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Falcon Shield Countering the Drone threat



11th September 2019



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Aim

- **The aim of this presentation is to highlight the threats posed by accidental, malicious and targeted Class 1 drone activity in both the Civil and Defence sectors.**
- **Present the Leonardo Falcon Shield system, capable of providing a Detect, Track, Identify and Defeat capability to counter this threat.**



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Content

- The Threat
- Overview
- System Integration
- System Functionality and Operation
- Summary



London Gatwick

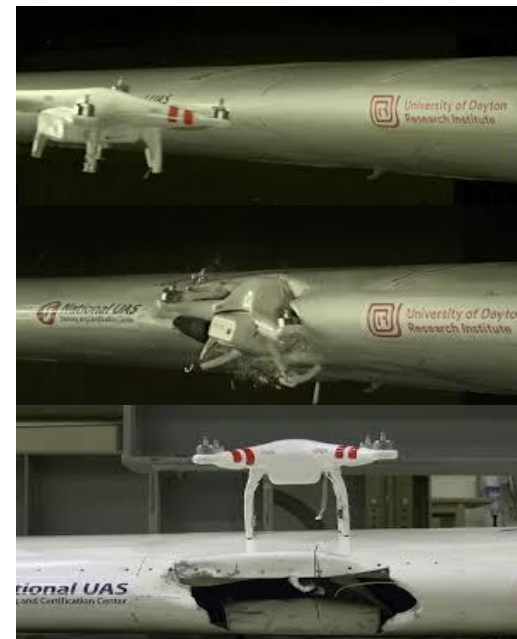




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The Threat

- Defence
- Civil
- Not all drones are bad.....





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Falcon Shield

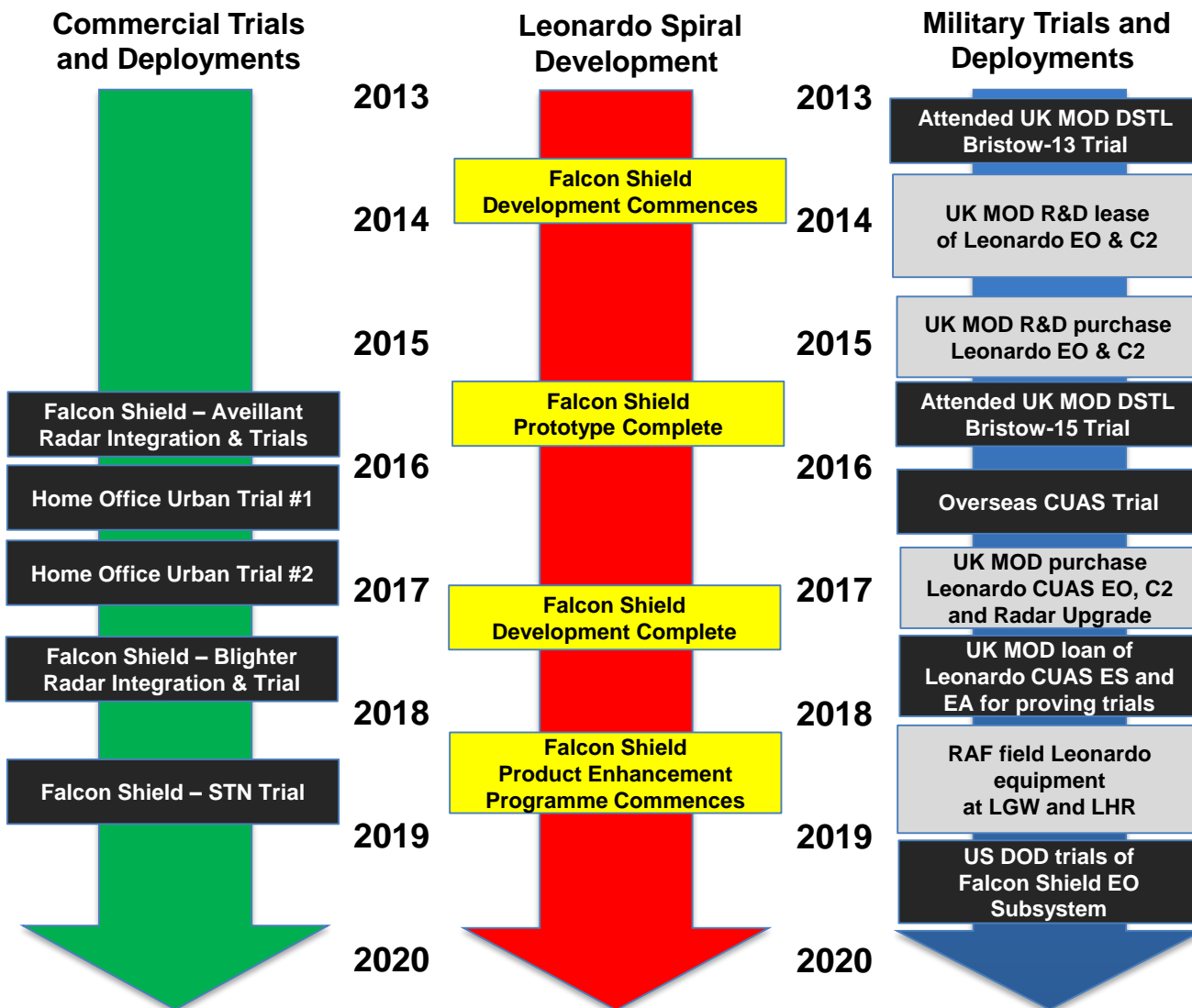
- Falcon Shield is Leonardo's Counter-UAS/Counter-Drone System.
- Falcon Shield represents the baseline capability for Planning, Detection, Tracking, Identification and Mitigation of the Drone threat for both the Civil and Defence sectors.
- Leonardo's system solution is modular & scalable and we are agnostic with respect to the integration of specific detection equipment.
- Leonardo possesses the necessary technical expertise in depth within all of the key technology domains necessary to intelligently configure and integrate C-UAS/Counter-Drone solutions according to specific customer needs.
- Further dialogue is welcomed.





