Resilient Space Architectures for Defense Dominance

Presentation by **PwC**
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Resilient Space Architectures for Defense Dominance

The future of military space operations demands architectures engineered for continuous operation under contested conditions.

Technical Foundations

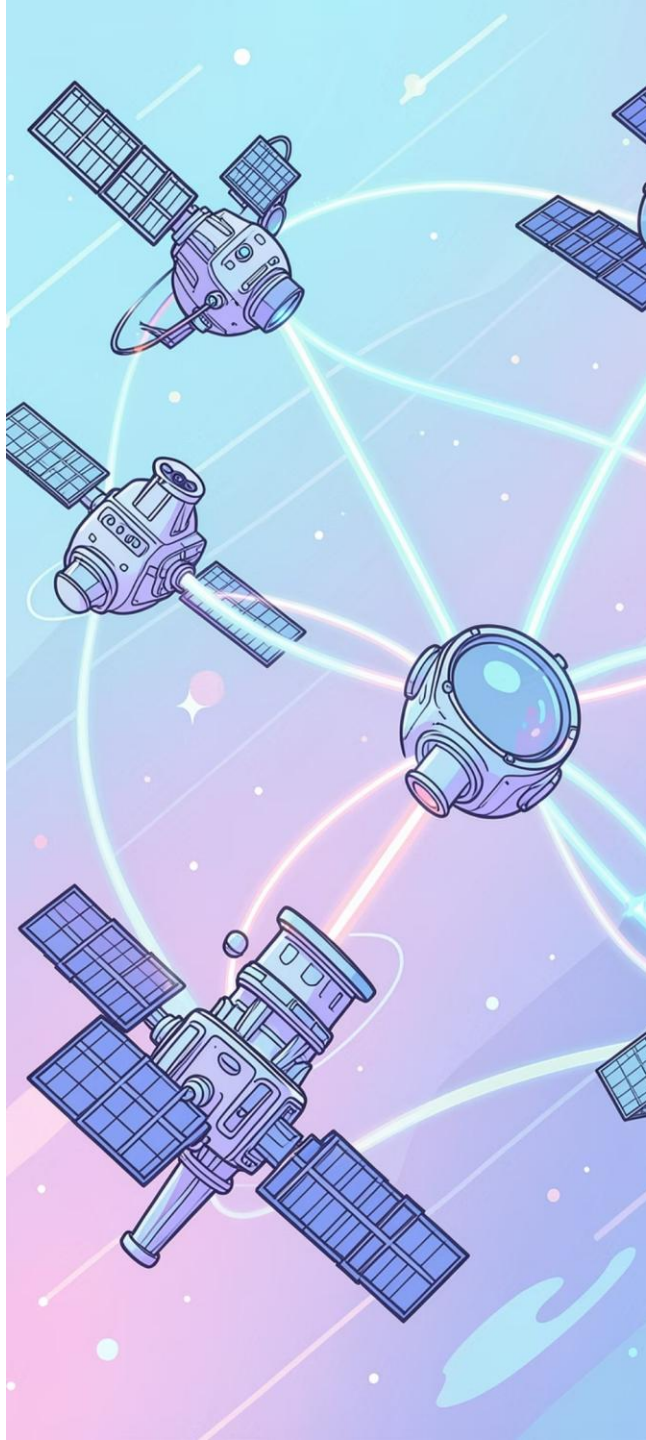
Built on modular, mission-ready space systems designed for secure performance at scale.

