Redefining possible®

Countering the Evolving Drone Threat

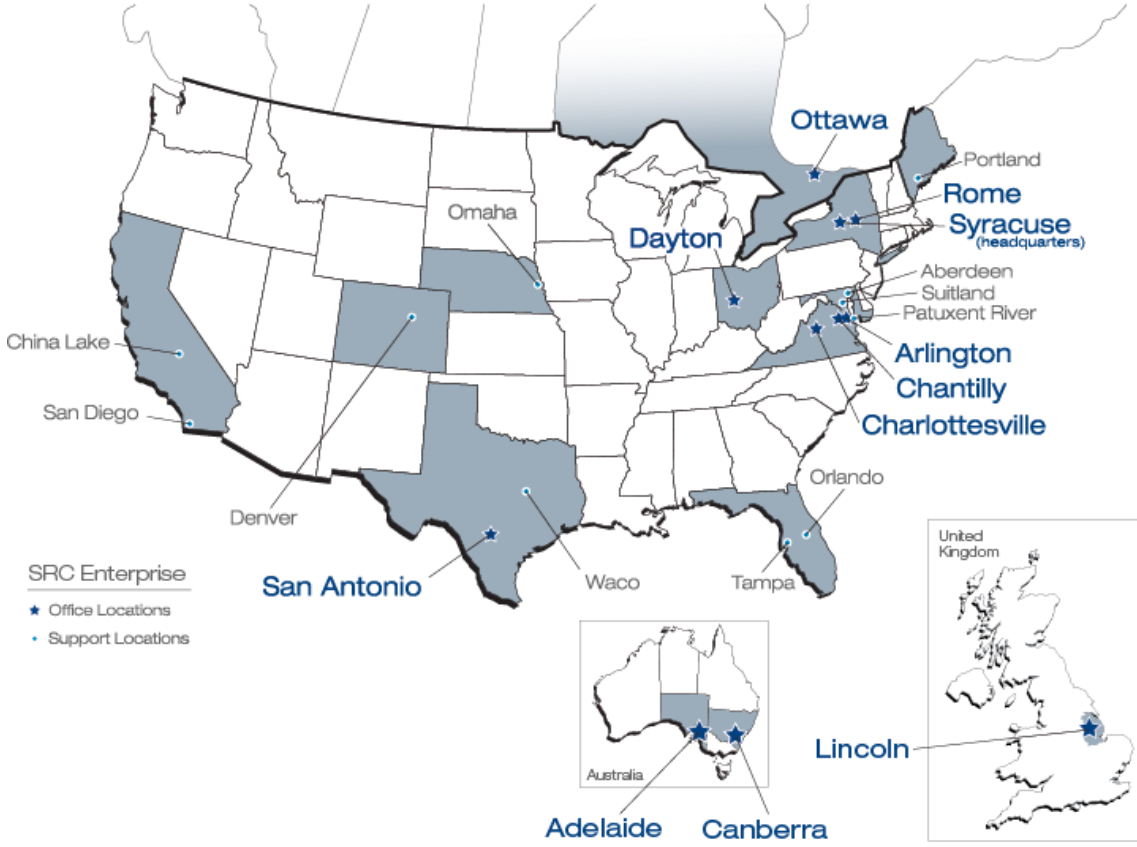
The Need for a System-of-Systems Approach

SRC

Defense › Environment › Intelligence

Who Is SRC?

- Founded in 1957 as a “Not-for-Profit” Research & Development company
  - Earnings reinvested into company – **No stockholders**
  - Technology innovation, state-of-the-art RF, EW systems
- Today: End to End product design, development, production and life cycle support
  - Focus in Radar and EW system
- ~1,400 employees
- FY19 projected revenue $340M



What We Do …

Partners with the U.S. Military on Unmanned Aircraft Systems (UAS) threat since 2005

Electronic Warfare

Data Analysis

Radars & Sensors

Manufacturing & Test

Counter-Unmanned Systems

Machine Learning

Primary Provider of C-UAS Technology to The U.S. Military

Operational Integration

Intel, Surveillance, Reconnaissance

Environmental Health Analysis

Enabling the Evolving UAS Threat ….

