



SOLUTIONS FOR BORDER SURVEILLANCE

Meeting Frontex- Member States-Industry

05/10/18





FLIR SYSTEMS INC

COMPANY OVERVIEW

BUSINESS UNITS

GOVERNMENT & DEFENSE

SURVEILLANCE



- Airborne systems
- Maritime systems
- Land systems
- Border surveillance
- Tactical vision
- Command & control software

DETECTION



- Radiation detectors
- Explosives detectors
- Chemical-biological threat detectors
- Mass spectrometry systems

INDUSTRIAL

INSTRUMENTS



- Building inspection cameras
- Electrical / mechanical cameras
- Lab / R&D cameras
- Test & measurement tools
- Firefighting cameras

OEM & EMERGING



- Thermal camera cores & components
- Intelligent traffic systems
- Mobile accessories
- Commercial UAS

COMMERCIAL

MARITIME



- Multifunction displays
- Instruments
- Sonar
- Radar
- Thermal cameras

SECURITY



- Thermal security cameras
- Visible-light security cameras
- DIY security systems
- Software and analytics



GOVERNMENT & DEFENSE

SURVEILLANCE GROUP

ABOUT FLIR SURVEILLANCE



\$545M

2017 REVENUE



30%

OF TOTAL COMPANY REVENUE



9.5%

OF REVENUE TO R&D

INDUSTRY AVERAGE 1-2%



1,121

EMPLOYEES WORLD WIDE

SURVEILLANCE

COMMITTED TO YOUR MISSION BY PROVIDING
MISSION CENTRIC PRODUCT AND SOLUTIONS

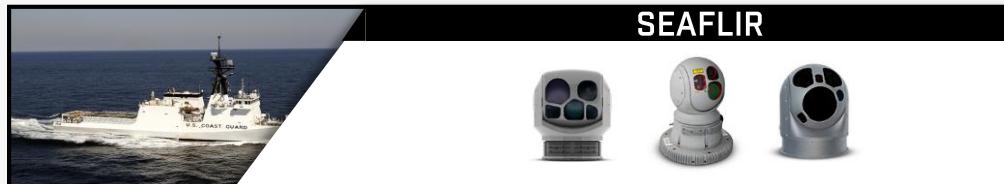


MISSION FOCUSED PRODUCTS

AIRBORNE SURVEILLANCE



MARITIME SURVEILLANCE



LAND SURVEILLANCE



RADARS



TARGETING



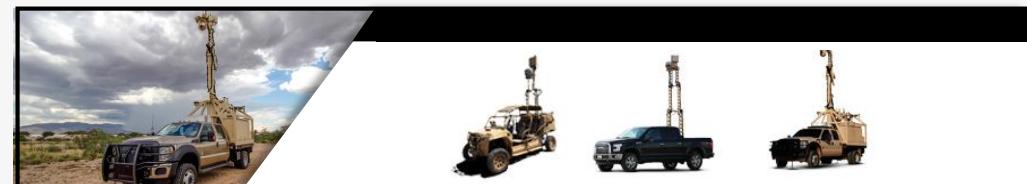
HANDHELD



WEAPONS SIGHT



INTEGRATED SOLUTIONS



MANUFACTURING LOCATIONS

NORTH AMERICA

WILSONVILLE, OR USA

Corporate Headquarters

Stabilized Sensors

Patterned Optics

Reticle Optics

NORTH BILLERICA, MA USA

Stabilized Sensors

Weapons Sights

Pan-Tilt Sensors

Cryo-Coolers

BOZEMAN, MT USA

VENTURA, CA USA

Lasers

Crystal Growth

Laser Development

Range Finders and Designators

ELKRIDGE, MD USA

Integrated Systems

Mobile surveillance Towers

Sled Based Vehicle Surveillance

Deployable Equipment Kits

FREEPORT, PA USA

Precision Optics

Precision Turned Optics

Thin Film Coatings

Solderable Edge

Metallization

LAVAL, QC CANADA

Radars

Coastal Surveillance

Radars

Land Radars

UAV Detection Radars

EUROPE

TÄBY, SWEDEN

Pan-Tilt Surveillance Sensors

Drive and Situational Sensors

Heavy Weapons Sighting Systems

HVALSTAD, NORWAY

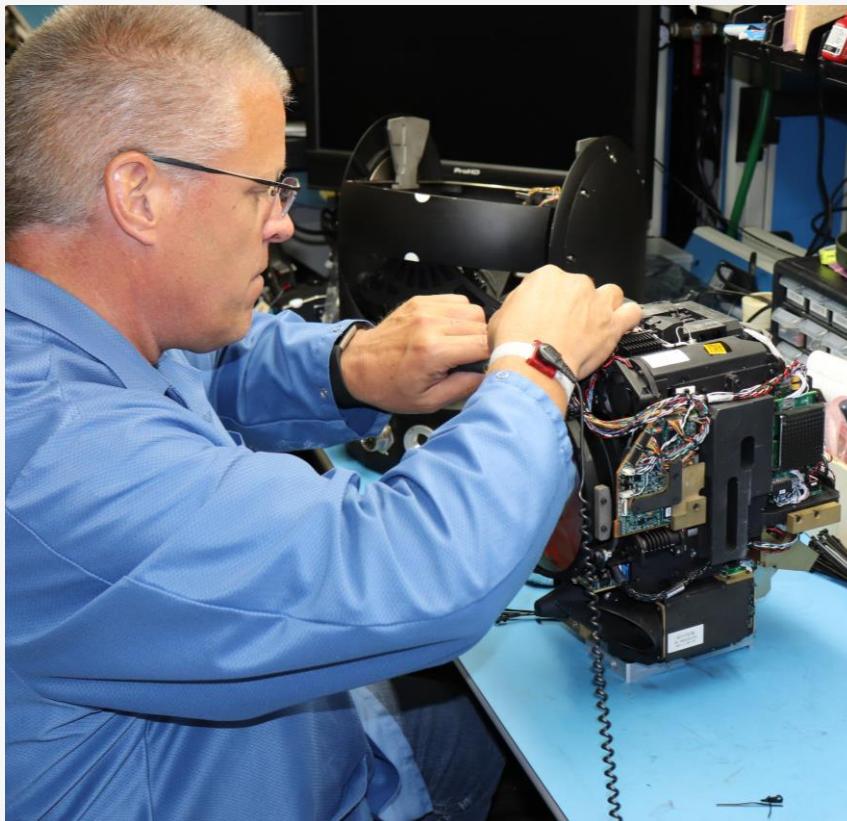
UAS Operations

Integrated UAS Solutions

Nano UAS Sensors

WORLD WIDE SUPPORT MODEL

OUR COMMITMENT TO SERVICE & SUPPORT:
ENSURING MISSION SUCCESS NOW AND INTO THE FUTURE



NORTH AMERICA

Wilsonville, OR USA
Elkridge, MD USA
North Billerica, MA USA
Jacksonville, FL USA
Tucson, AZ USA
Dartmouth, NS CA
Laval, QC CA

SOUTH AMERICA

Sorocaba, BR
Sao Paulo, BR
Bogota, CO

MIDDLE EAST

Dubai, AE

AFRICA

Pretoria, ZA

ASIA PACIFIC

Adelaide, AU
Seoul, KR
Kaohsiung City, TW
Tokyo, JP
Kuala Lumpur, MY

EUROPE

West Malling, UK
Taby, SE
Furstenfeldbruck, DE
Istanbul, TR
Rome, IT
Madrid, ES
Kjeller, NO