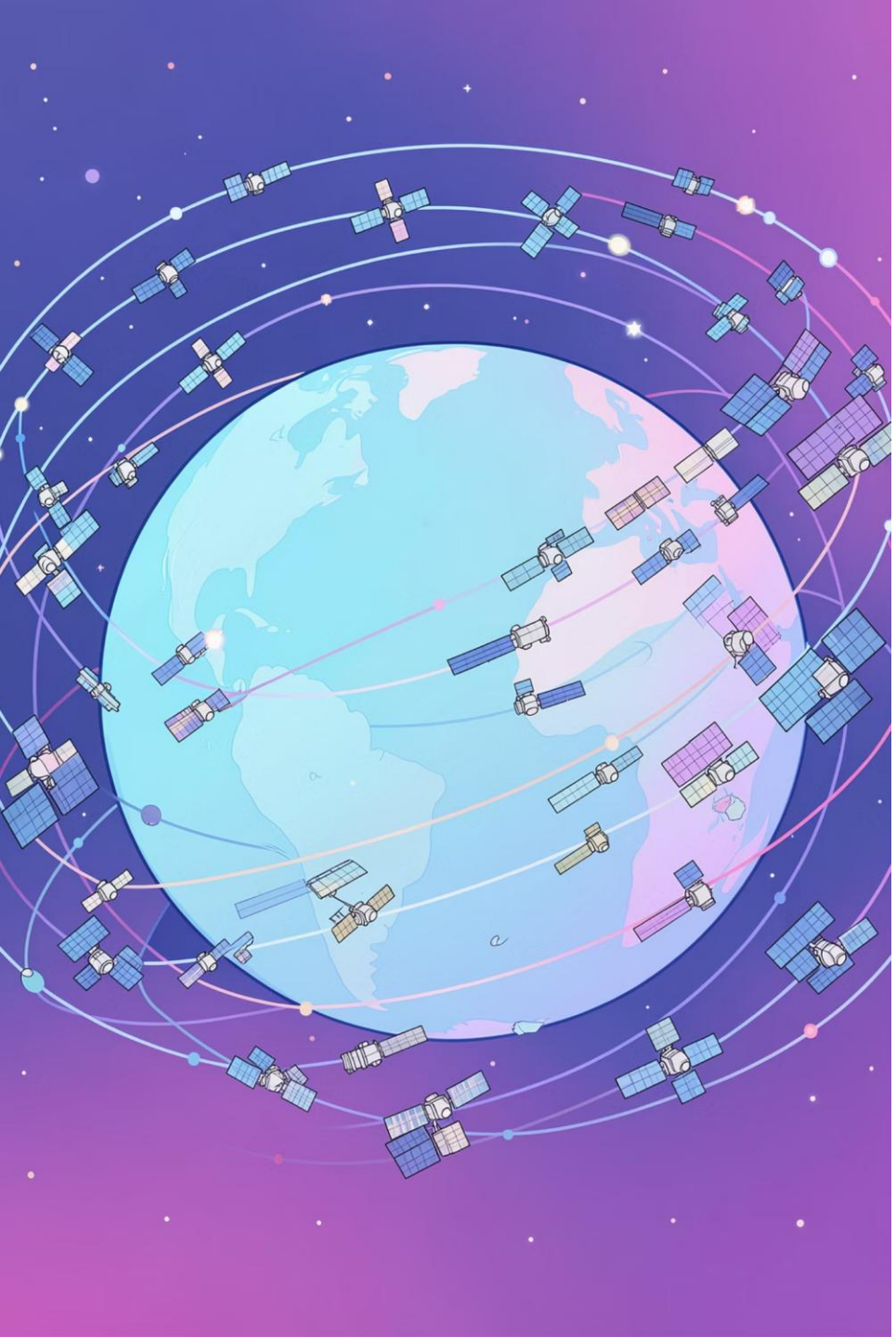
Resilience Mechanisms

Redundancy, distributed connectivity, and rapid rapid recovery capabilities help sustain operations under threat.

Commercial Opportunities

Dual-use technologies technologies and service models are expanding the market market for defense-aligned space infrastructure.





Architecture & Infrastructure

Proliferated LEO Constellations

Mass deployment of smallsats in multiple orbital orbital planes creates distributed architectures with architectures with inherent redundancy and rapid rapid reconstitution capability.

Multi-Orbit Network Architecture

Seamless integration across LEO, MEO, and GEO GEO layers optimizes coverage, latency, and survivability trade-offs for defense missions.

Mesh Networking

Inter-satellite links enable autonomous routing and and reduced ground station dependence, dramatically dramatically improving operational resilience.

STARLINK STARSHIELD Concern National Security

Intellian

TERAWAVE Space-Based Connectivity

eutelsat NETWORK SOLUTIONS

Key Areas to Lookout for

- Global P-LEO market
- Mesh networking hardware and software
- In-orbit assembly and deployment services

Growth Opportunities

High-Growth Segments: Smallsat manufacturing, inter-satellite link technology, autonomous mission management software

Strategic Focus: Modular satellite buses, radiation-radiation-hardened components, rapid launch integration

Resilience & Survivability

Anti-Jam & Secure Communications

Frequency-agile transceivers and quantum key distribution ensure command uplinks remain operational during electronic warfare campaigns.

~$28B

Secure Comms Market

Space Domain Awareness

AI-powered tracking of adversarial assets, collision prediction, and ASAT threat characterization enable proactive defensive measures.