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Development and Deployment Heritage



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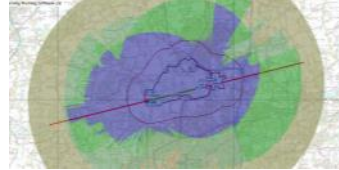
Falcon Shield – Typical Configuration

Leonardo Falcon Shield Partners & Suppliers

Planning & Assessment

Falcon Shield Deployment

- SW planning tool to facilitate system configuration & optimisation of laydown
- Optimises operational DTID coverage
- Facilitates targeted search for Drone GCS.
- Provides central database for the recording of search report data.



Detect (Passive)

Electronic Surveillance

- **Metis Skyperion ESM**
 - Detection and location of Drone / GCS RF emissions.
 - 30MHz to 8GHz coverage of Drone bands.
 - Geolocation of threat via distributed sensor arrays.
 - Simultaneous detection of Drone and GCS.
 - Classification of selected COTS Drones.
- **Alternative ESM options available**



Detect (Active)

Radar

- Radar option available and selected based on deployment needs and constraints
- Recommended / preferred radars
 - **Aveillant - Gamekeeper 16U**
 - **SRC - LSTARv4 or R1410 Gryphon**
- High probability of detection from 500m to >5km
- **Alternative radar options available**



Track & Identify

NERIO-ULR EO Tracker

- Long-Range positive drone identification & automated tracking
- High Definition TI & Colour Day TV sensors – Low maintenance.
- 24 hour, all weather operational capability.
- Automated drone acquisition from the Detect function.
- Digital interfaces for threat data storage (evidential data) and interface into broader network infrastructures.



