

Introduction - Software Defined Antenna (Quantum Rydberg) Radio [SDAR]

This unclassified presentation will discuss the benefits, transition paths and impact of SDAR.

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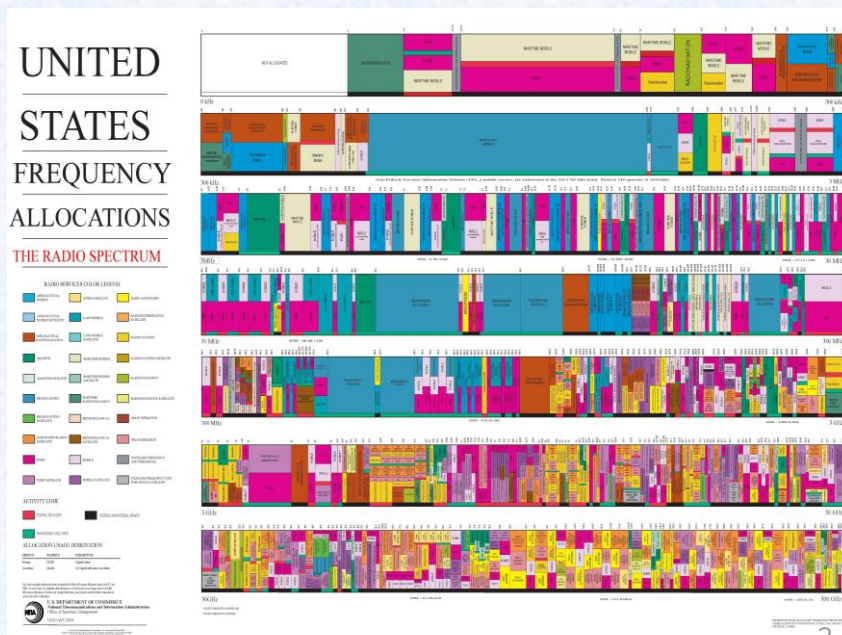
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Introduction to the Problem

- **Traditional antennas are bulky, heavy, and have limited bandwidth:** Traditional antenna systems require significant space and have a restricted range of operation, limiting their effectiveness and flexibility.
- **The foundation of those restrictions is the Chu-Wheeler-Harrison (CWH) limit.** With 1 to 2% bandwidth to frequency. It constrains the spectrum and cascades problems.
- **High visibility of transmit signals makes personnel easy targets:** These systems are easily detectable, putting personnel and assets at risk by revealing their location.
- **Multiple antennas required for different functions, increasing complexity and cost:** Each function (communication, surveillance, etc.) needs a separate antenna, adding to the logistical and financial burden.
- **Operational constraints due to outdated antenna technology:** Older technologies fail to meet increasing demands for speed, efficiency, and covert operations.

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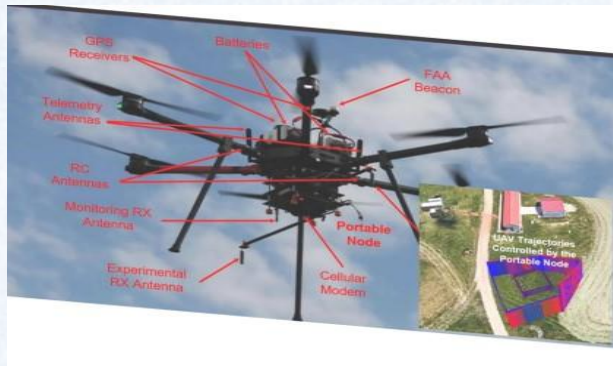
Now: Every frequency band needs an antenna





Now: Antennas Drive Costs

Multiple antennas with individual uses, cost more and complicate; cabling, interference, logistics, and operations.



Capabilities are limited by the size, weight, and power and logistics cost drivers [SWaP-LCD] of antennas.



The platform, its size and cost, and how many are affordable within a budget, are all driven by antennas.