~3.5x

SDA Growth Factor

Zero-Trust Architecture

End-to-end encryption, hardware root-of-trust, and continuous authentication prevent compromise of critical command and control channels.

~60%

Encryption Adoption

Operational Enablement

In-Orbit Edge Processing

AI accelerators onboard satellites enable real-time data processing and autonomous autonomous tasking without ground loop latency (without relying on ground stations). ground stations).

Autonomous ISR Tasking

Machine learning models prioritize targets and allocate sensor resources dynamically dynamically based on mission priorities.

Tactical Network Integration

Direct downlinks to mobile platforms create sensor-to-shooter loops operating in operating in seconds rather than minutes.

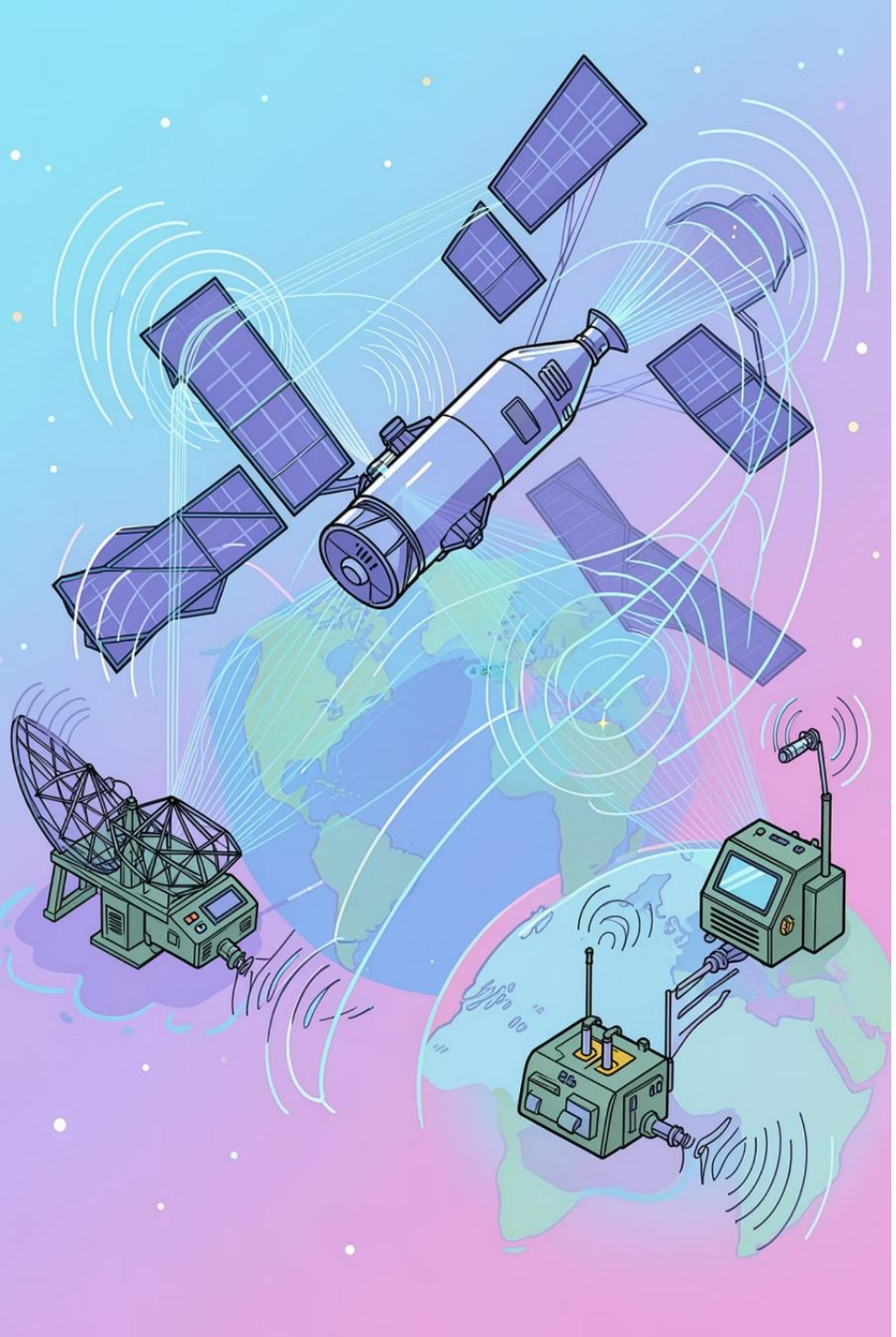
Key Areas to Lookout for

- Edge AI processors for space
- Autonomous mission management software
- Tactical terminal integration