GOVERNMENT & DEFENSE

HDC Multisensors and Radars

Technology evolution



DefendIR/ R3D

Piraeus November 2012



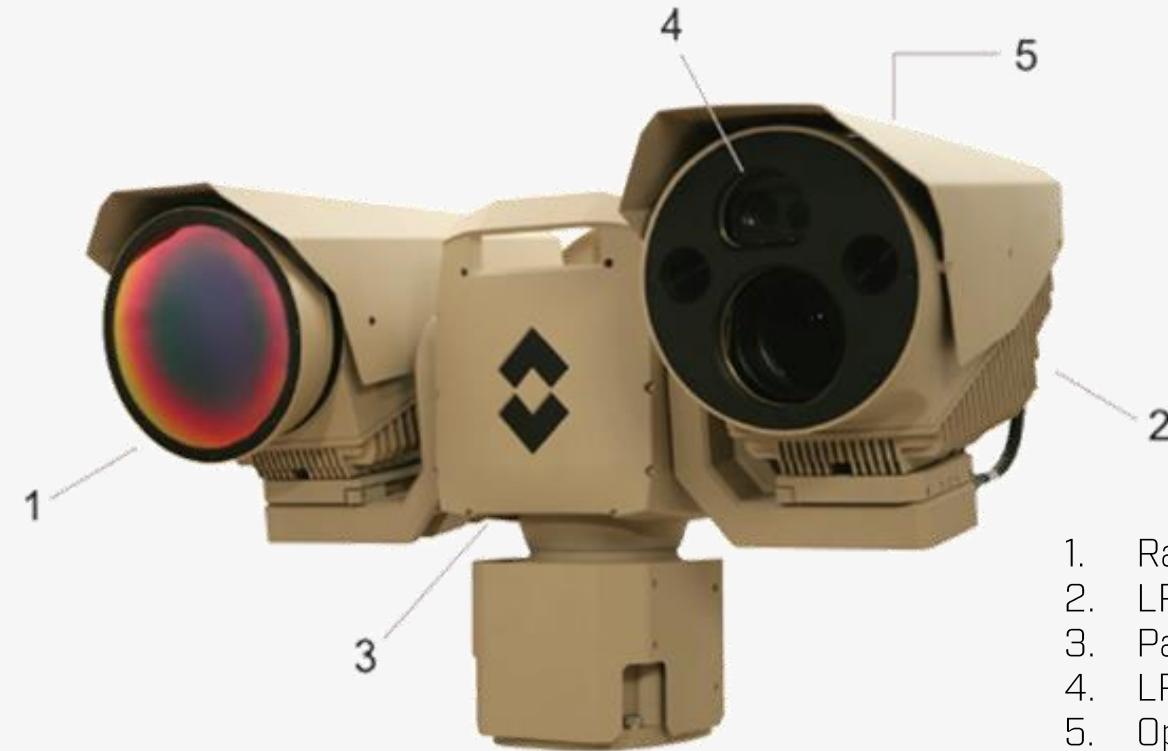
Radar R20SS

Athens March 2018

Ranger HDC MS



Ranger HRC MS



1. Ranger HDC
2. LR-HDTV
3. Pan & Tilt
4. LRF
5. Optional GPS, DMC

Additional features:

HD Thermal and HD/ Full HD Visible
Turbulence Filter on both channels

Fog Filter on TV camera

NEW Linear cooler with 20 to 25 k hours MTBF
And more...

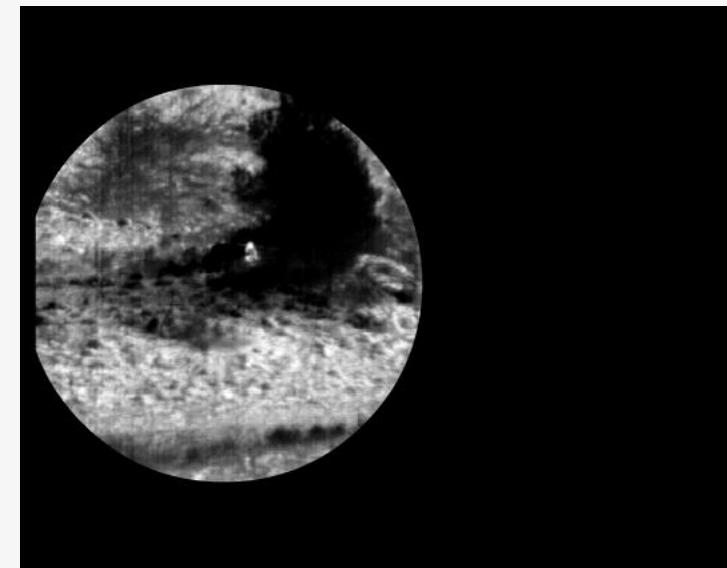
Ranger HDC High Definition Thermal camera

1280x720 – better situational awareness!

Standard Resolution



High Definition



Maintain situational awareness!

Ranger HDC High Definition Thermal camera

Efficient use - 1280x720 - twice the coverage at any given range!

640x480 resolution



High Definition



Embedded MERLIN® ASX Turbulence filter in HDC thermal camera



...See targets through heat turbulence!

Embedded MERLIN® ASX – Turbulence filter in LR- HDTV



...See targets through heat turbulence!

Fog filter in HDC MS - HD LR-TV 1000

13:38:37:052

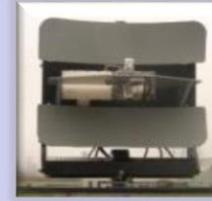
 FLIR

...See targets through fog and low light!

Combination of Merlin ASX and fog filter in HD LR-TV 1000



Wide Range of FLIR Radars

R1-R2-R3	R5	R3D	R5D	R6SS	R20SS- R20SS Coastal
					
700 1,400 2,800	5,000	6,500	10,000	15,000	30,000 60,000
Instrumented Range (meters)					



- Designed specifically for force protection and perimeter Security applications
- All Radars are interoperable
 - All ICD-0100 compliant (same Ethernet connection with XML software)

Radar evolution over the years

- 1st Generation radars:

Traditional Pulse Doppler radars

Radar antenna had to physically rotate in order to make its 3° narrow beam to cover the area of interest.

Track update rate: typically 10s

- 2nd Generation radars:

E-Scan radars

Radar antenna did not need to rotate but its narrow 3° beam was electronically moved from one side to the other in order to cover the area of interest.

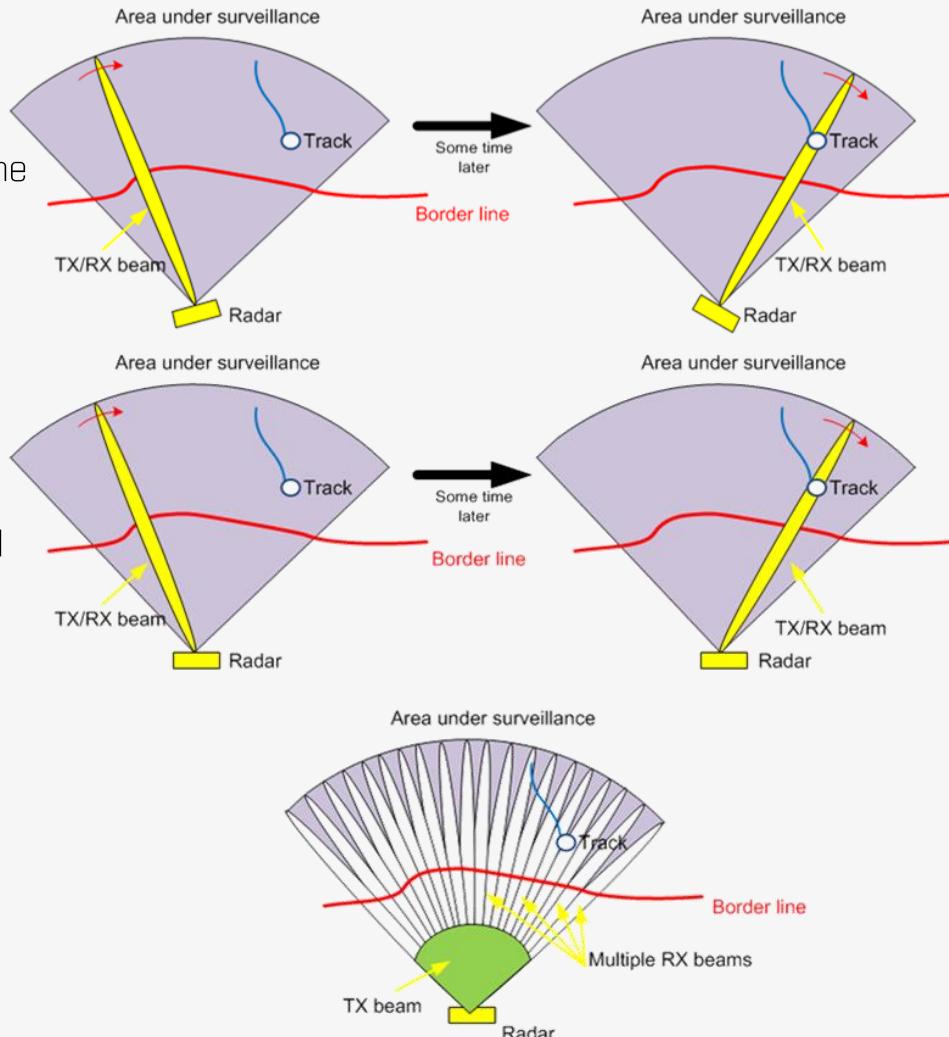
Track update rate: typically 5s

- 3rd Generation radars:

Digital Beam Forming (DBF) FMCW radars

Radar antenna does not need to rotate in order to cover the area of interest, it just Stares While Scan (SWS) at a full 90 sector 2 times per second.