Our Solution – Software Defined Antenna (Quantum Rydberg) Radio [SDAR]

The bad old Constraints & Cost Drivers

Customer Opportunities

- **First mover customers: Covert Defense organizations (e.g., Marines, SOCOM, JSOC):** The missions require advanced communication and surveillance technologies demanding low SWaP-C for mobility, and efficiency.
- **DAF customers: Retrofit to existing programs of record:** Aircraft, Ships, Land Vehicles. **Design-in:** to achieve extraordinary mission effectiveness for new smaller cost-efficient platforms.
- **Commercial customers & Spectrum Architecture: Sectors in: Telecommunications, Satellites, and Medical imaging:** SDAR's technology is versatile and can power Future G, sensing and Profit.
- Adversaries are combining Commercial and Military Spectrum Architecture using conventional science. SDAR provides an opportunity to leapfrog technology and integrate spectrum architecture across commercial and defense domains.

CONVENTIONAL ANTENNA CONSTRAINTS

Antennas of 1 to 2% * Bandwidth / Frequency limit drives complexity and cost.

Cross- Domain communications multiple antennae, switched and transcription

130 year old processing sequence

Many antennas add complexity and layers of cost.

Propagation, bandwidth and directivity are baked into the single antenna design

SDAR RYDBERG VAPOR CELL

Massive bandwidth Eliminates (Chu) limit while retaining lightning and EMP resilience

Provides relay cross-domain communications with intrinsic processing

Programable Processing order e.g. : Angle of Arrival before Frequency.

Exceptional SWaP-C. Fewer antennas and cascading benefits

Significantly more versatile and novel information for C4ISR & PNT

Software Defined Antenna (Quantum Rydberg) Radio [SDAR]

Antennas drive costs because of

1% to 2% (Chu Wheeler Harrison Limit)
bandwidth to frequency spectrum.

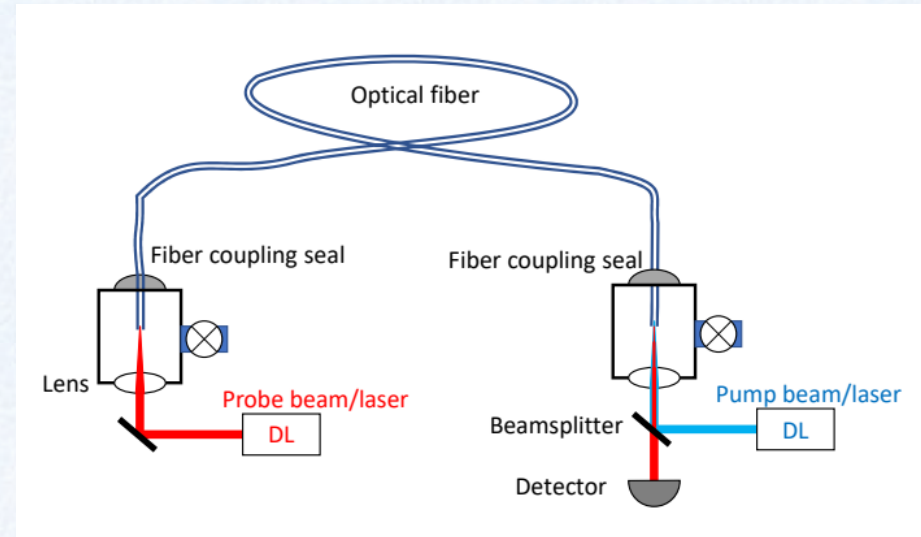
(that's passive classical antennas but not quantum)
Other quantum Rydberg cells are fragile, small or still use
classical antennas.

Hollow Optic Fiber is
Operationally Robust.

Laser timing, optical physics & math gets:

- Transformational solutions
- Programmed mission capability

After: One modular design from Cubesat to
1 km long array for submersible or stratospheric balloon



USPTO Patent Applications of 5 in process:

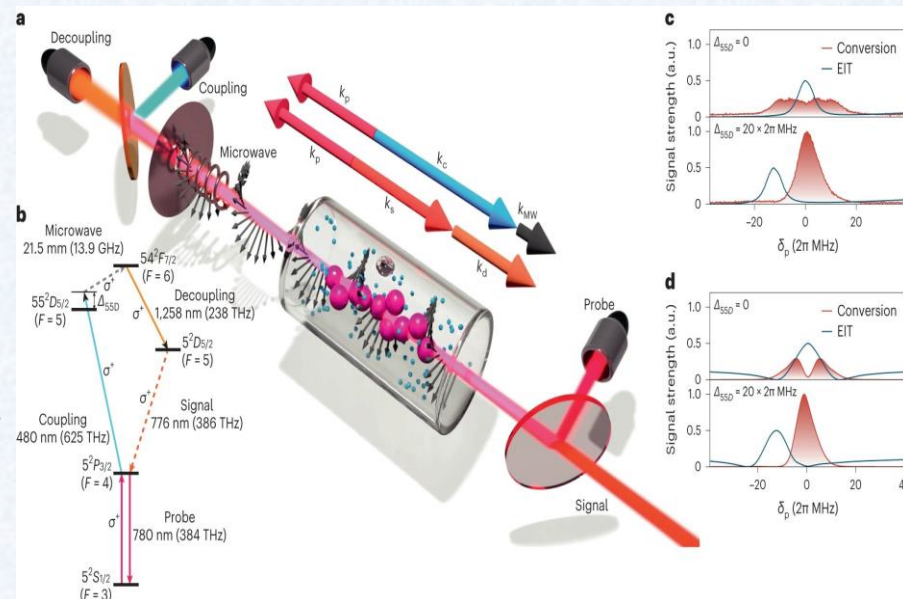
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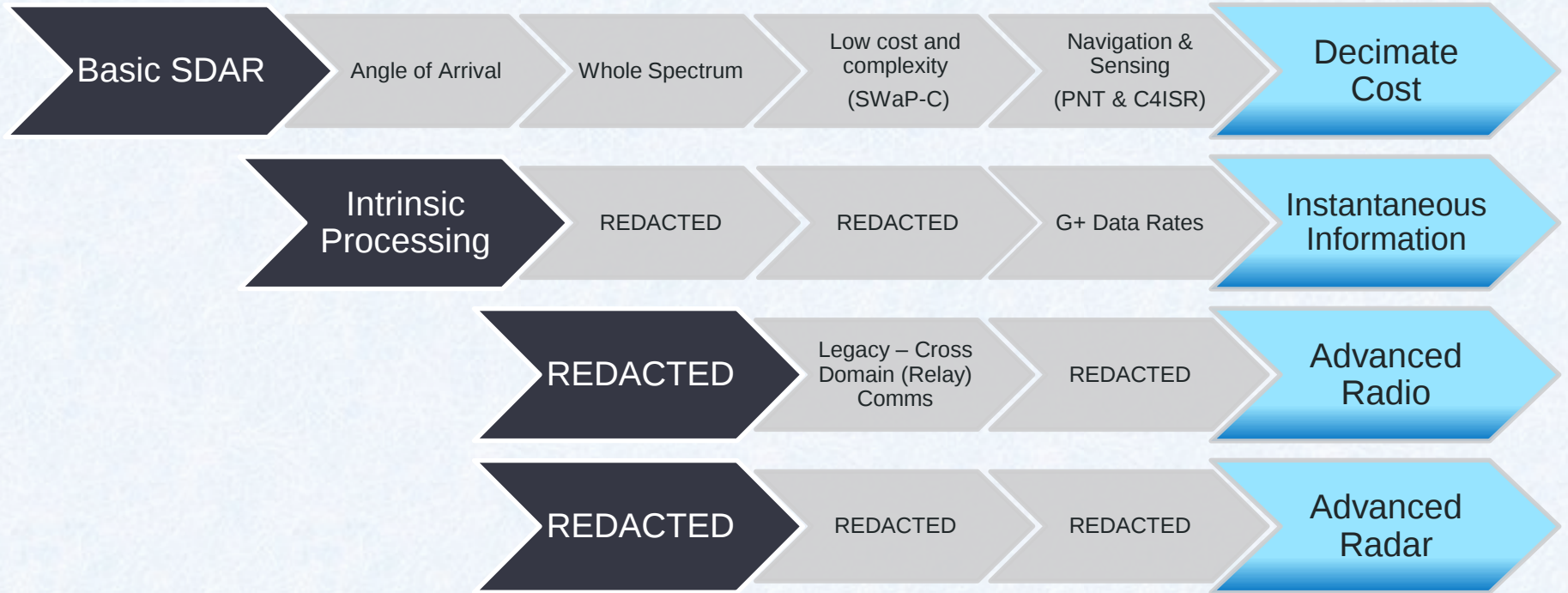
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What is SDAR's Competitive Edge?