Growth Opportunities

High-Growth Segments: In-orbit AI chips, autonomous satellite operations software, tactical SATCOM terminals

Strategic Focus: Radiation-tolerant AI accelerators, real-time processing algorithms, algorithms, multi-band terminal technology technology



Spectrum Resilience & Electronic Warfare

01

Adaptive Frequency Hopping >>> Cognitive Spectrum Warfare

Dynamic spectrum access across multiple bands avoids jamming while maintaining link integrity

02

Cognitive EW Systems >>> Multi-domain Spectrum Dominance

AI-powered signal analysis identifies threats and autonomously selects optimal countermeasures

03

Spread Spectrum Techniques >>> Adaptive Spectrum Shaping Across Network Stack

Ultra-wideband transmissions resist narrowband jamming while maintaining low probability of intercept

04

Multi-Path Diversity >>> Adaptive Network Level Survivability

Simultaneous transmission across multiple orbital paths ensures message delivery

Key Areas to Lookout for

- Adaptive radio technology
- Cognitive EW processors
- Anti-jam terminals
- Predictive spectrum control

Growth Opportunities

High-Growth Segments: Software-defined radios, radios, cognitive EW systems, anti-jam terminals

Strategic Focus: GaN-based power amplifiers, real-time spectrum sensing, AI/ML for signal classification

Sustainment & Scalability

Rapid Reusable Launch Infrastructure

Reusable rockets and dedicated smallsat launchers enable enable constellation replenishment within days rather than than months.

1

2

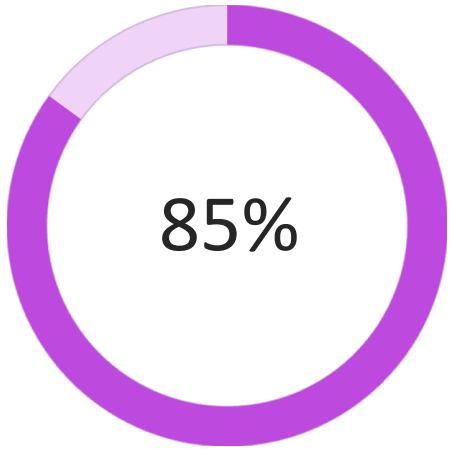
In-Orbit Servicing

De-orbiting, robotic refueling, component replacement, and satellite life extension extension reduce reconstitution costs by 70%.

3

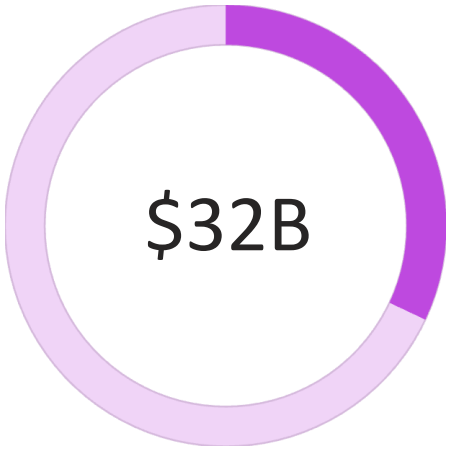
Commercial-Military Integration

Hybrid architectures leverage commercial LEO constellations for constellations for assured capacity during conflict surges.



