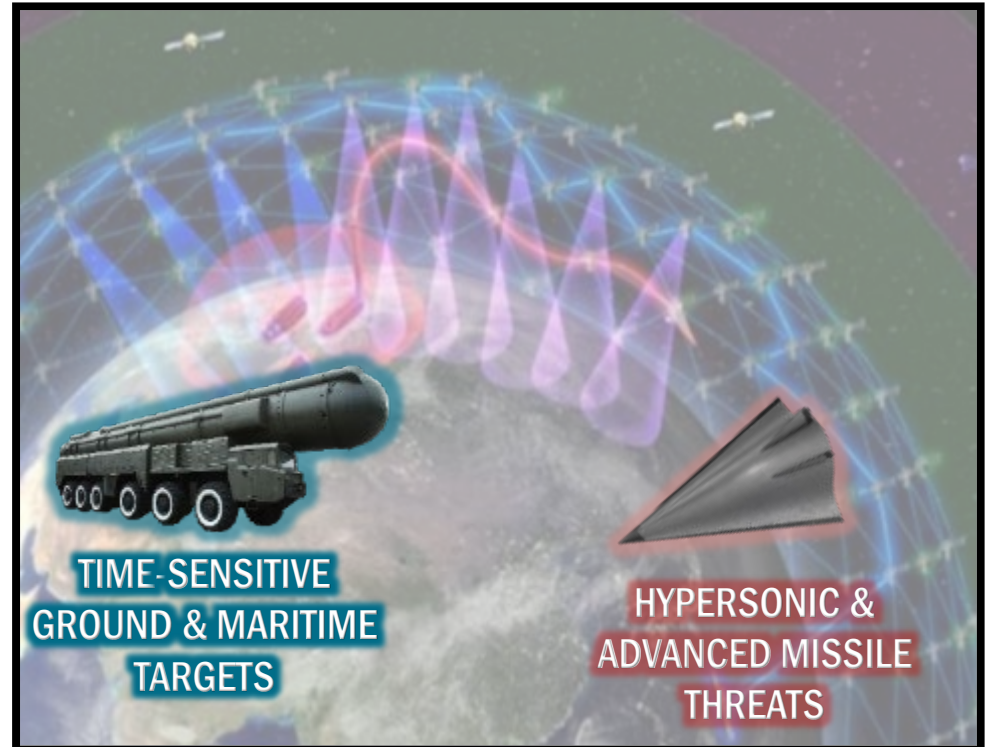
**Hypersonic and advanced missile threat warning and tracking**

SDA's architecture endeavors to perform the following functions from space:

- Detect threat systems
- Track threat systems
- Identify threat systems
- Develop targeting solutions
- Distribute targeting data directly to warfighters

...to close kill chains precisely and at a currently unattainable pace

**Deliver the Department's threat-driven hybrid space architecture by fielding next-generation space capabilities on two-year spirals.**



**Resilient military sensing and low-latency data transport by means of a proliferated low-earth orbit space architecture**

# SEMPER CITIUS

In Latin, it means “always faster.” SDA recognizes that good enough capabilities in the hands of the joint warfighter sooner may be better than delivering the perfect solution too late. Because of this, it means we as an agency accept a higher level of risk, employ novel business models, and move to develop and field capabilities more quickly than you might see in “traditional” government agencies. We believe this builds resiliency into our people and our product—the Proliferated Warfighter Space Architecture.

When we say “semper citius,” we mean that we are moving at or ahead of the speed of the threat because we know the joint warfighter is counting on us.

SEMPER CITIUS

## *What is the Calvelli formula for success?*

$\{\sqrt{x}\}^2$

Build smaller systems

+

Use existing designs to minimize non-recurring engineering

+

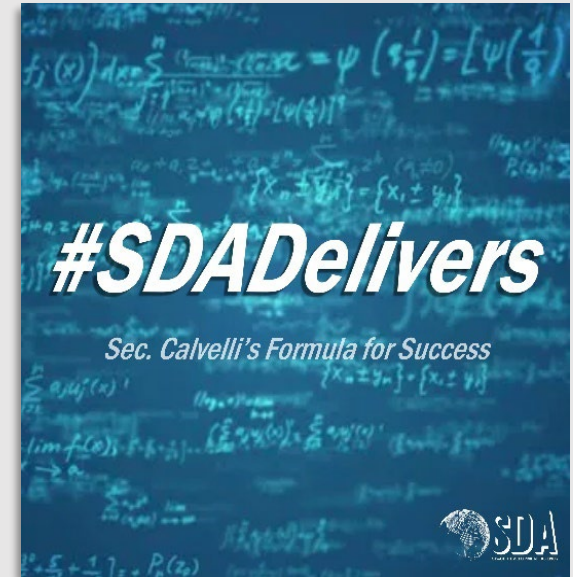
Drive contract scope to 3 years or less, from start to launch