Integrated User Interface

Falcon Shield C2 Software

- Automatic system management of sensors & effectors providing low user workload & system cost of ownership.
- Sensor data association, track formation and threat assessment.
- Tactical situational awareness via Geospatial Information System.
- Network interfacing and management.
- Event and data recording for evidential purposes.



Optional Capability

Defeat

GUARDIAN-EA

- Electronic denial of drone control, video datalink and GNSS.
- Reactive RF spectrum jamming (in conjunction with ES)
- 400Mhz to 6GHz capability to cover all Drone control bands.
- Automatic tracking - slaved to EO system
- Narrow beam with low collateral jamming effect.





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Falcon Shield – Typical Performance

Integrated Functionality & Layered Capability/Performance against Class 1 UAS

Radar



ESM



EO



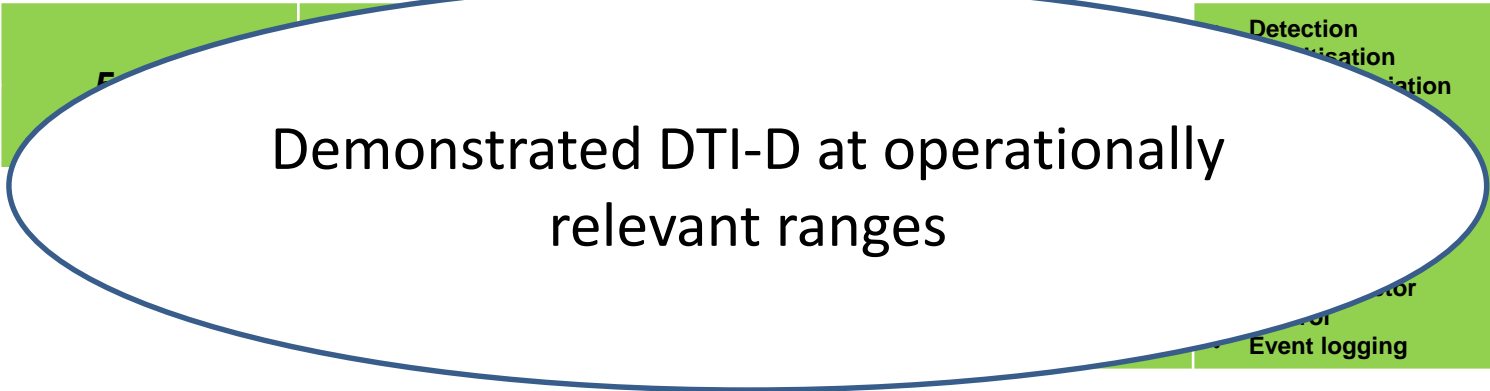
EA



C2



Detect
Track
Identify
Defeat
(Optional)



Demonstrated DTI-D at operationally relevant ranges

Capability Highlights:

Precision tracking in range for 3D Geolocation in Landing and Take-Off flight paths

Classification of Uplink and downlink datalinks and Identification of some specific drone types

Long range threat classification/identification and precision tracking in azimuth and elevation for 3D geolocation

Directional narrow spectrum electronic Countermeasure with low collateral effect

Single user distracted operator providing low workload and ease of employment. Highly automated requiring only operator 'decision'

System Integration



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Systems Integration

- **Primary Systems Drivers**
 - Operational Security
 - Sustain the ability to deliver safe and secure operations and Freedom of Manoeuvre
 - Integration with and provision of Alerts and Situational Awareness to Ops staff
 - Recognised Air picture, Counter Surveillance planning
 - Ability to support future DDS enhancements
 - Enhancement or addition of further sensing, processing and Command and Control capabilities
 - Networking to Central DDS Centre
 - Single 'Distracted Operator'
 - Minimal operator workload, high autonomy, decision based operator interaction
- **Exploiting Leonardo CUAS/DDS capability**
 - Leonardo involvement on CUAS / DDS since London Olympics 2012
 - Delivery and loan of equipment and support to Civil UK CUAS Operations
 - Configuration of existing Falcon Shield CUAS
 - Variant of CUAS system previously supplied to UK MOD and Airport Operation feedback
 - Exploits Modular Open System Architecture (MOSA) of Falcon Shield
 - Leverage off ongoing CUAS / DDS activities
 - UK MOD Programme
 - CPNI and other Government Agency consultation and assessment
 - Company Private Venture investment programme
 - Leveraging off Leonardo established supply chain and network
 - Prior integration with other CUAS / DDS elements