Track update rate: 0.5s (20 x to 50x faster than conventional Pulsed Doppler radars).



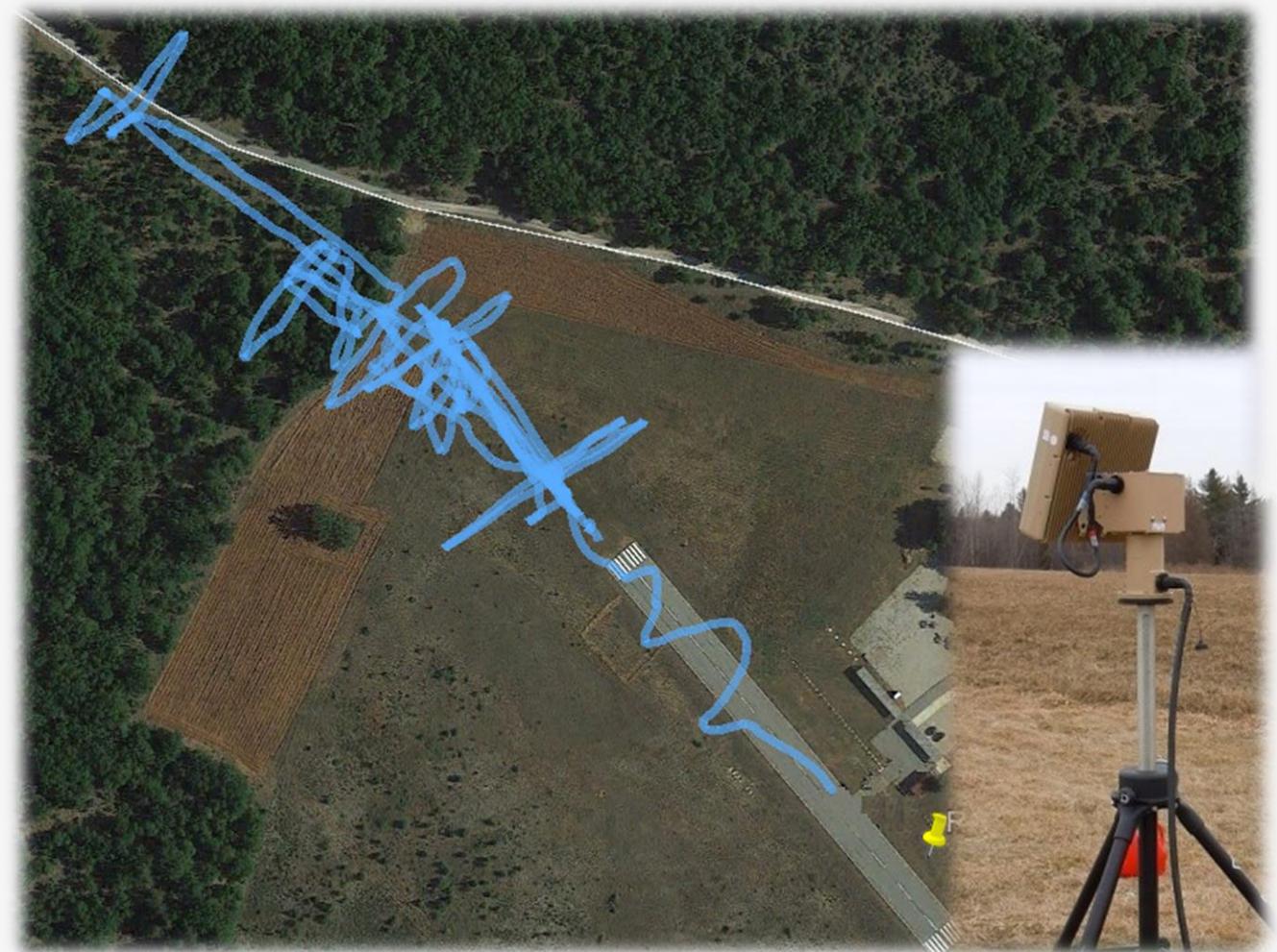
R6SS and R6SS-U UAV Detection

Parameters	R6SS	R6SS-U
Instrumented Range		15,000 m
Radar Targets		Persons, UAS, boats, vehicles
Detection Range	Person 6 Km Light Vehicle 10 Km Large Vehicle 15 km	Mini UAS 1.8 km Person 2.5 Km Light Vehicle 5.5 Km
Minimum Detection Range		10 m
Scan Sector	+/- 45° (fixed) – 360° with P/T	
Vertical Coverage	> 4°	>40°



R6SS and R6SS-U

- Micro UAS detection is very challenging
 - Very low RCS
 - Great agility
 - Short range, large elevation angle
- R6SS-U detection performance
 - ≥ 1000 m on 0.01 m² RCS (micro UAS)
 - ≥ 1800 m on 0.1 m² RCS (mini UAS)
 - ≥ 3200 m on 1 m² RCS (small UAS)
- Vertical coverage ≥ 40 degrees
 - Achieved with alternate antenna version
- Accuracy
 - 3m in range
 - 0.2 degrees in azimuth
- Scan
 - electronic @ 2Hz for 90 degree sector
 - 30 RPM for 360 degree surveillance (in-development)



R20SS Features

- Ranges
 - Pedestrian 10 km
 - Light Vehicle 20 km
 - Heavy Vehicle 27 km
- Coastal version (Algorithm adapted for over water)
 - Jet Ski 12 km
 - Small Boat 20 km
 - Large boat 35 km
 - Tanker 55 km
- Fast detection and tracking
 - 2 Hz track update rate
 - 3 to 10 sec typical track initiation time
- Very low Minimum Detection Velocity (MDV)
 - < 0.1 m/s capability
 - Detects low speed targets (including crawlers) from virtually any direction
- Low False Alarm Rate
 - High resolution and 2 Hz update rate results in low false alarm rate



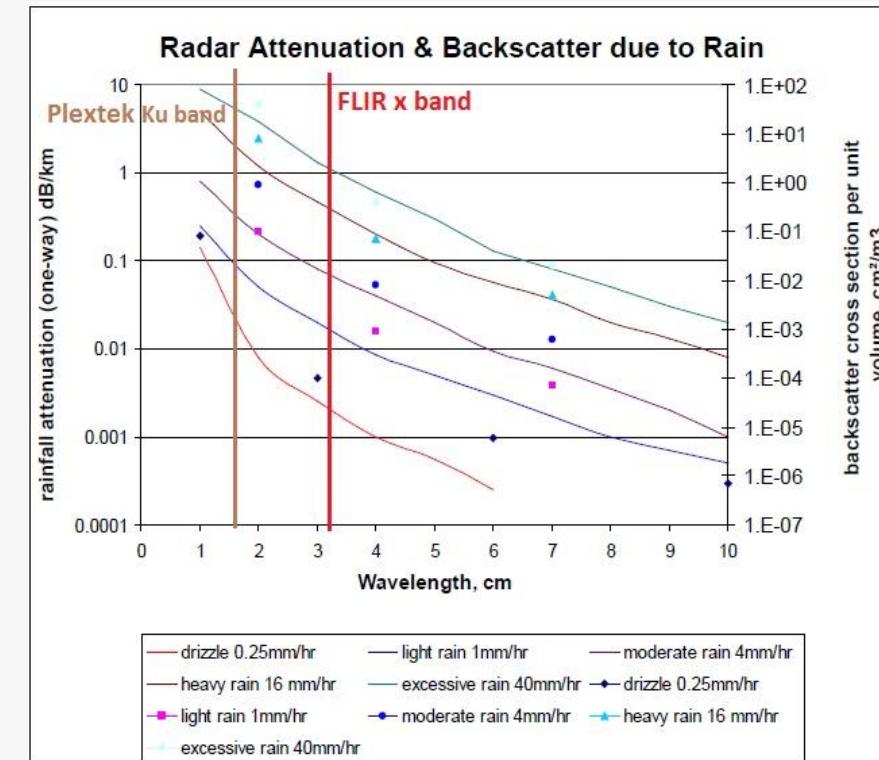
Radar with P&T Vs Multi-panel Radar



Radar frequency X Vs Ku band

X band radar frequency has much better performance than Ku band Radar frequency in bad weather conditions

In moderate rain of 10mm/h, X band has a 2-ways attenuation of 0.26 dB/km while Ku band has 1.4 dB/km of attenuation (which is a significant amount in dB scale, where 3 dB means double power). For a target at 10 km, at 10 mm/hr, 2-way attenuation at X band is 2.6 dB vs 14 dB at Ku band; 11.5 dB is a huge difference! Moreover, Ku band radars receive 4 x more backscatter (clutter) from the rain than an X-band radar.