+

Use fixed price contracts

=

Mission capabilities faster to our troops



# GOING FAST IN SPACE ACQUISITION

*How does SDA deliver on Assistant Secretary Calvelli's formula for success?*



## Build smaller systems



- The Proliferated Warfighter Space Architecture is a fully capable, low latency data transport network and military sensing system. The PWSA's **proliferation and resilience** will enable faster and more reliable delivery of data to the tactical edge, including missile warning and tracking.



- The **smaller space vehicles and commercially-based ground systems** of the PWSA will deliver faster capabilities to the warfighter.



## Use existing designs to minimize non-recurring engineering



- SDA prioritizes both speed and schedule to leverage commercial advances to deliver on a **two-year spiral development timeline**.



- SDA uses **commercial or commercially-derived small satellite buses** developed in commercial markets and modified only as needed for the PWSA.

**\$15M**

- For Tranche 0 of the PWSA, SDA acquired Transport Layer space vehicles for less than **\$15 million each** by using existing technology!

# GOING FAST IN SPACE ACQUISITION

How does SDA deliver on Assistant Secretary Calvelli's formula for success?



## Use Fixed Price Contracts



- SDA uses Other Transaction Authorities for most awards enabling **greater flexibility** in negotiating an agreement while also enabling SDA to **deliver at speed**.
- From 2021-2022, SDA awarded 13 Other Transaction Authority agreements for prototyping to field both the Tranche 1 Transport Layer and Tranche 1 Tracking Layer. Additionally, SDA made **fixed-price awards** for the PWSA Experimental Testbed (NEXT), and Tranche 1 Demonstration and Experimentation System (T1DES).



## Drive Contract Scope to 3 years or less



- **From order to orbit**, SDA launched the first Transport satellites in **30 months** and the Tracking satellites launched in just **27 months!**



- Vendor lock is unacceptable at SDA... we will conduct **full and open competition** for every layer in every tranche, wherever possible. Our goal is to allow industry the opportunity to invest, plan, and compete on a predictable timeline.



- Currently SDA averages just over **100 days from solicitation to award!**



## Mission capabilities faster to our troops



- SDA will continue to apply Assistant Secretary Calvelli's formula for success to **deliver space-based capabilities to the joint warfighter FASTER!**

SDA's business model supports the use of commercial space technologies and capabilities and commercially owned and operated services to *develop, augment and improve* the PWSA