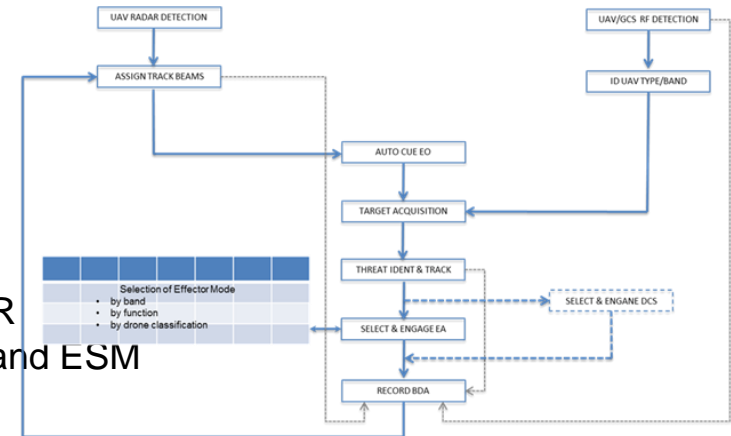
System Functionality and Automation



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Falcon Shield Systems Functionality and Automation

- **Falcon Shield is designed to be configured for either interactive or semi-autonomous operation**
 - Semi-autonomous mode provides auto-alerts with only Key Decision operator input.
 - Interactive mode enable component of Falcon Shield to be used for Auxiliary (secondary) tasks.
 - Does not detract from primary Drone Detection function.
- **Operator Key Decisions**
 - Accept or Reject Alert
 - On Accept then issue Alert Report
- **C2 Sensor Data Processing**
 - Sensor Data Association for increased P_D and minimal FAR
 - Embedded Detection / Classification processing in Radar and ESM
 - Machine Learning & Rule Based processing algorithms
- **EO Processing**
 - EO Auto-Acquisition
 - Machine Learning & Rule Based processing to minimise operator workload
 - EO Auto-Track
- **Auto-reporting**
 - Drone Alerts automatically transmitted / relayed on 'Accept'
 - C2 DDS Common Operating Picture could be repeated in a formation ops room or control tower equivalent

