Approved, DCN# 43-8606-21

SA Photonics

EagleEye™

Multi-Aperture Airborne FSO Communication System

Topic: N182-132 – Office of Naval Research

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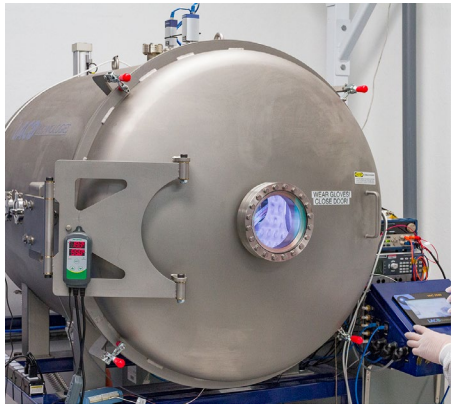
SA Photonics History / Background

- **SA Photonics principals background is a combination of space/military, commercial, and venture capital startup:**
  - > 120 technical staff members: 12 PhDs and 22 Sr. Engineers
- **Established in 2002**
- **Consists of two main technology areas**
  - **Communication and Sensors Group** - specialized in optical, RF and high performance mixed signal communication and sensing systems
  - **Vision Systems Group** – specialized in human factors and developing leading edge augmented reality and nigh vision systems
- **Over 40,000 square feet of mixed office/laboratory space in Bay Area**
  - New 10,000 sq. ft. clean room facility recently leased to support space system test, assembly and manufacturing
  - Establishing 13,000 sq. ft. manufacturing facility in Florida to support OISL volume production
- **Proven record of product development from concept generation through qualification and manufacturing general availability**
  - Over $10M invested in 2020-2021 to enhance OISL manufacturing capabilities

Electro-optical R&D lab & assembly Area



Environmental Testing

3800 sq. ft. Clean Room

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Navy Challenge

F/A-18F Super Hornet (Credit: U.S. Navy)

- **Strong demand to provide robust communication capabilities in RF denied environments**
- **Free-space optical communication enhances signal security, is harder to intercept and increases the amount of data delivered in a low size, weight and power (SWaP) package**

Operational Need and Improvement

- **Navy Aircraft require a high data rate communication capability that is…**
  - Resilient to RF interference and jamming
  - LPI/LPD (low probability of intercept/detection)
  - Extremely low SWaP
- **EagleEye FSO communications system provides these capabilities and is suitable for air-to-air, air-to-ground and air-to-space applications**

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EagleEye™

EagleEye is a fully integrated FSO solution

- Conformal aperture allows use on high velocity aircraft without introducing turbulence or drag
- 50 degree Risley Prism based beam steering provides wide field-of-regard operation
- Integrated platform stabilization to support operation on airborne platforms
- Wide Field-of-View acquisition sensor provides rapid autonomous acquisition in RF denied environments.
- 100 Mbps data rate – can be increased to 1+ Gbps

- SA Photonics' field proven HARQ Physical Layer retransmission overcomes both atmospheric scintillation and aero-optic effects
- Supports link distances up to 100 nmi