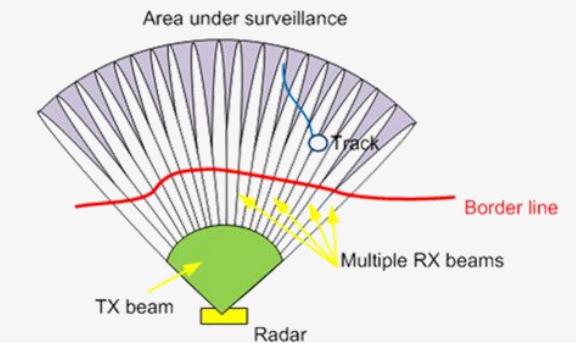
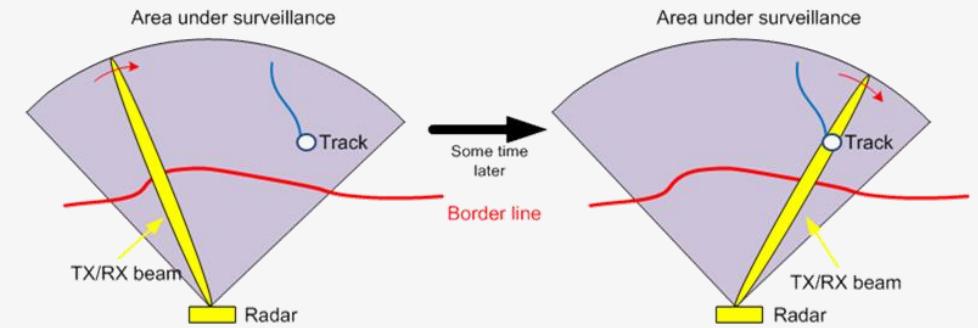


Red line: 9GHz rain attenuation at 3.19cm wavelength. Brown line: 16.7GHz one (1.79cm wavelength)

Digital Beam Forming DBF Vs e-scan

Transmit beam covers a 90° sector

- Modern DBF approach makes for multiple narrow simultaneous and continuous (FMCW) beams with ultralow side lobes
- Receive beams **stare** instead of scanning to allow long time on target and very fine Doppler resolution for very low MDV
- All Receive beams are updated at a rate of 2 Hz, or approx. 20X faster than older scan technology
- Fast update rate allows fast track initiation
- DBF solves the X vs. Ku band trade-off, since **staring** provides long time on target: 1- Ku-band not needed for low MDV and 2.- X-band can be used for minimal weather impact on performance



Scan rate (2Hz R20SS Vs 1 Hz Blighter)

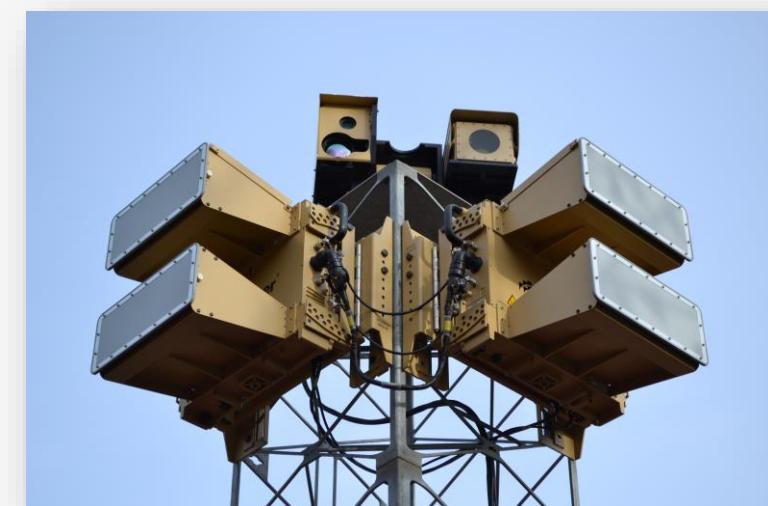
Less False alarms. While fastest Blighter scan rate is 1 Hz, all FLIR radars like R20SS and R6SS have a scan rate of 2 Hz which allows to minimize false alarms, as each target is analyzed every 0.5 seconds and not every 1 second (or even every 27 seconds, which is the slowest Blighter scan rate for 90°).

Better MDV (Minimum Detectable Velocity). When protecting a border, radars must detect targets at large azimuth angles that have low apparent speed to the radar and require more observation time for detection. The Digital Beam Forming architecture of the R20SS solves that problem by having multiple simultaneous beams. Because the beams don't have to scan, they just stare at targets with a long observation time which is exactly what is required to detect targets with low radial speed. Better MDV (Minimum Detectable Velocity) performance means better probability of detection and better protection of the border.

Dimensions



For a vehicle installation, the space available use to be very limited. Additionally, higher weight would require more heavy and complex elevation structure



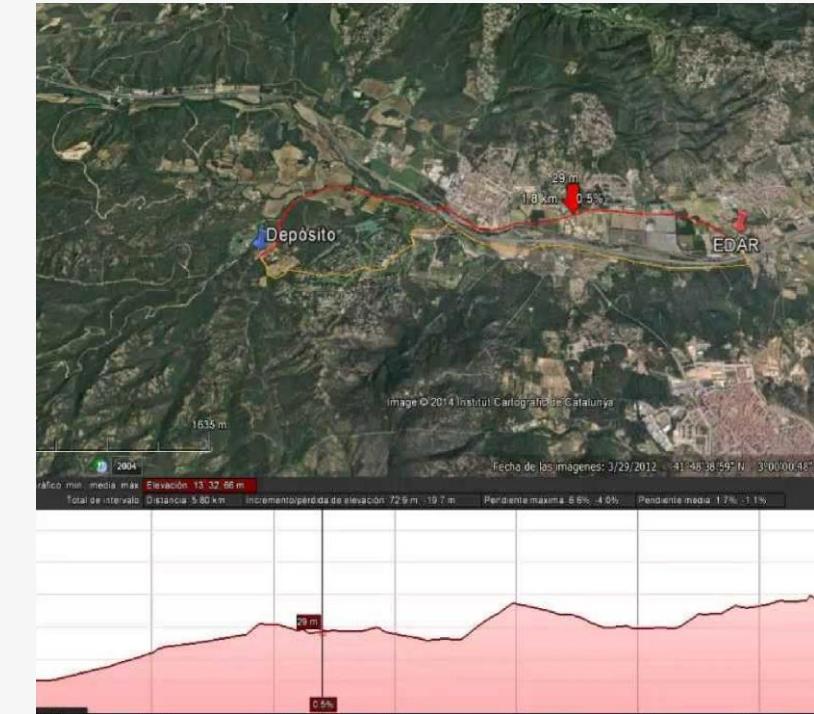
Coverage



Just Radar $90^\circ \times 5^\circ$ (HxV)
With P&T $360^\circ \times +/-90^\circ$ (HxV)



Just Radar $90^\circ \times 20^\circ$ (HxV)
With 442 ant $360^\circ \times 20^\circ$ (HxV)



Due to the different scenario where a mobile surveillance vehicle would be used, depending on the terrain orography the 20° , fix elevation would not be enough for monitoring a mountain skirt or a valley

MTBF and maintenance

For a 360 degree coverage, the Blighter 442 model (includes 4 panels) has a MTBF of 16250h.

For a 360 degree coverage, the R20SS model (includes P&T) has a MTBF of 18300h.

Having no moving parts , does not mean a better MTBF.