## Spiral Development

SDA Incorporates new technologies and capabilities **every two years**



## Competitive Marketplace

SDA predictably solicits for new capabilities through competitive solicitations



## Interoperability

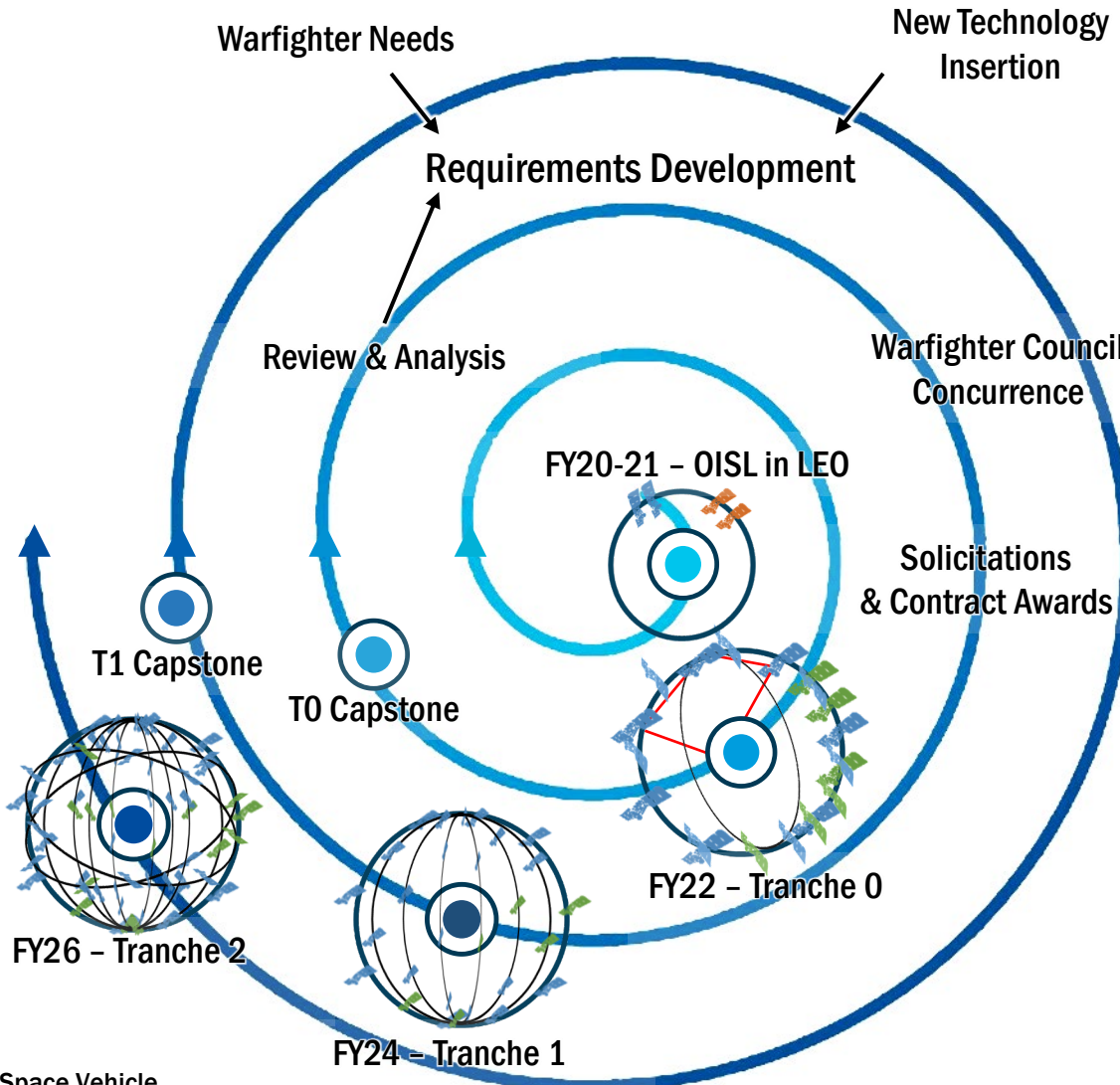
Development of **standards** and **open systems architecture**



## Affordability

Acquisition of **commercial commoditized spacecraft** and purchasing at scale to drive down cost

# SPIRAL DEVELOPMENT



## Increased Capability Delivery with Each Tranche

### Limited Capability

- **Tranche 0 (FY22)**
  - **Periodic** regional access
  - Limited Tactical Data Link (Link 16)
  - Two OCTs per Transport SV
  - 10's of SVs, high inclination
  - Average Price Per Transport SV: ~\$15M

### Operational Capability

- **Tranche 1 (FY24)**
  - **Persistent** regional access
  - Tactical Data Link (Link 16)
  - Integration with Tracking
  - Four OCTs per Transport SV
  - 100+ SVs, high inclination
  - Average Price Per Transport SV: ~\$14M

- **Tranche 2 (FY26)**
  - Persistent **Global** access
  - Tranche 1 Capabilities
  - -- and --
  - Enhanced Link 16
  - On-board processing
  - 100's of SVs, mixed inclinations
  - Average Price Per Transport SV: ~\$13M

**High throughput, low latency data transport across all tranches**

SV: Space Vehicle  
 OISL: optical inter-satellite link  
 OCT: optical communications terminal



# SDA PUBLISHED STANDARDS



Space Development Agency  
Network Established Beyond the Upper Limits of the  
Atmosphere (NEBULA) Standard