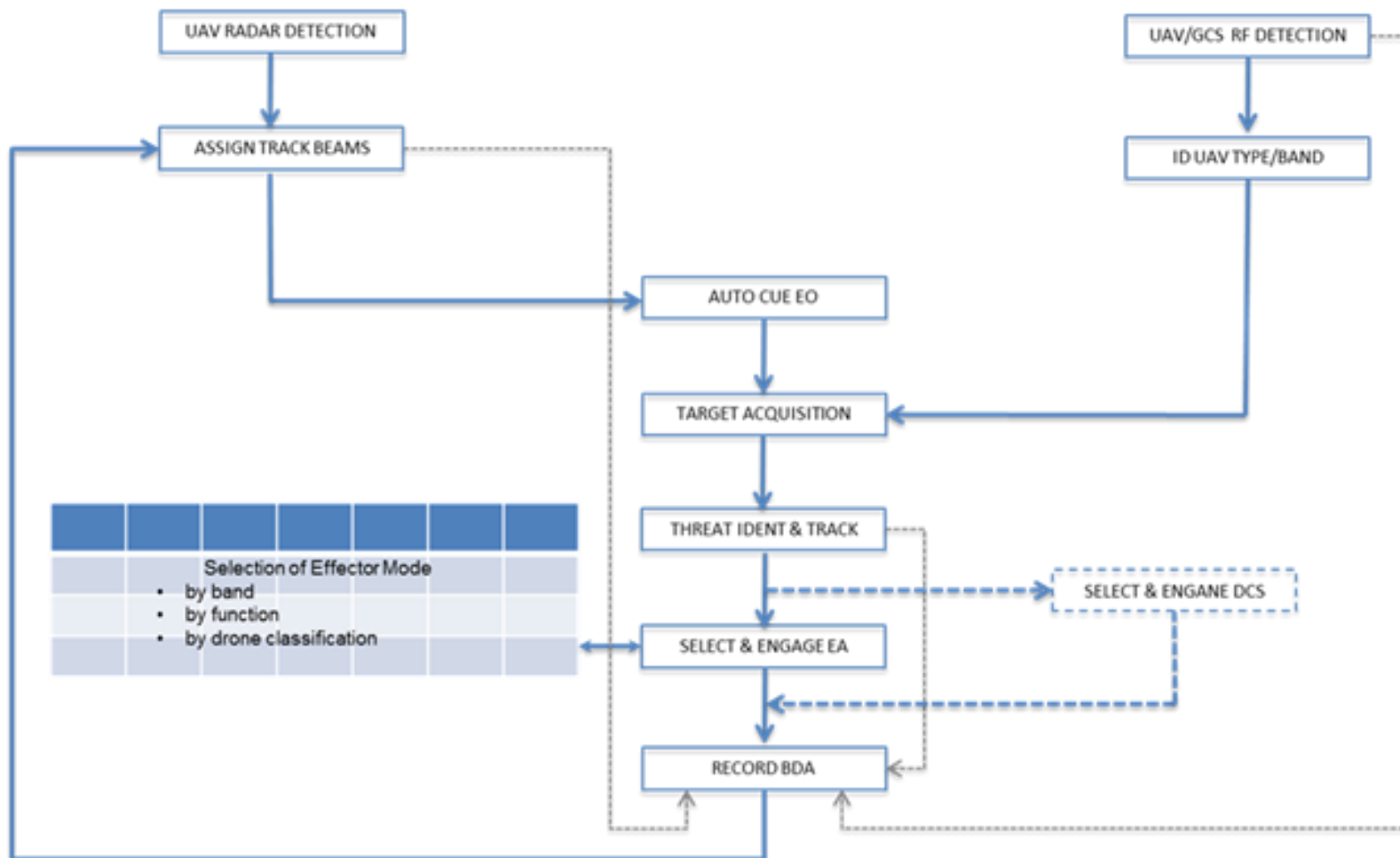


Simplified CONUSE Process Chart



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Falcon Shield Concept of Operations



System C2 and User Interface

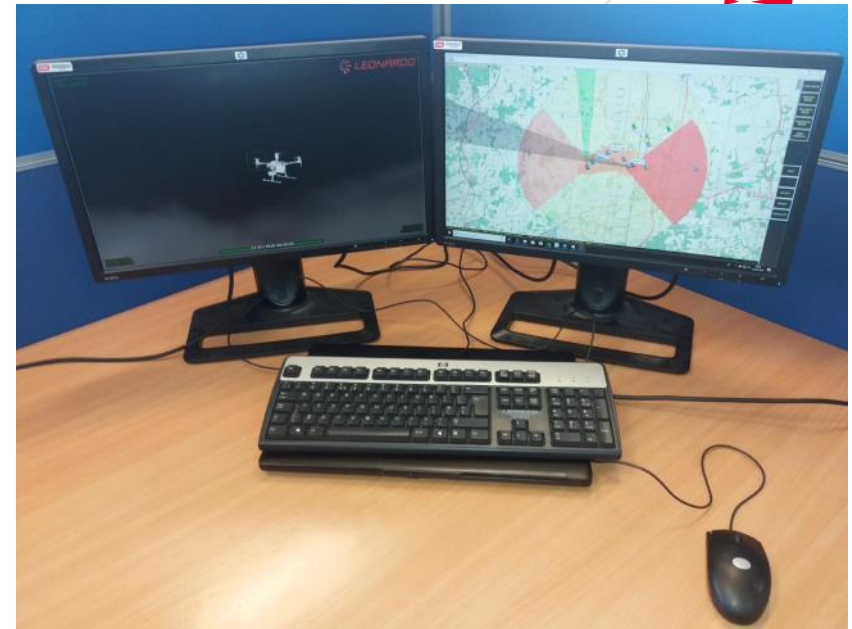
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C2 Terminal