Both solutions are maintenance free

R20SS - Why it's better

- Next generation Digital Beam Forming technology
- Better false alarm rate
- Better range resolution
- Faster detection and track initialization
- Faster scan rate
- Much better at tracking low velocity targets
- X-Band operation for better rain penetration and clutter rejection
- Detects and tracks more targets - up to 512 simultaneous targets
- Fully adaptive and easy to integrate





GOVERNMENT & DEFENSE

Examples of installation

TacFlir + RADAR INSTALLATIONS ON VEHICLES





GOVERNMENT & DEFENSE

Airborne solutions

Star SAFIRE HD - System Family



Family of Airborne ISR & Targeting Systems

230HD



260HLD



275HD



380HLD



380HD



380HDc



20 Years of experience with over 5000 SAFIRE systems fielded

Star SAFIRE 380-HD - High Performance ISR System



Star SAFIRE 380-HD

Modest 38cm diameter turret is only 47cm tall & weights less than 45kg

Single Line Replaceable Unit

Self-contained unit includes built-in geopoint navigation system (GPS, IMU) & advanced real-time image processing in hermetically sealed MIL-qualified turret assembly

High-Def Mid-Wave IR / Thermal Imager

True HD native resolution with 1.3 megapixel Focal Plane Array with extreme long range 1500mm telescope

Laser Payloads

Install up to three separate laser payloads for range finding (eye-safe), pointing / marking targets & covert infrared illumination of the scene

High-Def Color & Short-Wave IR Cameras w/ Shared Aperture Long Range Telescope

Large scale 2-megapixel HD 'broadcast-quality' color sensor with 120x 5-field of view telescope also supports high resolution SWIR imaging

High-Def Low Light Color Camera

High sensitivity CCD provides clear full-color & near-IR detail under moonlight conditions with 30x magnification continuous zoom telescope optics

Advanced Image Processing

- *Colour image blending* combines two sensors into one image

IR+EO & IR+SWIR

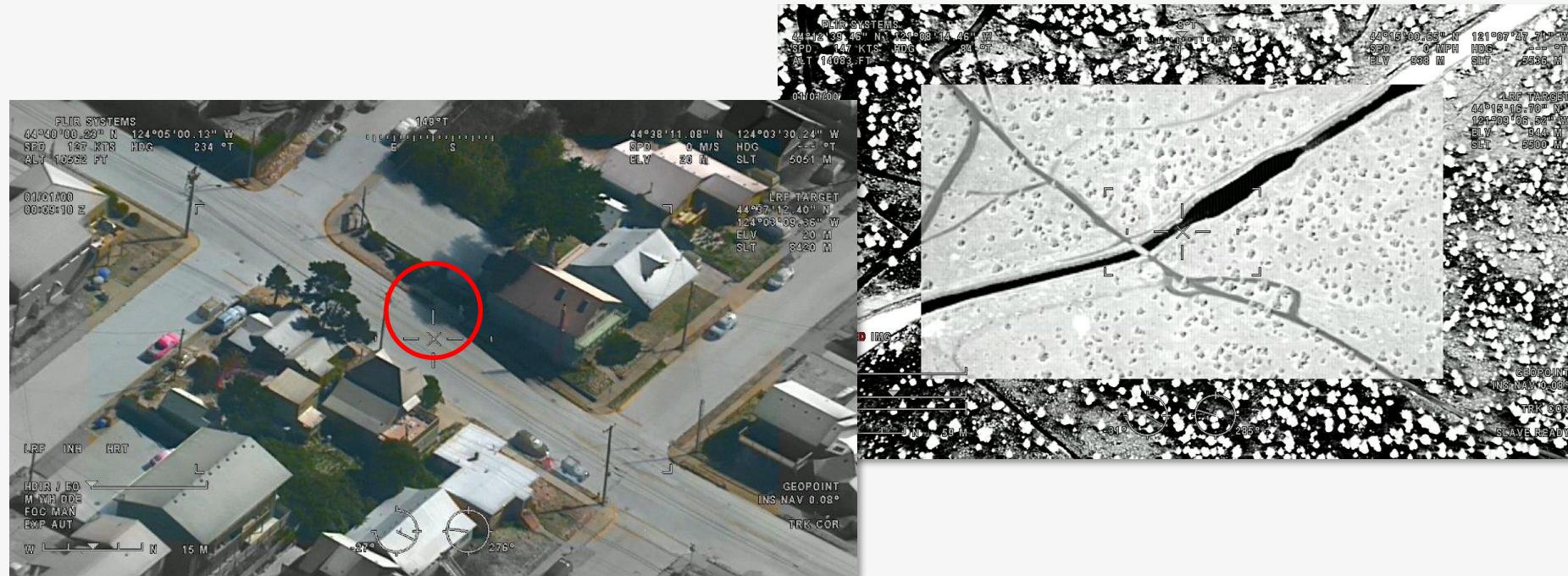
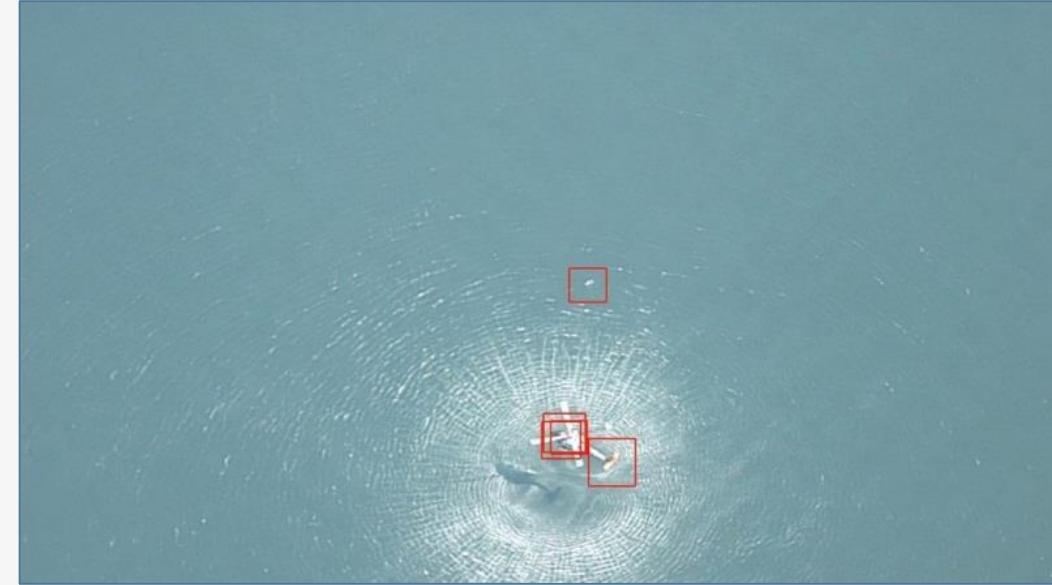
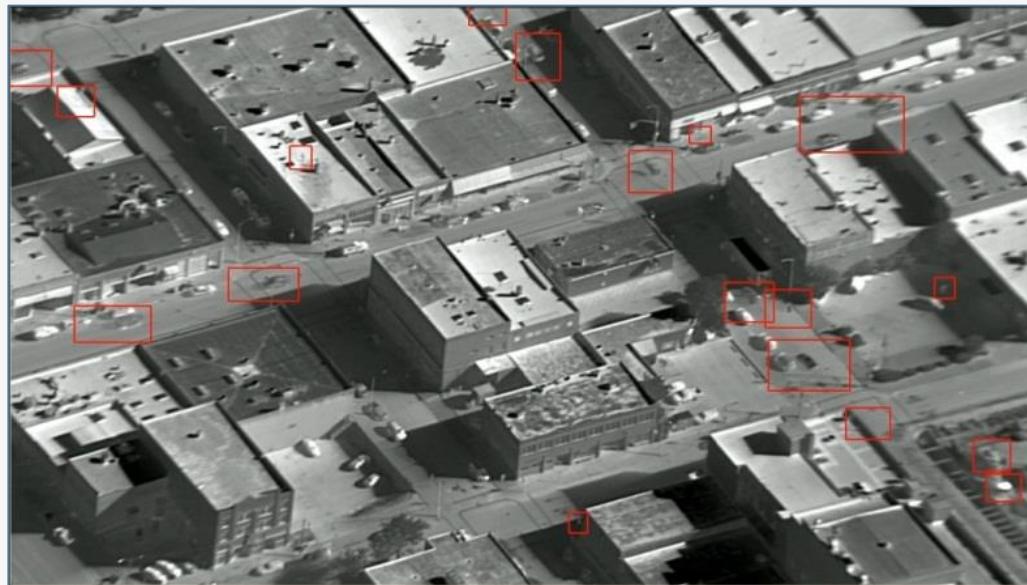


Image blending of IR with color (left) & IR with SWIR (right)

Automated Target Detection

FLIR introducing fully integrated MTI Moving Target Indicator functionality



MTI in action:

Scenes from an actual MTI trials from over-watch position. Land mode (on left) uses color cues to alert operator to people and objects as small as 2x2 pixels. LSA Life Saving Appliance mode (on right) detects diver in water by finding the faint color tint used for the life jacket and immersion suit. Diver was impossible to detect manually due to white-caps from rotor downwash. Cues also act as stimulus to help reduce operator fatigue.