- **Massive increase in bandwidth and Exceptional signal sensitivity:** SDAR's innovative technology provides transformational new applications and a powerful boost in performance compared to traditional systems.
- **Single, versatile antenna for multiple functions, reducing SWaP-C:** One antenna performs multiple roles, simplifying design and logistics.
- **Programable for each simultaneous mission:** In-the-field characterization library discovery and update.
- **Advanced intrinsic signal processing capabilities:** The design allows cutting-edge technologies with revolutionary signal processing and adaptability.



Transition - Capability Path - Impact



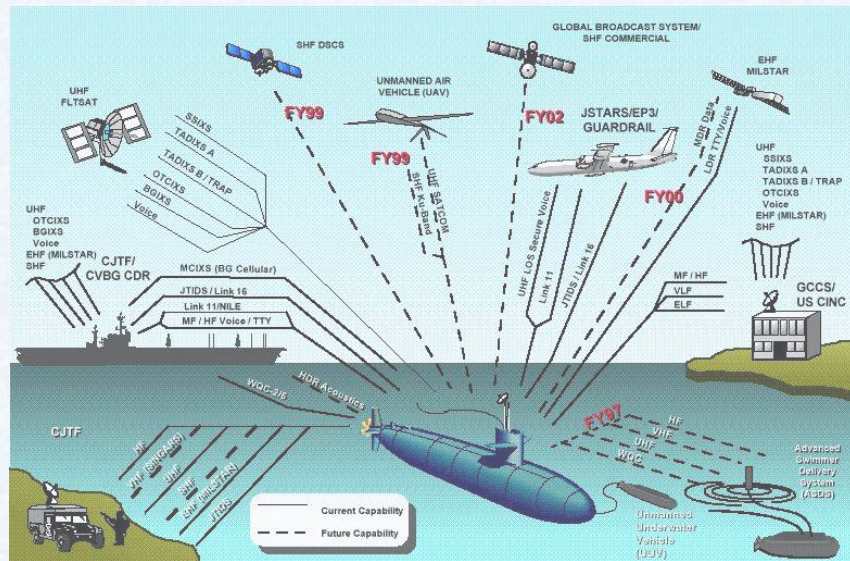
Drivers Prioritizing SDAR Implementation

- **Revolutionary Threats: C4ISR, SIGINT, EW demands: stealth and agility:** SDAR provides the necessary operational capabilities to programmatically deploy against current and future threats, providing intelligence libraries with new information types.
- **C4ISR, SIGINT, EW Operations need: Enhanced mobility and rapid deployment capabilities:** With SDAR, forces can move swiftly and efficiently deploy new libraries toward a strategic advantage.
- **SWaP-LCD Efficiency: Reduces costs, time and risk for effective missions:** Investing in SDAR Reduces **Size Weight, & Power** while cascading reductions in **Logistics & Cost Drivers** including, Design standardization, Price, Manufacture, Retrofit, Certification, Transition, Training, Operations, Maintenance, Support and Updates; resulting in a **Strategic Benefit** of high and unknown risk for the adversary.



Tactical Pain of Not Having SDAR

- **Exposure to Enemy Detection: Traditional antennas emit strong signals, making soldiers easy targets:** Without SDAR, soldiers' positions are easily detectable, putting them at constant risk.
- **Operational Inefficiency: Bulky, outdated equipment limits mobility and response time:** Legacy systems hinder quick maneuvers and adaptive responses, endangering missions.
- **High Logistic Cost Drivers: Maintaining and transporting large platforms with legacy equipment drains resources:** The financial burden of outdated technology affects mission capabilities, budget allocations and strategic overmatch.