Optical Communications Terminal  
(OCT) Standard Version 3.1.0

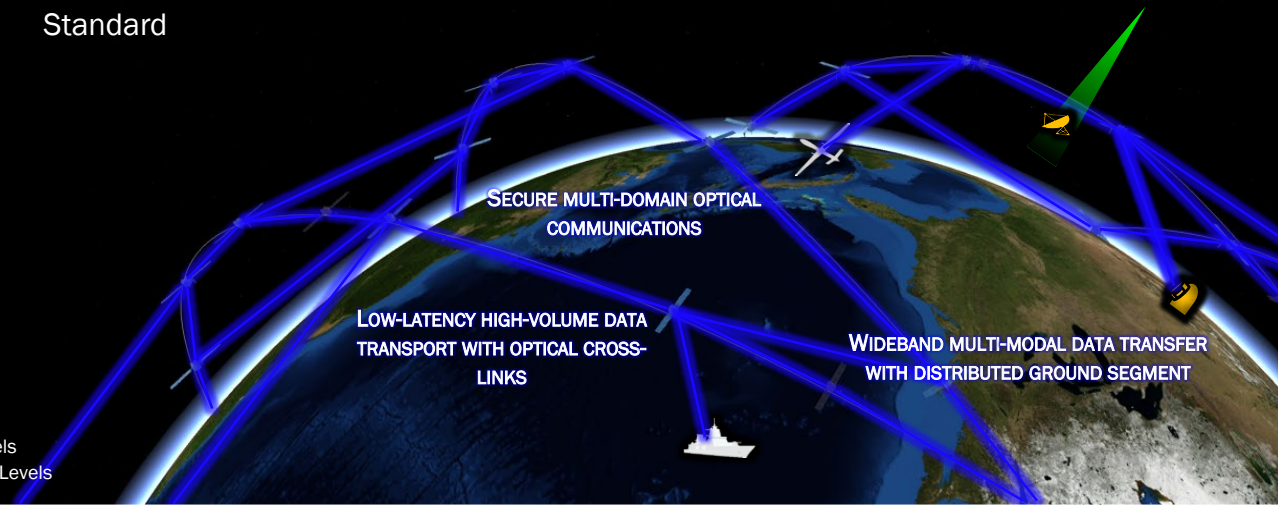
Developed by the:  
Space Development Agency  
United States Space Force  
1470 Air Force Pentagon  
Washington, D.C. 20330

## NEBULA Networking Standard

- The SDA Network Established Beyond the Upper Limits of the Atmosphere (NEBULA) Standard provides networking requirements to enable interoperability of the PWSA
  - Each node must have compatible networking hardware, same network implementation as per SDA NEBULA Standard
  - Static routing policy through the Crawl stage of Nominal Operations, with a progression toward BMC<sup>3</sup>-enabled dynamic routing by the Run stage

## Optical Communications Terminal (OCT) Standard

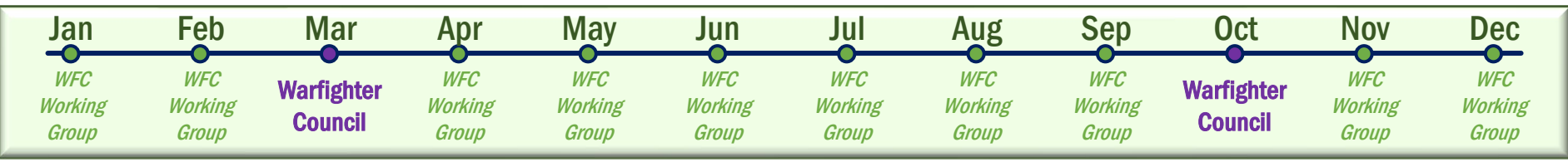
- The SDA Optical Communications Terminal (OCT) Standard provides interoperability specifications for optical communications systems employed by SDA and its partners
  - Applicable for all Space-to-Terrestrial (S2T) links
  - Balances performance against marketplace availability and technology maturity
  - Interoperability requires all OCTs have high TRL, high MRL, and comply with the SDA OCT Standard



FSOC: free-space optical  
communications  
OCT: optical communications terminals