- **Technology Evolution -** *The accelerating pace of UAS Capabilities ….*
- **Proliferation -** *Low/Decreasing cost and ease of access*

- **Command & Control System Improvements**
  - ***Autonomy***: Ease of Use - *AI & ML - Masses/Cooperative Swarms*
  - ***Command & Data links*** - Encrypted/encoded/frequency hopping
  - ***Improved guidance -*** Satellite, Inertial, Optical, hybrid

- **Air Vehicles**
  - **Smaller & Quieter** … Harder to detect/track
  - **Longer Range/Endurance** … Increased threat envelope
- **Payloads**
  - **ISR payload improvements** …. More stand off range
  - **Lethality** … Increased payloads & autonomous targeting

This Threat Requires

A SYSTEM-OF-SYSTEMS APPROACH

Detection, Identification, Decision and Defeat

Counter-UAS Functional Requirements

Detection & Identification				Decide	Defeat		
Radar	**Spectrum Sensing/ Geolocation**	**EO/IR Camera**	**Acoustics**	**C2/User Interface**	**Electronic Warfare (EW)**	**Laser/ High Energy RF**	**Kinetic**
•**All UAS Ops Modes** •**Primary Function:** Air Vehicle Detection/ Tracking - All Ranges (10+km) •**Secondary Function:** Target Confirm	•**Command Link Ops - "Primarily"** •**Primary Function:** Air Vehicle/ Controller Detection/ Geolocate •**Secondary Function:** ID/ Confirmation	•**All UAS Ops Modes** •**Primary Function:** ID/Confirma-tion •**Secondary Function:** Tracking/ Geolocate •**Range:** Daylight >5 km; Night ~2 km	•**All UAS Ops Modes** •**Primary Function:** Detection (Short Range < 1km) •**Second-ary Function:** Direction Finding (DF)	•**All UAS Ops Modes** •**Primary Function:** Integrated Common Operating Picture – All Sensors •**Secondary Function:** Sensor & Defeat Command Interface	•**All UAS Ops Modes** •**Primary Function:** Non-Kinetic "Defeat" of UAS •Jamming, Spoofing, Cyber	•**All UAS Ops Modes** •**Primary Function:** Disruption/ Destruction of Air Vehicle	•**All UAS Ops Modes** •**Primary Function:** Disruption/ Capture/ Destruction of Air Vehicle

NO SINGLE PRODUCT OR SYSTEM CAN ADDRESS THE COMPLEXITIES OF THE UAS THREAT

Detection Mechanisms

Active Command Link Operation Mode

- Long Range: **>5km**
  - **Drone**: Radar and/or Spectrum Sensor/DF - **Controller**: Spectrum Sensor/DF
- Medium Range: **2km – 5km+**
  - **Drone**: Radar, Spectrum Sensor/DF, EO/IR - **Controller**: Spectrum Sensor/DF, EO/IR
- Short Range: **<2km**
  - **Drone**: Radar, Spectrum Sensor/DF, EO/IR, Acoustic - **Controller**: Spectrum Sensor, EO/IR

Autonomous Operation Mode

- Long Range: **>5km**
  - **Drone** : Radar - **Controller**: Spectrum Sensor/DF (@ Startup Only)
- Medium Range: **2km – 5km+**
  - **Drone** : Radar, EO/IR - **Controller**: Spectrum Sensor/DF (@ Startup Only), EO/IR
- Short Range: **<2km**
  - **Drone** : Radar, EO/IR & Acoustics - **Controller**: Spectrum Sensor (@ Startup Only)

Identification Mechanisms

Controller

- ***RF Spectrum Sensing, DF and Geolocation***
  - Command and/or Data Link Characteristics - Threat Library Based

Drone

- ***Radar***
  - Size (RCS) - Environment (Birds, RF Domain) - Kinematics of UAS - Micro-doppler
- ***RF Spectrum Sensing, DF and Geolocation***
  - Command and/or Data Link Characteristics - Threat Library Based
- ***EO/IR***
  - Size (Physical) - Kinematics of UAS - Environmental (atmospherics, clutter, birds)
- ***Acoustic***
  - Size/Mass and Propeller No. and Design - Environmental (Atmospherics, Noise Spectrum)

Decision Mechanisms – *C2 & User Interface*

Primary Functions

- *Integration of Sensor Inputs*
- *Presentation of a Common Operating Picture*

Secondary Functions

- *User Command Interface for Sensors and Defeat Mechanisms*

Open Architecture Essential

- *Pace of threat evolution and Myriad of components/systems available … flexibility required*

Increasing use of AI & ML to support work loads and decision aids

Defeat Mechanisms

- Countermeasure is driven by the UAS, the Mission and Environment of the engagement
  - **Non-Kinetic Mechanisms**
    - **EW (Jamming, Spoofing)** – Cost effective but operational environment limitations
    - **Cyber** – Limited/continuously evolving set of applicable drones
    - **Low energy Laser Dazzlers** - Optical Seekers or Video Cameras
    - **High Energy Lasers** – Expensive and “not there yet”
    - **High Energy Microwave/RF** – Promising but collateral risk is present
  - **Kinetic Mechanisms**
    - **Guns** – High collateral damage risk with lower P-Kill ….
    - **Rockets/Missiles** – Effective but Cost Ratio is currently non-supportable
    - **Netting Systems** – Effective for single drones, but at very short ranges
    - **Capture Drones** – Diminished effectiveness against swarms/masses

Trends We See Today in Counter UAS Needs…..