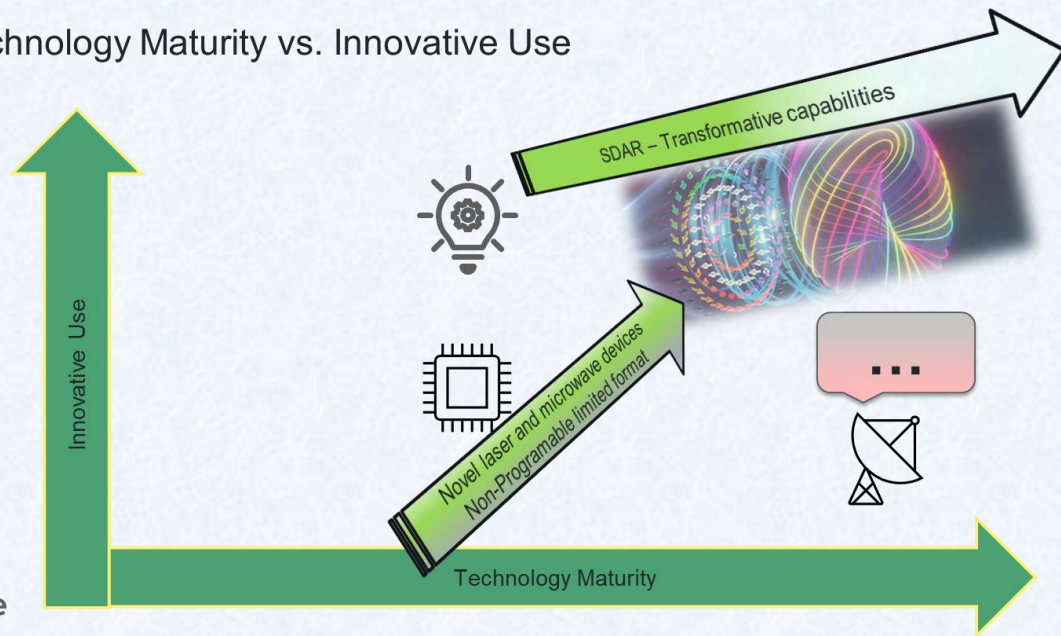


Strategic Gain of having SDAR – Overmatch reduces conflict risks.

Technology Creating new capabilities affordably

- **Quantum Rydberg Technology: Superior sensitivity and bandwidth:** Offers unmatched sensitivity and a 40-fold increase in bandwidth.
- **Multi-Functionality: Single antenna for multiple tasks reduces SWaP-LCD:** Reduces size, weight, and power consumption by consolidating multiple functions into one wholistic architecture.
- **Remote Updates: Continuous improvement without physical modifications:** Allows for seamless updates and enhancements, maintaining cutting-edge performance.
- **Edge Processing: Faster decision-making on-site analysis:** Enables quick, informed decisions by processing data at the source. Delivering a kill-chain that increases adversaries' risk.

Technology Maturity vs. Innovative Use



Execution and Partnership Resources

- **Collaboration with top research institutions (WRC-NC, NCSU, Duke, NIST):** Working with leading research institutions ensures access to cutting-edge technology and expertise.
- **Support from major defense contractors:** Partnerships with established defense companies facilitate design, manufacturing, integration and deployment.
- Planned Series A & B investments for target market valuation
- **Agile design and rapid prototyping capabilities:** Quick iteration and development cycles are facilitated by access to a wide group of users to meet market demands and operational needs.
- **We have a proven track record in securing funding and executing high-impact projects:** Experience in obtaining investment and successfully delivering complex projects. Our partners play in that area too.