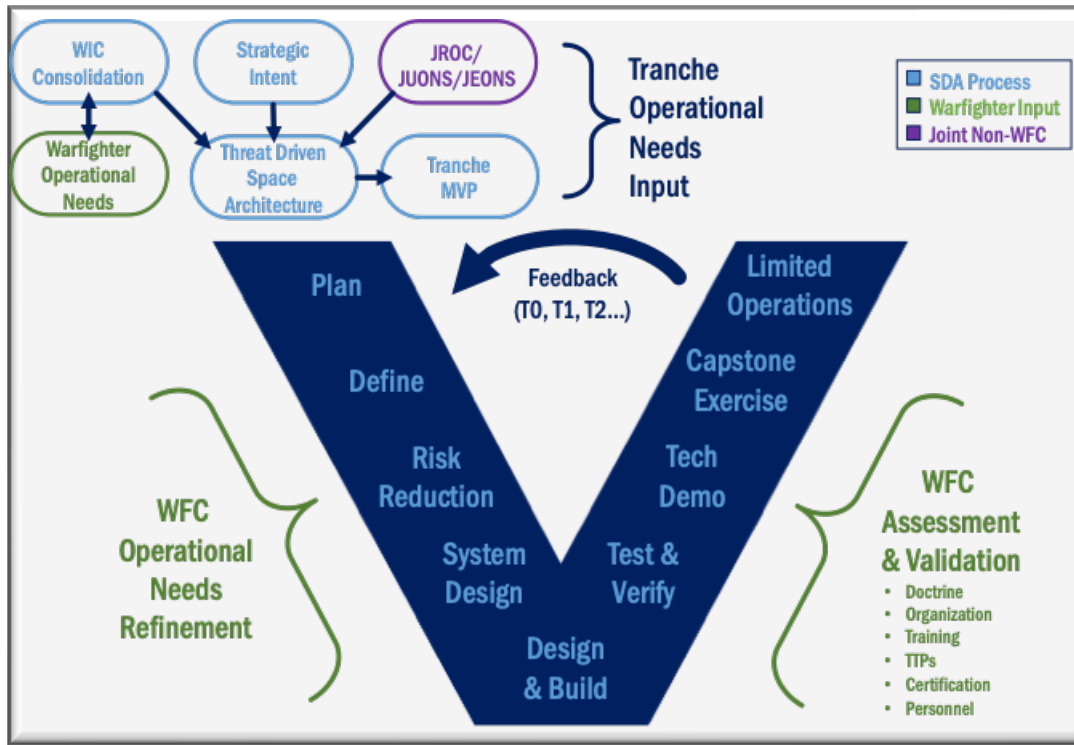
TRL: Technology Readiness Levels  
MRL: Manufacturing Readiness Levels

# REQUIREMENTS - DRIVEN BY THE WARFIGHTER



## WORKING GROUPS (Monthly)

- Focus on SDA Tranches (MVP, Integrated Test Methodology)
- WFC Member organizations populate AO-level Groups