Current Status

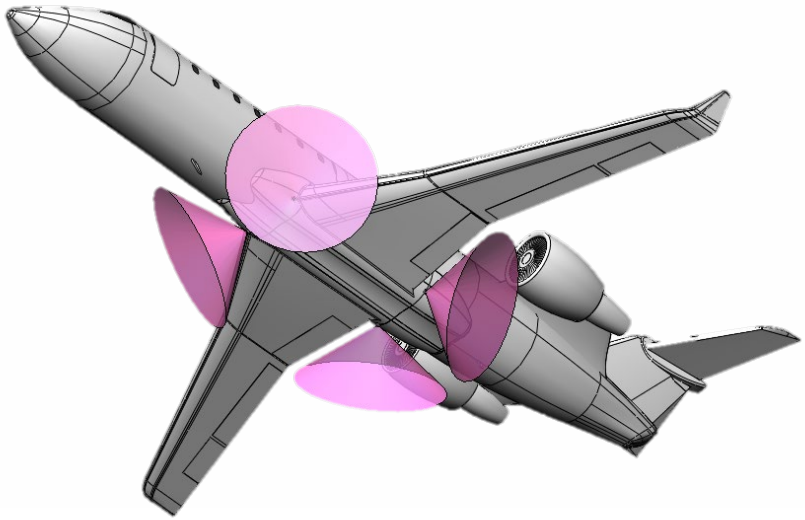
Phase II Prototype System

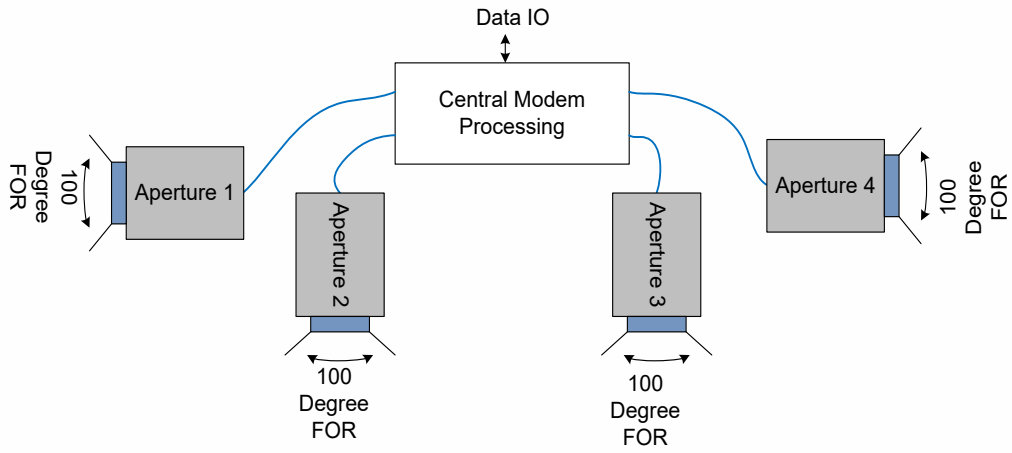
- **Program started November 2019**
- **Prototype system complete November 2021**
- **Outdoor Testing complete in mid 2022**

Key Features / Advantages / Benefits

- Up to 40x increase in data rates compared to CDL based systems, with data rates up to 10 Gbps
- Link distances up to 100 nmi and beyond
- Extremely low probability of interception and detection
- Ability to operate in RF-denied environments with complete resistance to jamming
  - Provides communications without RF emissions, allowing use during Emissions Control (EMCON) conditions
- Eliminates spectrum allocation restrictions
- Very low Size, Weight and Power compared to RF solutions
- Accurate range and time-transfer capability can be used to provide “GPS-free” alternative PNT to distribute position, velocity and time to optically connected platforms

Multi-Aperture Operation





- **Multiple conformal apertures provide the ability to provide full hemispherical link coverage, as well as support multi-link mesh networking**
- **Each aperture can support independent links, or can be used for spatial diversity when field-of-regard overlap**
  - Spatial diversity can help overcome atmospheric effects
- **Handoff of established link will be "hitless" between apertures as aircraft maneuverers**
  - Each Tx wavelength has dedicated beacon AM modulation that is detected by quad cell

Transition to Fleet

- Strong interest from multiple agencies (Navy, Air Force, MDA, DARPA, SDA, Army, etc..) for low SWaP resilient communications
- Key technology can be scaled to support wide range of applications
  - Airborne
  - Ground
  - Space
  - Maritime
- Related system has been transitioned to provide air-to-space communication and A-PNT to DARPA's Blackjack and SDA T0 proliferated LEO constellations

Types of Partners Sought/Transition

- **Organizations or companies looking for low SWaP-C resilient communications**

- **FSO also provides multiple mission critical functions**
  - High data rate communications
  - LPI/LPD
  - Operate in RF denied environments
  - Ranging can be used to provide relative and/or absolute navigation and time transfer

- **Likely path forward**
  1) Manufacture and sell EagleEye systems
  2) Also able to license design

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