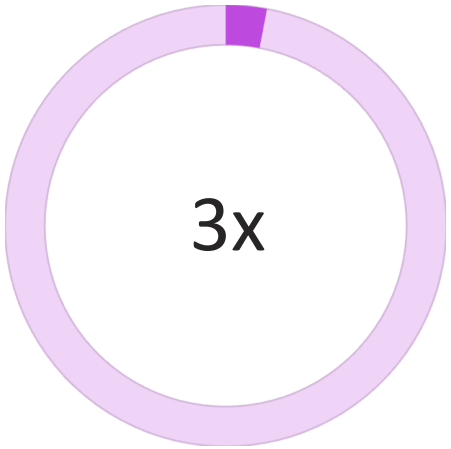
Cost Reduction

Reusable launch economics for rapid reconstitution



Commercial LEO Services

Military access to commercial satellite capacity



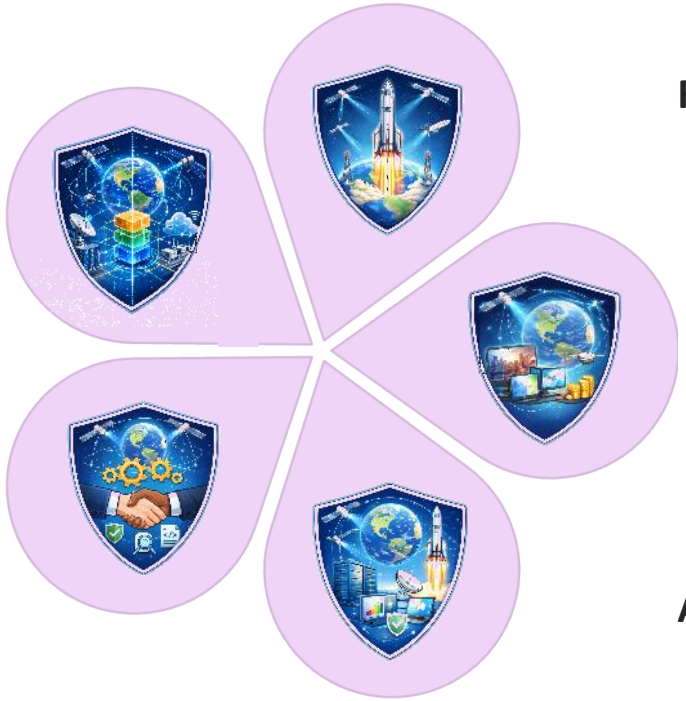
Launch Tempo Increase

Rapid deployment capability growth by 2030

Commercial-Military Integration Strategy

Hybrid Architecture Models

Rapid Launch Access



Commercial Data Feeds

Common Standards

Assured Capacity

Strategic partnerships between defense agencies and commercial operators create resilient architectures that leverage market-driven innovation cycles. innovation cycles. Military payloads on commercial buses, priority access agreements, and standardized interfaces enable rapid capability deployment at capability deployment at reduced cost.

~$45B

Commercial Space Services

Military spending on commercial satellite services through 2030

~40%

Cost Efficiency

Commercial architectures vs traditional traditional military-only constellations constellations

~3x

Innovation Velocity

Faster technology refresh in commercial vs military programs programs

Operational Advantages Driving Defense Spending

Persistent ISR

24/7 coverage with revisit rates under 10 minutes for any location on Earth

Assured Communications

Continuous connectivity even under electronic attack conditions conditions

Mission Continuity

Self-healing networks maintain maintain operations through satellite losses

Decision Superiority

Real-time intelligence fused from multiple sensors

These capabilities establish the foundation for space-enabled military operations that maintain decisive advantage in contested environments. The integration of commercial innovation with military requirements creates asymmetric capabilities that are difficult for adversaries to counter.

Future Growth Opportunities

Smallsat Manufacturing & Components

Key Focus: Automated AIT & Localized Supply Chain | **Key Segments:** Modular buses, radiation-hardened processors, power systems

Inter-Satellite Link Technology

Key Focus : Laser Terminals/Payloads, AI-enabled Routing | **Key Segments:** Optical communications, mesh networking software, autonomous routing

Launch Services & Reconstitution

Key Focus : Launch Networks, Weekly Launch Cadence | **Key Segments:** Dedicated smallsat launchers, rapid response integration, on-demand capacity

In-Orbit Servicing & Maintenance

Key Focus : Space-tugs, Active Debris Removal, Standardized Interfaces | **Key Segments:** De-orbiting, robotic refueling, life extension services

AI/ML for Space Operations

Key Focus : Automated Station-keeping & Collision Avoidance, Threat Prediction | **Key Segments:** In-orbit processing, autonomous tasking, anomaly detection

Secure Communications

Key Focus : Post-quantum Cryptography, Integrated Networks | **Key Segments:** Anti-jam terminals, quantum cryptography, zero-trust architectures

Strategic Path Forward

Invest in Modular Architectures

Develop satellite buses and components that support rapid reconfiguration and mission mission adaptation

Build Commercial-Military Partnerships

Establish assured access agreements and hybrid architecture models with defense agencies

Accelerate Technology Refresh

Leverage commercial innovation cycles to maintain competitive advantage over over traditional programs

Scale Global Operations

Deploy distributed ground stations and mesh networks for continuous coverage and coverage and resilience

- Master the intersection of commercial speed and military-grade resilience.
- Focus on flexible spacecraft design & manufacturing, integration of AI technologies and and optimization capabilities to develop offensive, defensive and support measures.

Thank you

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