- **Single User C2 Terminal**
 - C2 Display
 - Primary User Interface
 - EO Display
 - Visual confirmation of threat / risk
 - Evidential recording
 - Audio and Visual Alerting
 - 2 Level – Amber and Red
 - User Interface
 - Joystick and Primary Controls
 - Alternative Options
 - Inc. Meerkat - Eye Point of Regard System

- **Configured for Distracted Operator**
 - Operator *'Action on Alert'*
 - *Decision* based interaction
 - Accept or Reject
 - Intuitive Display

- **CONOPS / CONUSE Driven**
 - Refine in consultation with user for use with established Standard Operating Procedures (SOPs)

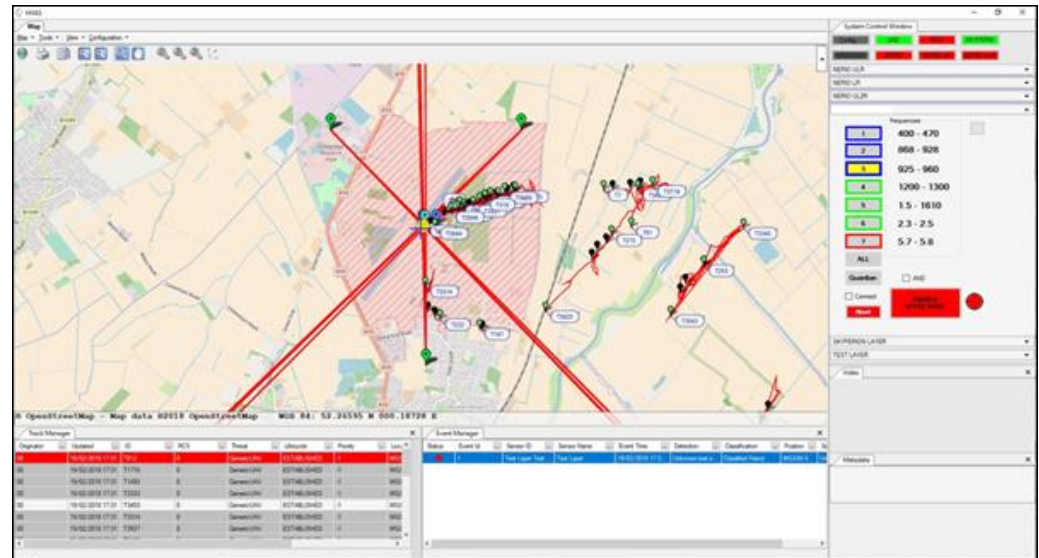




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C2 Display

- **Scalable Integrated Drone Detection System with Common Operating Picture**
 - Map based environment
 - All sensor coverage (Deployment Planning View only)
 - Sensor locations
 - EO sensor coverage
 - Drone incursion alert zones
 - Drone detection and tracks
- **Primary Systems Control and Status**
 - Sensor status
 - Mode
 - Map Mode
 - Grid
 - Range Ring
 - EO Track Status
- **Primary Operator Commands/Actions**
 - Drone Detection/Track 'Data'
 - Drone Alert 'Accept' and Report
 - Drone Alert 'Reject'
 - EO Sensor Control
 - Drone defeat (Hard or Soft kill)





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C2 Display – Modes and Controls