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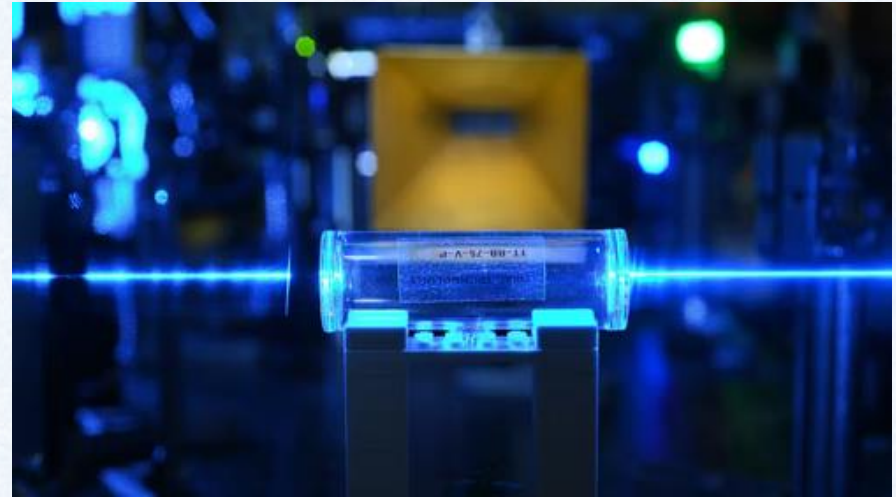
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Proof of Concept through to Transition

- **Successful Field Tests: Proven performance in real-world defense scenarios:** SDAR precursor technology has demonstrated exceptional reliability and effectiveness in field operations.
- **Operational Feedback: Positive responses from military personnel and strategists:** Feedback from the field confirms the targeted value in enhancing mission capabilities and planning.
- **Transition planning:** collaborate with industry partners, plan for the highest value first, and ensure logistics and training support the rollout.
- **Strategic Advantage: Significant improvements in mission success rates and safety:** Implementing SDAR provides a critical edge in strategic and tactical operations.



The Value Proposition

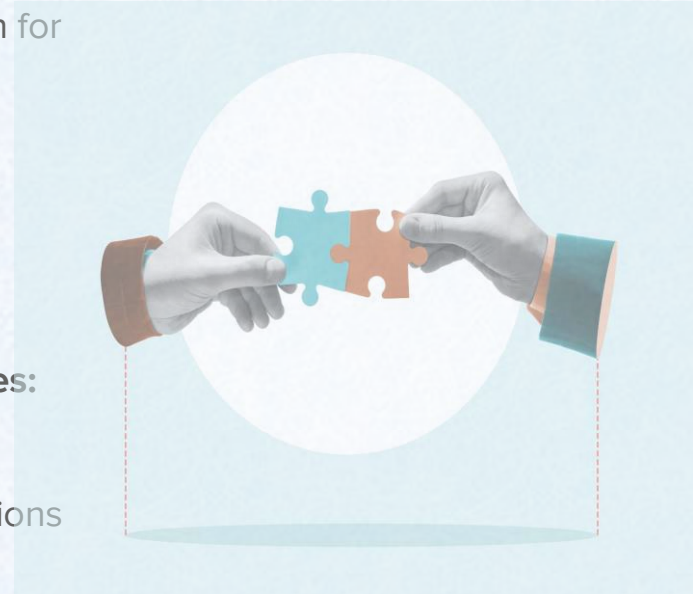
- **Revolutionary antenna technology that transforms communication capabilities:** SDAR offers unprecedented improvements in bandwidth, sensitivity, networking operations and versatility.
- **Significant cost savings and operational efficiency:** Reduces the need for multiple antennas, simplifying logistics and delivering a cascade of lower costs.
- **Enhanced safety and effectiveness for defense operations:** Low detectability ensures safer operations, while advanced capabilities improve mission success.
- **Dual-use technology with broad commercial applications:** Applicable to both military and commercial markets, expanding revenue streams.



Photo by Johannes Plenio on Unsplash

What is the Transition Plan and Path to the Market?

- **Initial prototypes and demonstrations are targeted at defense applications:** SDAR's technology will be first demonstrated for defense missions to showcase its capabilities, gain initial traction and plan for fast implementation of decisive capabilities.
- **Partnering with major defense contractors and technology integrators:** Collaborations with established defense companies, reduce friction in wide integration and deployment across many platforms
- **Expanding into commercial markets with the proven capabilities:** Once validated in defense, the technology will be built using the standards invoked for the military, for commercial uses like telecommunications and satellite operations. Commercial operations now become compatible as channels for military use as needed.
- **Licensing technology to manufacturers and integrators for broad, prompt and coordinated adoption:** Licensing agreements will allow widespread use of SDAR technology across various industries.