MERLIN Life Saving Appliances Detection LSA

FLIR





GOVERNMENT & DEFENSE

FLIR Unmanned Aerial Systems AS

Product Lines



Black Hornet

- Common Nano Air Vehicle
- Reduced Logistics

PRS



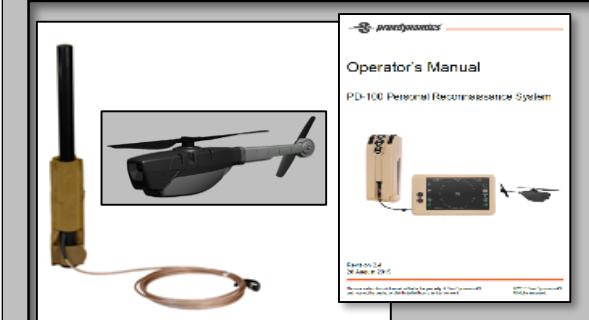
- Personal
Reconnaissance System
- Designed for dismounted
soldiers
 - Immediate airborne
reconnaissance
 - Easy to operate
 - Silent and covert

VRS



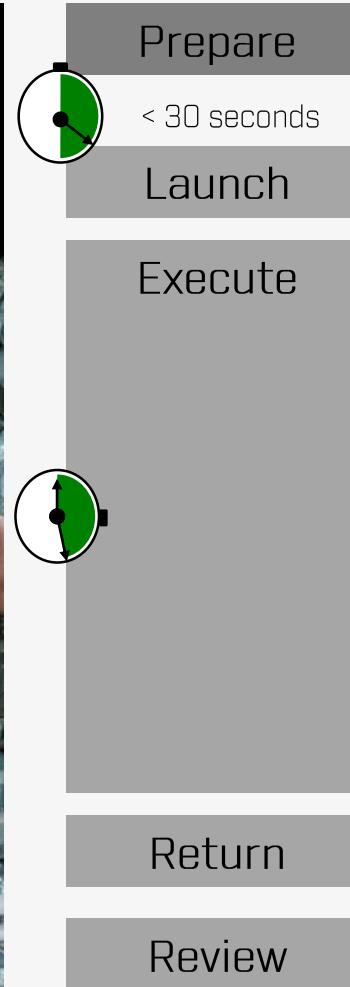
- Vehicle
Reconnaissance System
- Vehicle commander organic
airborne asset
 - Easy to mount and integrate
 - Launch from hatch
 - In development

CLS



- Contractor
Logistics Support
- Training and training aids
 - Documentation
 - Ancillary equipment
 - Spares
 - Repairs and support

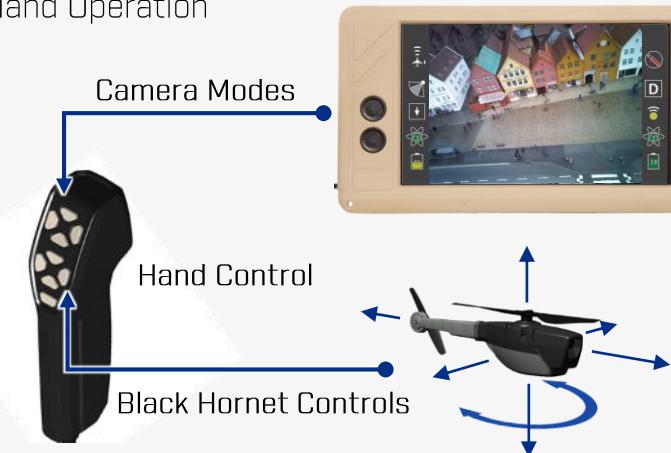
System Deployment



- None Required
- Mission Plan may be Generated
- Activate Black Hornet inside Base Station

- Launch from any Stance or Position
- Auto Takeoff and initial Climb

- Simple to Use Advanced Autopilot
- Manual and Auto Modes
- Single Hand Operation



- Automatic Return and Land
 - Place inside Base Station for Automatic Recharge
- Video and Snapshots
- Metadata

The Black Hornet PRS is **Immediately Available and **Easy to Use****

Application during operation

Mission Objectives

- Situational Awareness
- Reduce Own Risk
- Reduce Collateral Damage
- Save Lives

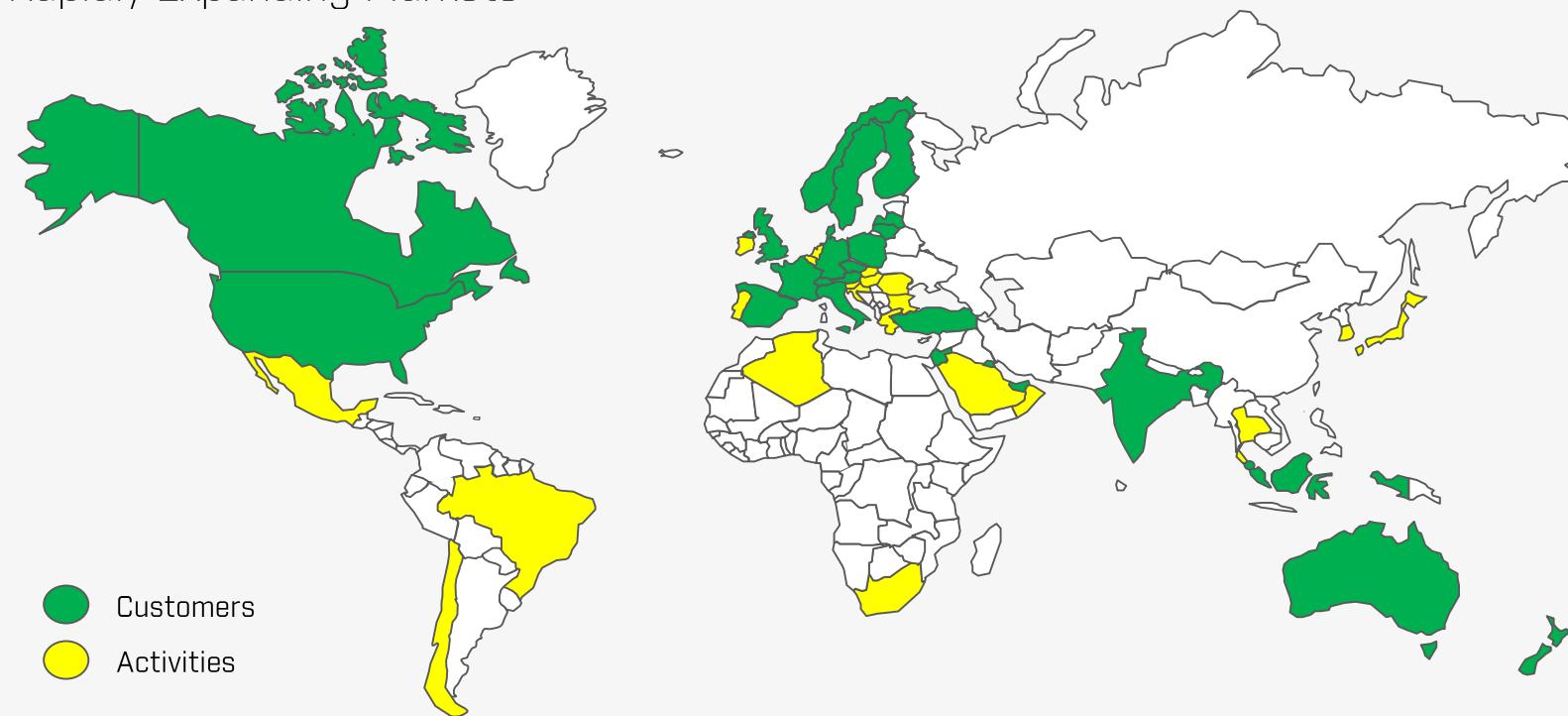


Typical Tasks

- Reconnaissance
- Surveillance
- Compound Clearance
- Target Location
- Object Identification
- IED Counter Measure
- Force Protection
- Crowd Control

Markets

- World Wide Sales and Marketing Activities
- More than 700 Systems and 5,000 Black Hornets in 30 Countries
- Rapidly Expanding Markets



Black Hornet Summary

- The PD-100 PRS with Black Hornet 3/3T use Combat Proven Technologies
- Increased Lethality, Survivability and Mobility for the Dismounted Soldiers
- Tactical Decision Kit
- Smallest, Lightest and Most Covert UAS in the World
- Immediate Squad Organic ISR Capability
- Operated by Non-Specialists
- Minimal Airspace Limitations
- Roadmap for Capability Growth