The screenshot displays the Falcon Shield C2 V 64.0.0.18 interface. At the top left, there is a 'Map' tab and a 'SELECT' dropdown menu. The main area is a satellite map of a region including White Bushees, Crawley, and Horley. Several colored zones are overlaid on the map: a large green zone labeled 'Alert Zone (Amber, 5km)', a red zone labeled 'Alert Zone (Red, Air Ops)', and a yellow circle labeled 'Control Window'. A red dashed line indicates a path or alert. On the right side, there is a vertical control panel with buttons for 'CUAS MODE', 'AIRPORT MODE', 'SECURITY MODE', 'ADVANCED MODE', 'GRID OVERLAY', 'TEST', 'ACCEPT', 'REJECT', and 'SATELLITE'. Callout boxes with white backgrounds and black text point to various features: 'Alert Zone (Amber, 5km)', 'Mode Select', 'Overlay Select', 'Control Window', 'Alert Select', 'Map View Select', and 'Alert Banner (Red, Amber)'. At the bottom, a large red banner reads 'DRONE DETECTION: AUTO TRACKING'. The bottom status bar shows coordinates: 'WGS 84: 51.16686 N 000.01511 W Height AMSL = 54 m'.



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C2 Display – Detections, Tracks and Alerts

Radar Detection (ID / Track / History)

EO Sensor (FOV / Status)

Mouse over ID to show Data Field

Operator selection of Accept (and Report) or Reject Track

Event Alert

ESM Detection (Hotspot)

Alert to Drone Incursion and EO Track Status

Sensor Locations & Status (Off / Standby / Online)

DRONE DETECTION: AUTO TRACKING

Map: NORMAL MODE SELECT

CUAS MODE
AIRPORT MODE
SECURITY MODE
ADVANCED MODE
GRID OVERLAY

TEST
ACCEPT
REJECT
SATELLITE

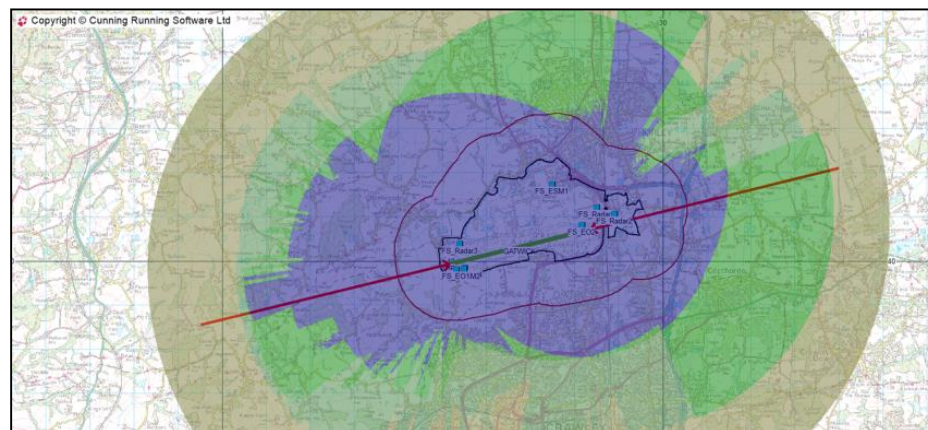
Zoom: 12 © OpenStreetMap - Map data ©2019 OpenStreetMap WGS 84: 51.16686 N 000.06969 W Height AMSL = 61 m



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Non-CUAS Modes

- **APOD Mode**
 - Glide Slope Monitoring
 - NERIO-ULR EO sensors aligned with approach / departure glide slope for Aircraft monitoring
 - Runway Monitoring Mode
 - NERIO-ULR EO sensors aligned with runway for Runway monitoring
 - Manual
 - Manual operation of NERIO-ULR EO sensors for general surveillance
- **DSG/BSG, CP Mode**
 - Manual
 - Manual operation of NERIO-ULR EO sensors for general surveillance
 - Autoscan Mode
 - Automatic scan of pre-loaded sectors / zones to provide STAP coverage
- **Advanced**
 - Deployment Planning
 - Overlay of Deployment Planning Views
 - Administrator



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