Where is the Money?

- **Defense market: \$120 B total addressable market (TAM):** The defense sector provides a vast market for advanced communication and surveillance technologies.

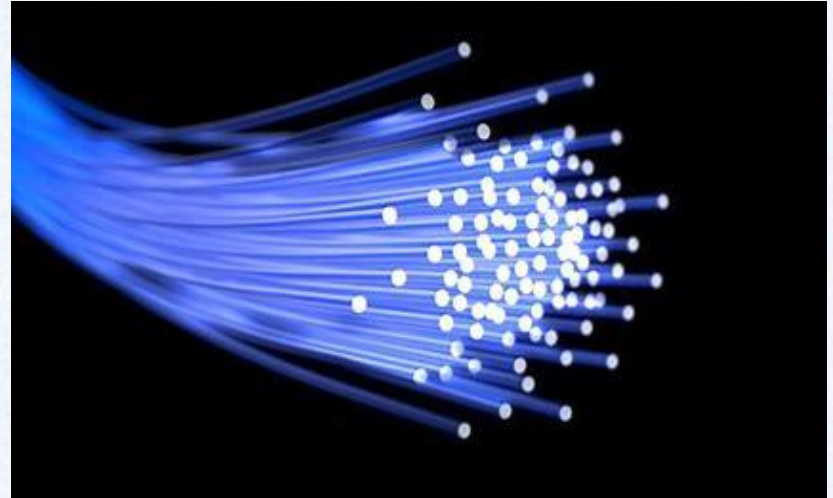
- **Commercial market: \$152 B TAM (Satellites, 6G, medical imaging):** Beyond defense, SDAR's technology brings performance and revenue to lucrative commercial sectors.

- **Our Revenue streams: agile manufacturing, licensed manufacturing, design tools, software components, consulting R&D, and direct sales:** Multiple revenue streams reduce risk, diversified markets ensure resilient financial growth.



Development and Business Horizons - Concept Category

- **Focus on a Market-Ready Idea for initial deployment:** Deploying a solution that is ready for the market ensures quick integration and immediate benefits.
- **Leverage existing technology for rapid implementation:** Using proven technology allows for faster rollout and lower risk.
- **Initial focus on defense applications to showcase immediate value:** Demonstrating value in defense applications paves the way for broader adoption.



Legal and Regulatory Considerations

- **Spectrum Allocation: Traditionally required to prevent interference by high spectral power density antennas:** Managing and assigning frequency bands to avoid signal overlap and interference. **The core CWH constraint.**
- **Regulatory Challenges: Existing regulations are hard to change:** Modifying established rules and policies is a complex and time-consuming process.
- **SDAR's Advantage::** High received power through directivity. Low power spectral density immune from current interference regulations.
- **Compliance: Legacy spectrum is not impacted legally or with existing regulations:** SDAR operates within the bounds of current legal frameworks without disrupting existing allocations.

Defense Problem Solved Horizon #1 SWaP-C constrained missions

- **Problem: Traditional antennas are bulky, costly, and vulnerable:** Current communication systems in defense are limited by size, weight, and susceptibility to detection. They require larger more vulnerable vehicles.
- **Solution: SDAR's technology offers a compact, efficient, and low-visibility communication solution:** SDAR provides a streamlined, secure, and versatile solution for immediate defense needs.
- **Impact: Fast deployment in defense applications enhances operational efficiency and safety:** Implementing SDAR technology improves mission success and personnel safety in defense operations.
- **SDAR** is a less burdensome solution to track and defend against innovative weapons.



SDAR's Position in the Marketplace

- **Disrupting Legacy Systems: SDAR replaces bulky, limited traditional antennas and large antenna arrays:** Providing a streamlined, versatile solution that surpasses the limitations of existing systems.
- **Comparison to Alternatives: SDAR's superior capabilities:** offer greater bandwidth, lower visibility, and cascading SWaP-C benefits compared to traditional and alternative technologies.

New Capabilities:

We are available for private meetings following this presentation.

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