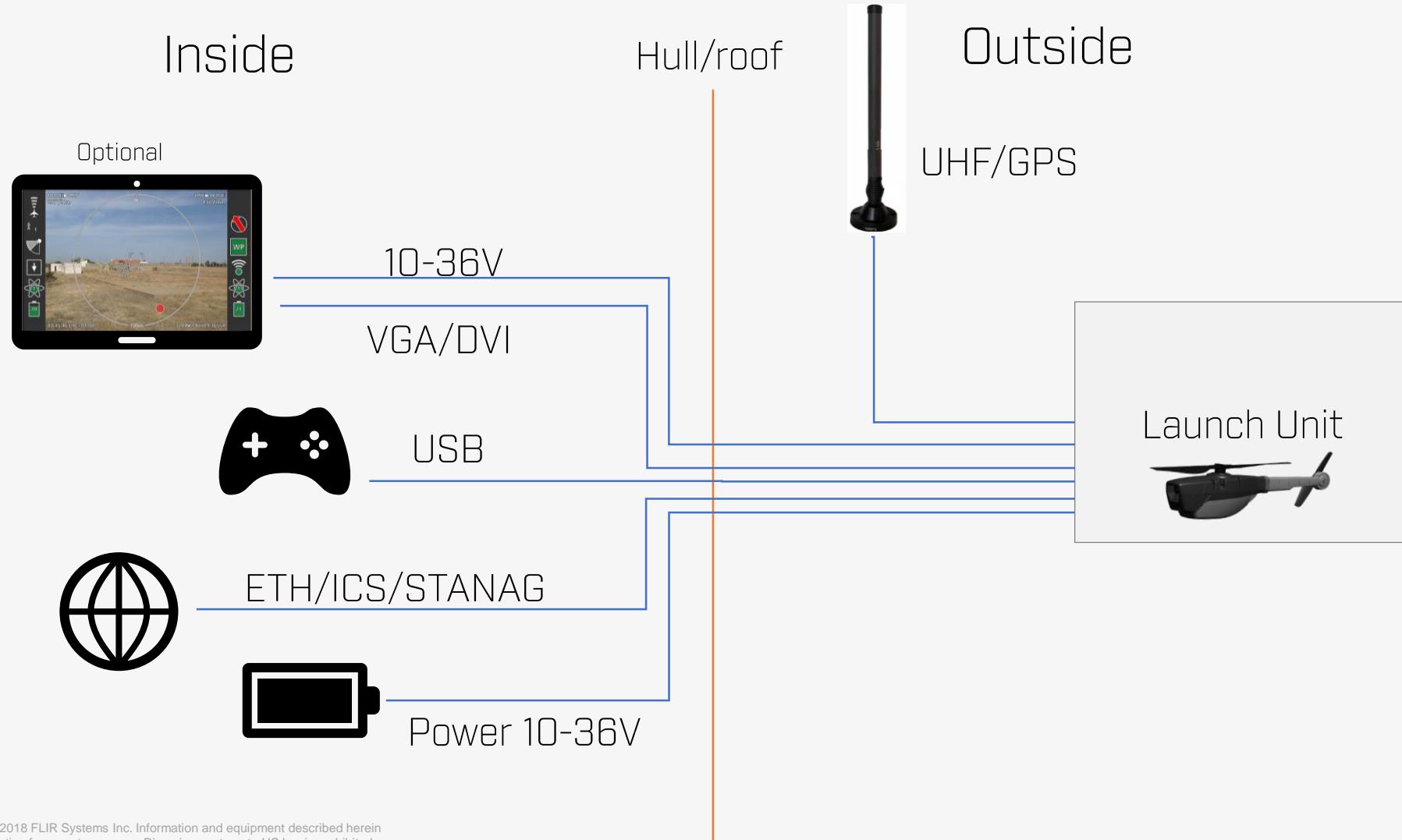
GOVERNMENT & DEFENSE

Vehicle Reconnaissance System

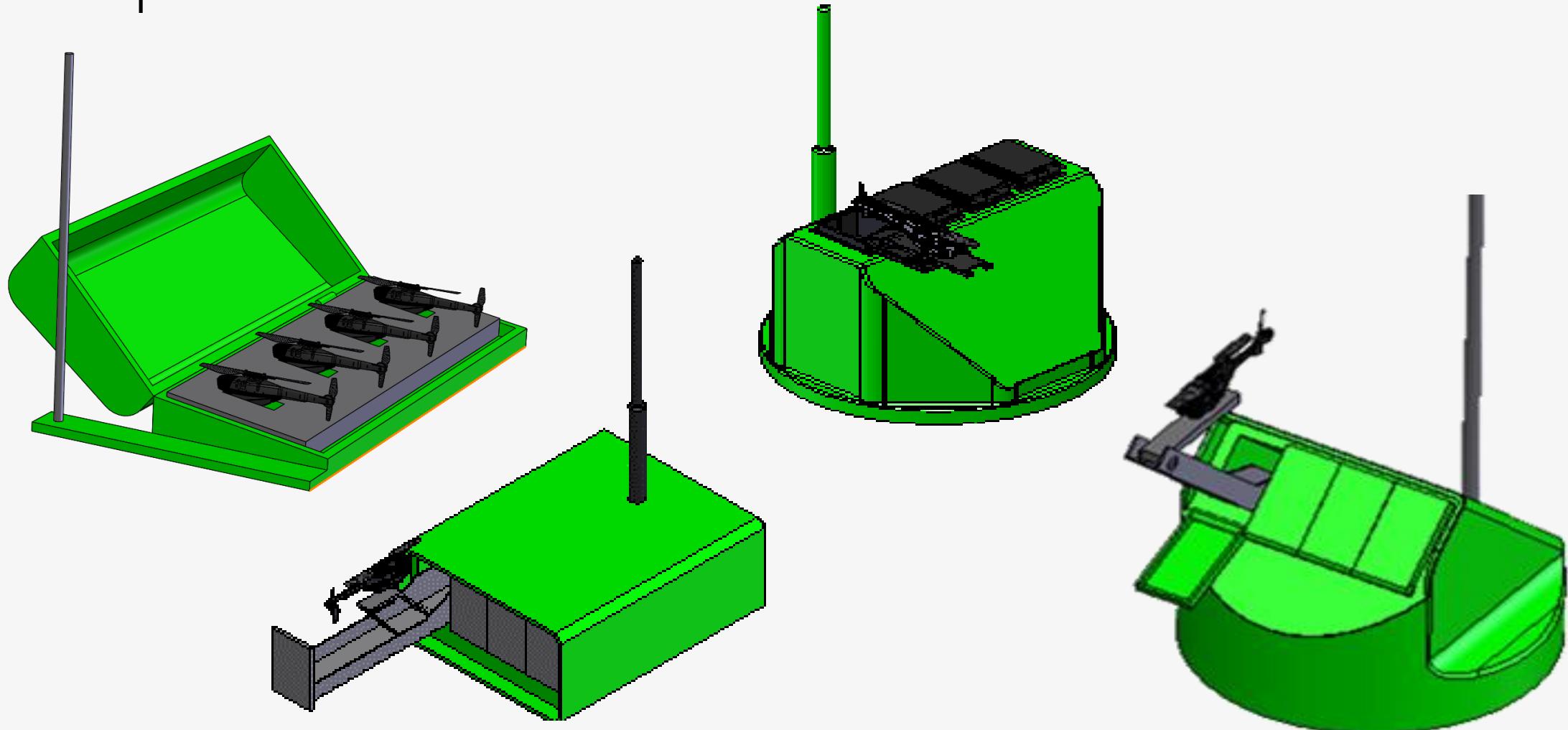
Black Hornet Route Recce



Black Hornet VRS System

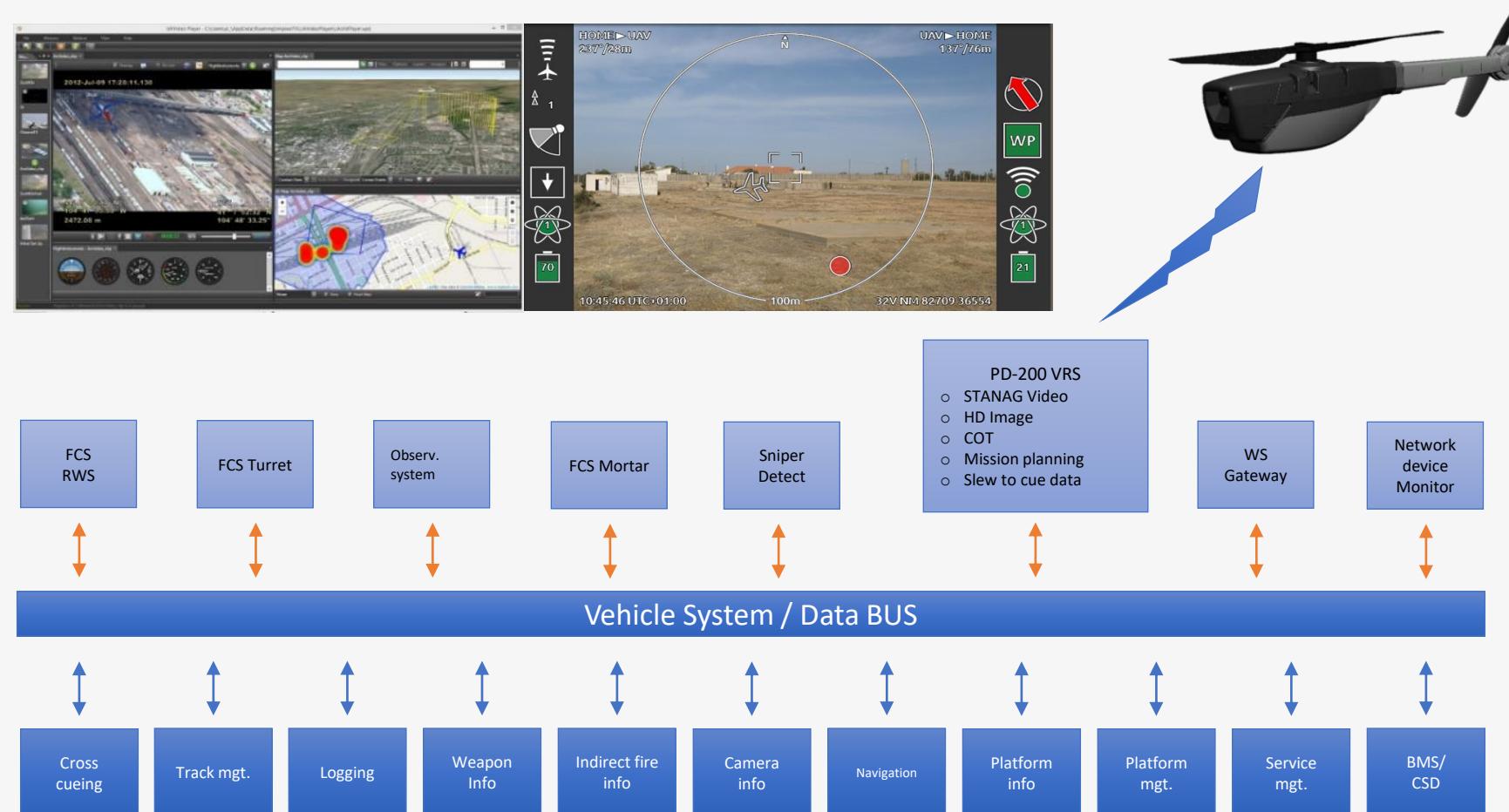


Concept

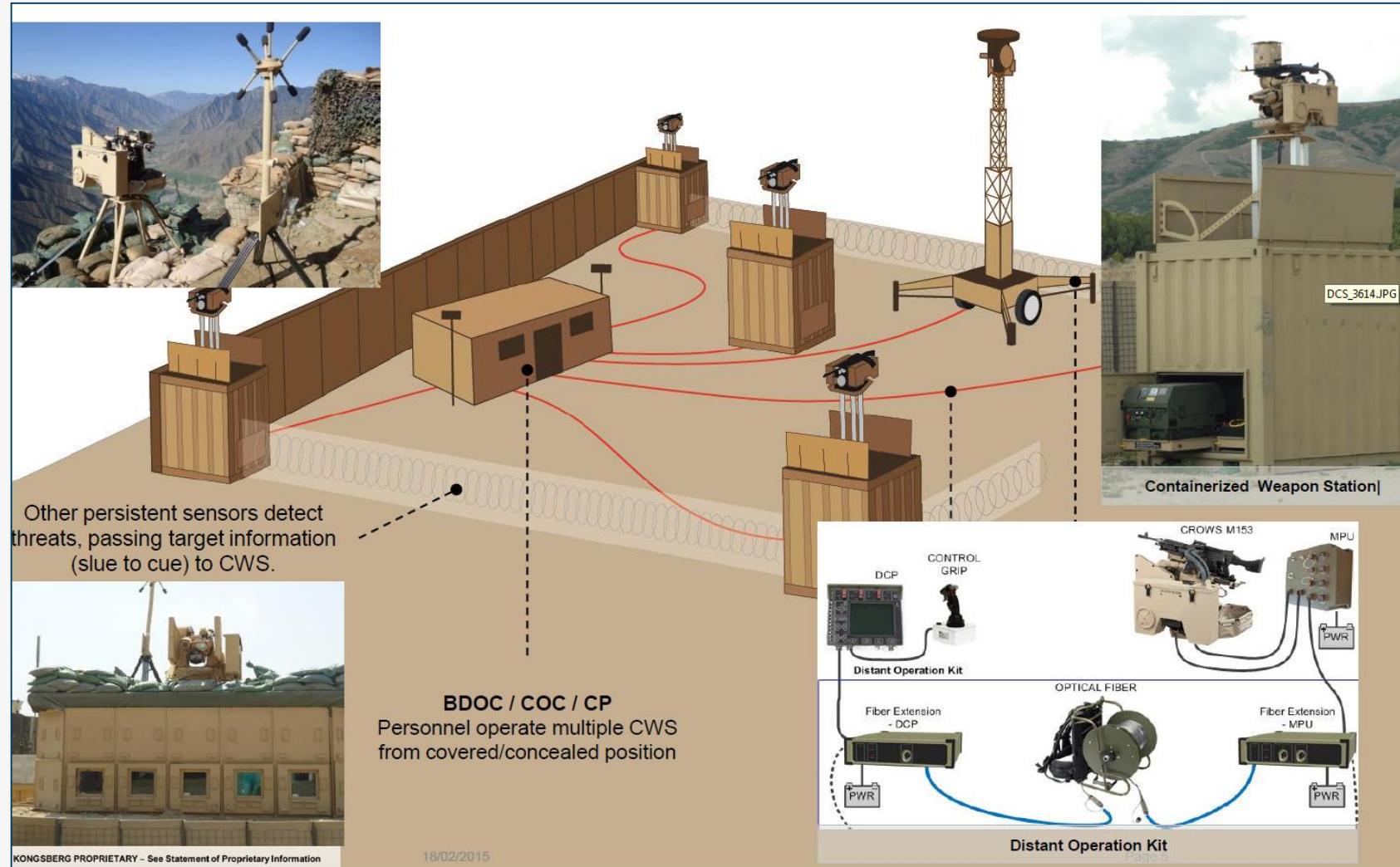


Black Hornet VRS Example