- **Increased AI & ML implementation – Autonomy**
  - **Threat**: Both Air Vehicles & Controllers … **C-UAS**: Primarily in C2/GUI …. But also Sensors & Defeat
- **Radar**
  - "On-the-Move" capabilities … Significant mission flexibility improvements
  - Multi-Mission/Multi-Function … Cost Ratio improvements
  - Dual/Multi-Band Systems to address RF spectrum conflicts
  - "Passive Radar" … not there yet, but promising/possible ….
- **EO/IR**
  - Increasing Detection Range with Optical Tracking and Discrimination/Identification
  - Improving Environmental/Atmospherics Conditions Performance – Optics and Processing Improvements
- **EW/DF**
  - Multi-mission Simultaneous C-IED, Counterfire and C-UAS
  - Improving DF/Geolocation and Identification
  - "Surgical" Jamming/Spoofing/Hacking
  - Swarm Defeat Mechanisms
- **Other Defeat Mechanisms**
  - Lasers – High and Low Energy
  - High Energy Microwave
  - "Cooperative" *Anti-Drones*
  - *"Smarter", Lower Cost Kinetic Kill/Capture*

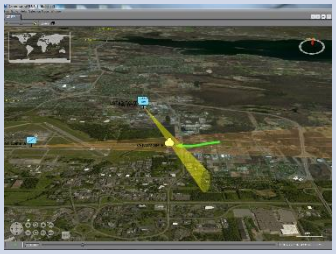
Redefining possible®

Silent Archer®

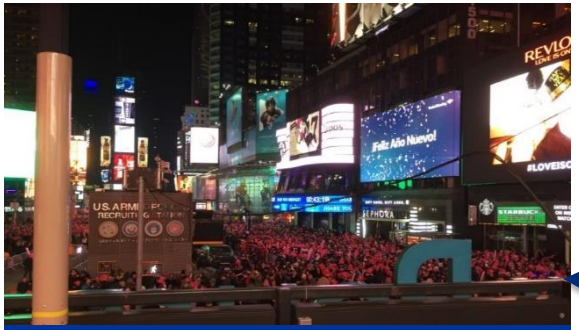
Mission Configurable Counter-UAS Technology

Family of C-UAS System-of-Systems Solutions

Core *Silent Archer* Components

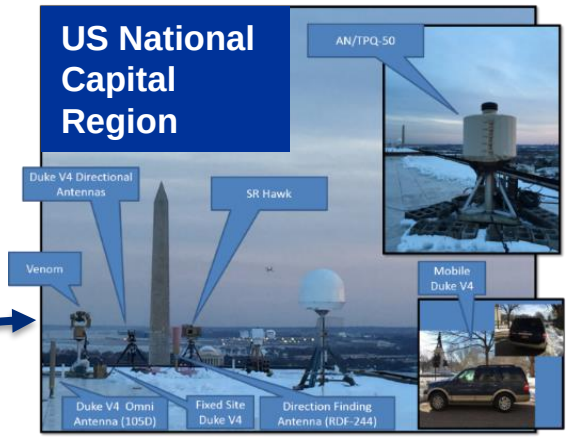
Air Surveillance Radar	Electronic Warfare System	Direction Finding Unit	EO/IR Camera	User Display
				
• *LSTAR*® air surveillance radar • *Gryphon R-1410* 3-D full AESA radar • *SkyChaser*™ On-The-Move radar	• EWSS (USG) • SRC / Micro transceiver • *Allen-Vanguard* ANCILE™ • 3rd Party EW	• *Whisper Hunter*™ DF unit • Gryphon S1200 Spectrum Sensor • *TCI* Model 280 • 3rd Party DF	• *Night Hawk* by PVP Advanced EO Systems • Camera agnostic – User Defined	• Silent Archer 3-D User Interface • Gryphon Skylight® Airspace Monitor Interface • Customer-specified C2

Experience Counts



New Years Eve Times Square

2017 Queen Elizabeth



SRC
Silent Archer®

2012 London Olympics

2013 G8 Summit - Ireland

U.S. Borders

2009 G20 Summit Pittsburg

Can You Guess Where?

Thank You

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