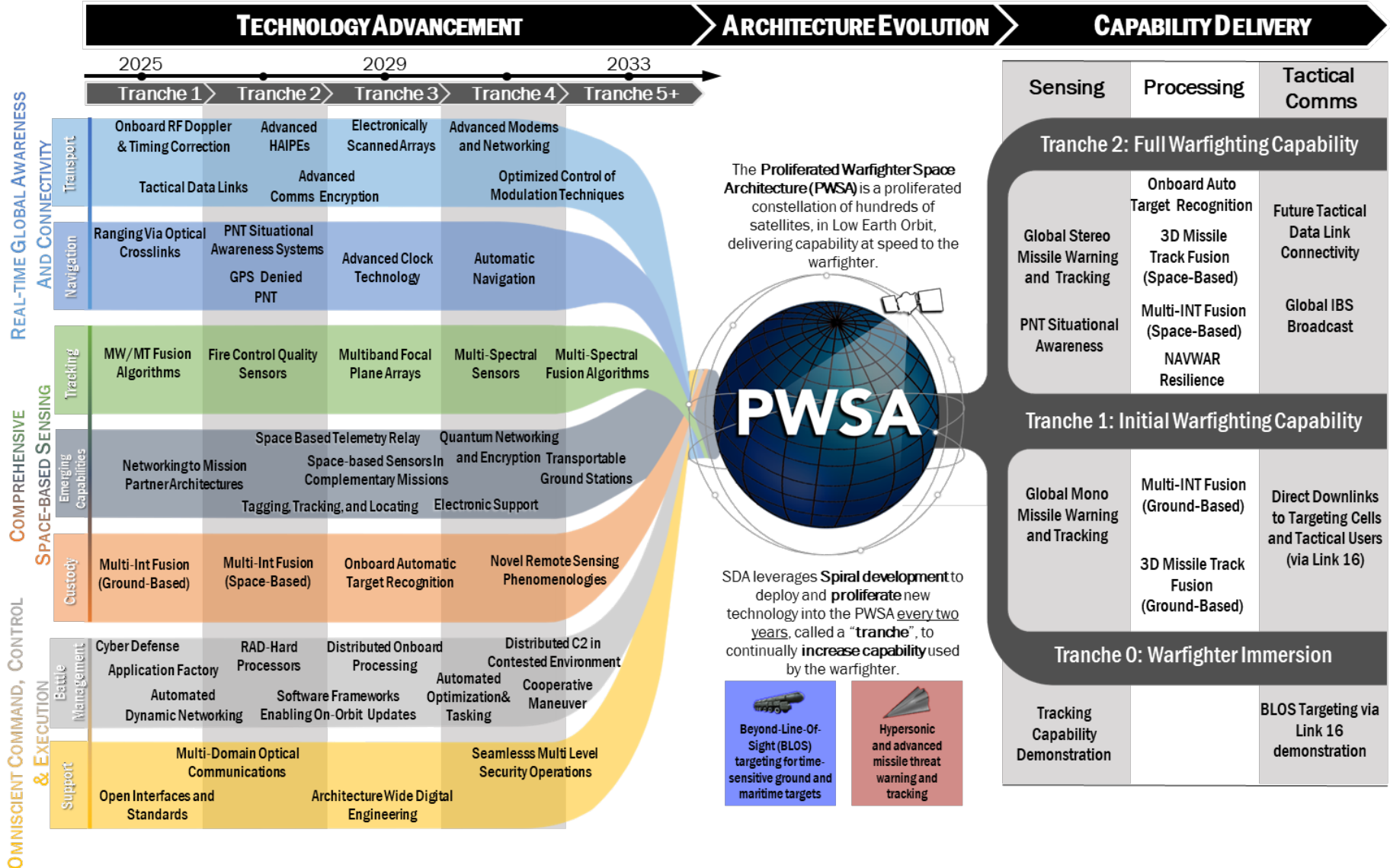


## WARFIGHTER COUNCIL (Semi-Annual)

- Co-chaired by:
  - VCSO and
  - SDA Director
- Each member organization represented at:
  - SES or
  - 1-star level



# MATURING TECHNOLOGY – ADVANCED CAPABILITY



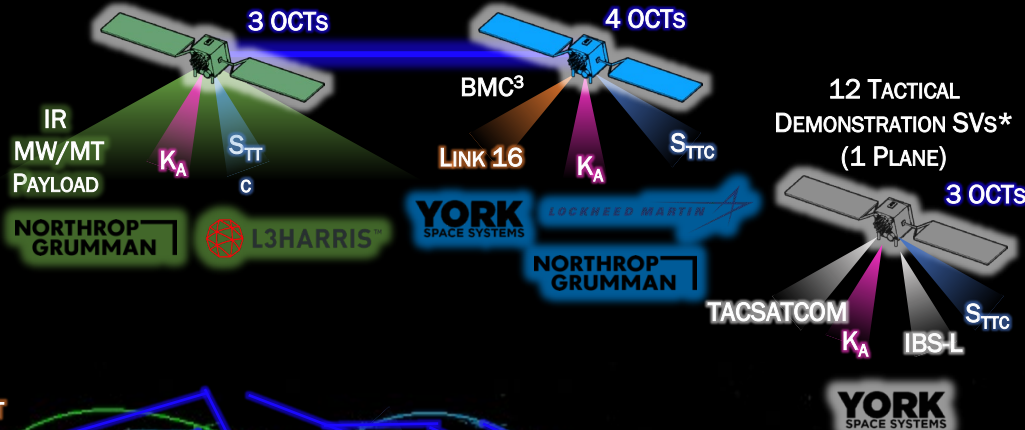
# TRANCHE 1 PROLIFERATED WARFIGHTER SPACE ARCHITECTURE (2025)