Black Hornet can be made available to the Vehicles sensors & Weapon System.



Camp protection



Camp protection

- FLIR LTV vehicle with sensors and BH VRS. ICS from KDA is also planned to be integrated.



Effect of an elevated sensor



Effect of an elevated sensor



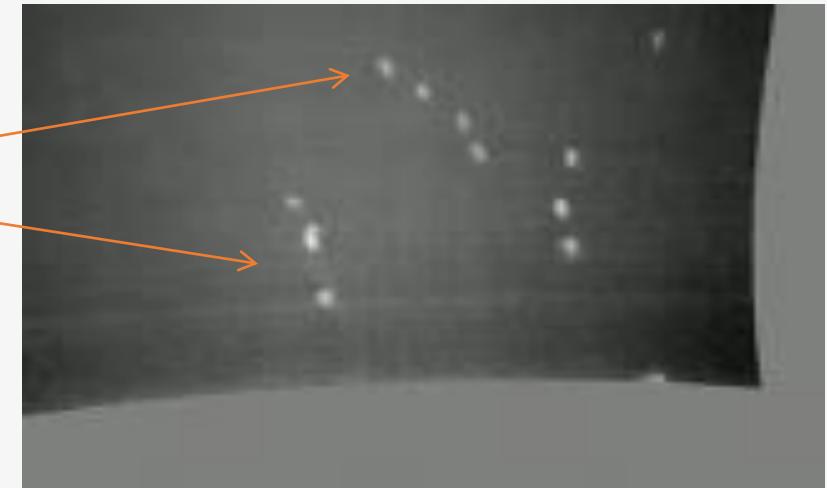
Day Camera



Thermal Camera



QRF







The World's Sixth Sense®