28 WFOV MW/MT TRACKING SVs  
4 MD DEMO TRACKING SVs  
(4 PLANES, MWTD)

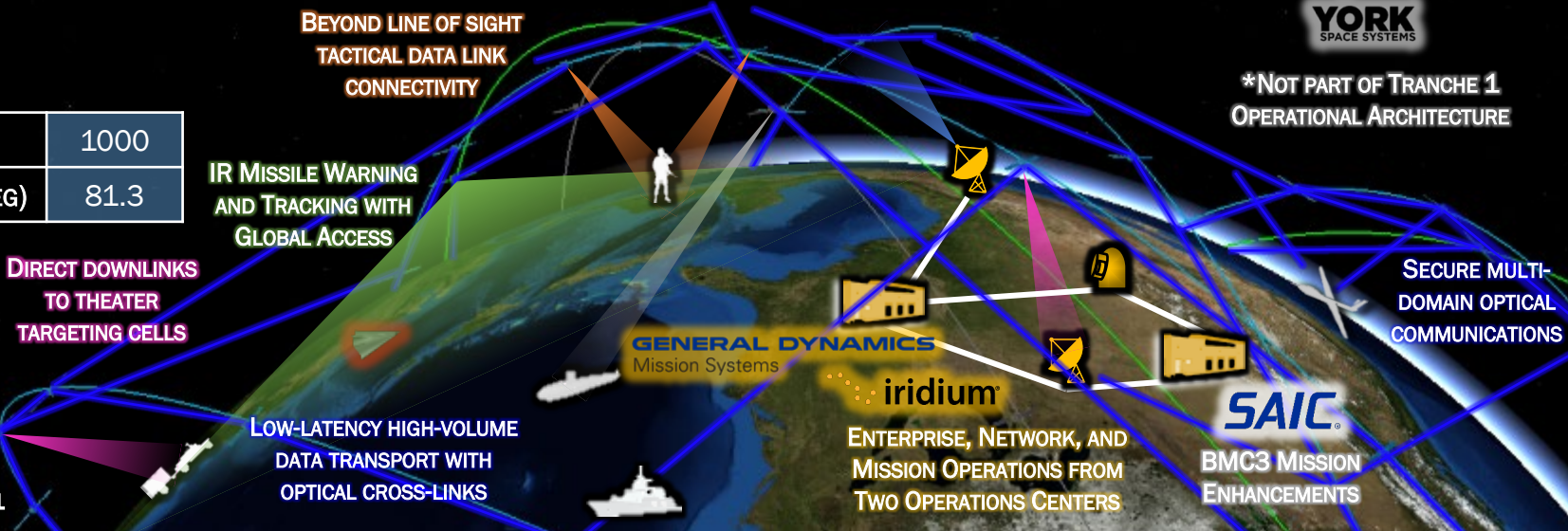
126 TRANSPORT SVs  
(6 PLANES, BLOS)

12 TACTICAL DEMONSTRATION SVs\*  
(1 PLANE)



\*NOT PART OF TRANCHE 1 OPERATIONAL ARCHITECTURE

ALTITUDE (KM)	1000
INCLINATION (DEG)	81.3



Version: 2023-12-01

# TRACKING LAYER EVOLUTION

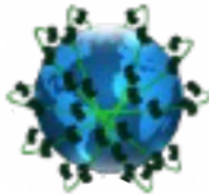


## SDA Tranche 1 (2025)

## SDA Tranche 1 + SSC Epoch 1 (~2026)

## SDA Tranche 2 + SSC Epoch 1 (~2027)

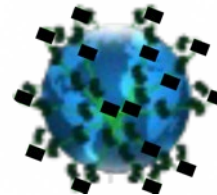
### LEO



#### Initial global *access* capability

- **Polar coverage** for missile warning and tracking of HGVs and other advanced below-the-horizon threats
- **Near-global track custody** for radar cueing-quality data
- **28 SVs** in 4 planes

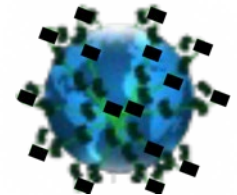
### LEO + MEO



#### Initial global *coverage* capability

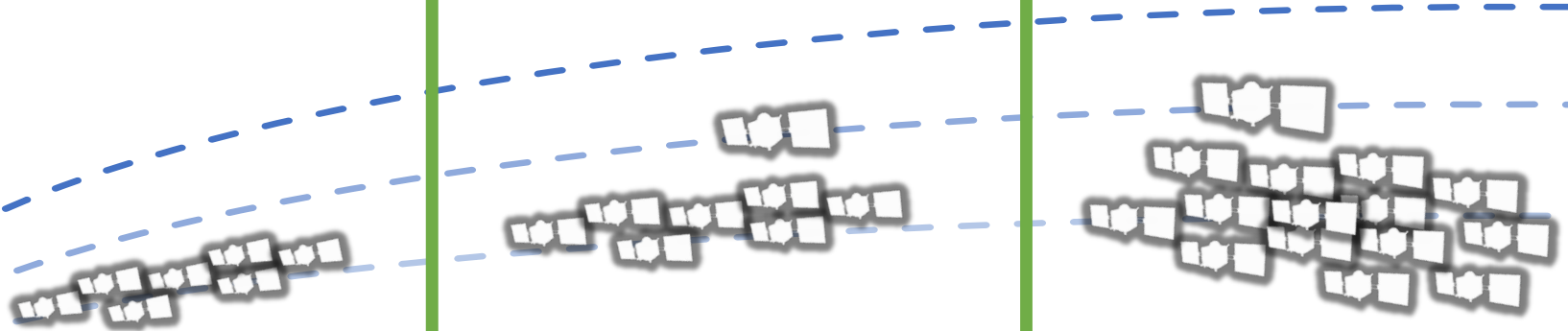
- **Addition of MEO** bolsters low-latitude coverage and track custody
- **Global track custody** for radar cueing and initial targeting-quality data
- **28 LEO SVs + MEO SVs** (2 planes)

### pLEO + MEO



#### Robust global *coverage* capability

- **Global coverage** for advanced missile warning and tracking
- Near-global track custody for radar cueing and **stereo targeting-quality data**
- **82 LEO SVs + MEO SVs**



T1 Tracking Layer is the first step toward an accelerated Global MW/MT Capability

# DELIVERING CAPABILITY



PWSA Layer	Tranche 0 (ILC FY23)	Tranche 1 (ILC FY24)	Tranche 2 (ILC FY26)
<p>Data &amp; Comm Transport</p>	<p><b>Periodic regional access</b></p> <ul style="list-style-type: none"> <li>Low latency data connectivity</li> <li>Data directly to tactical elements</li> <li>Dissemination to theater targeting cells</li> </ul>	<p><b>Persistent regional access</b></p> <ul style="list-style-type: none"> <li>Low-latency data connectivity</li> <li>Data directly to tactical elements</li> <li>Dissemination to theater targeting cells</li> <li>Tactical satcom / IBS demo</li> </ul>	<p><b>Persistent global access</b></p> <ul style="list-style-type: none"> <li>Low-latency data connectivity</li> <li>Data directly to tactical elements</li> <li>Dissemination to theater targeting cells</li> <li>Tactical satcom / IBS</li> </ul>
<p>Advanced Missile Tracking</p>	<p><b>Periodic regional access</b></p> <ul style="list-style-type: none"> <li>For detection &amp; tracking of HGVs</li> <li>Early flight demo for targeting quality data</li> </ul>	<p><b>Limited global access MW/MT capability</b></p> <ul style="list-style-type: none"> <li>For detection &amp; tracking of HGVs &amp; other conventional and advanced missile threats</li> <li>Targeting quality data</li> <li>MFOV fire control demo in operational system</li> </ul>	<p><b>Complete global access MW/MT capability</b></p> <ul style="list-style-type: none"> <li>For detection &amp; tracking of HGVs &amp; conventional and advanced missile threats</li> <li>Targeting quality data</li> </ul>
<p>Custody</p>	<ul style="list-style-type: none"> <li>Demonstrate multi-phenomenology sensor fusion (ground-based)</li> <li>Demonstrate on-orbit fusion (ground-assisted)</li> </ul>	<ul style="list-style-type: none"> <li><b>Periodic regional access</b> with multiple sensing types via mission partner contributions</li> <li>Demonstrate on-orbit fusion</li> </ul>	<ul style="list-style-type: none"> <li><b>Periodic global access</b> with multiple sensing types via mission partner contributions</li> <li>Enhanced on-orbit fusion</li> </ul>
<p>Navigation</p>	<ul style="list-style-type: none"> <li>Optical Comms Ranging demo</li> <li>Demonstrate PNT fusion</li> <li>Link-16 navigation demo</li> </ul>	<ul style="list-style-type: none"> <li>Operational PNT resilience via PNT fusion</li> <li>PNT Situational Awareness</li> <li>SDA PNT service (Optical, Ka, Link-16)</li> </ul>	<ul style="list-style-type: none"> <li>SDA PNT Service demos (L-Band, TACSATCOM)</li> </ul>

# TO LINK-16 SPACE TO GROUND SUCCESS SUMMARY



- On November 27, 2023, SDA successfully completed the demonstration of the first-ever Link 16 network entry connection from low Earth orbit to ground
- Tranche 0 Transport Layer SVs used to transmit tactical messages from space to a ground test site, via Link 16
- Represents major milestone for Tranche 0 of the PWSA:
  - Demonstrates beyond-line-of-sight connectivity of existing Tactical Data Links for the warfighter
  - Contributes to the DoD's Joint All Domain Command and Control (JADC2) initiative



THE PWSA TRANSPORT LAYER IS THE BACKBONE OF JADC2 IN SPACE AND WILL ENABLE BEYOND-LINE-OF-SIGHT DELIVERY OF TACTICAL MESSAGES USING SPACE-BASED LINK 16 RADIOS