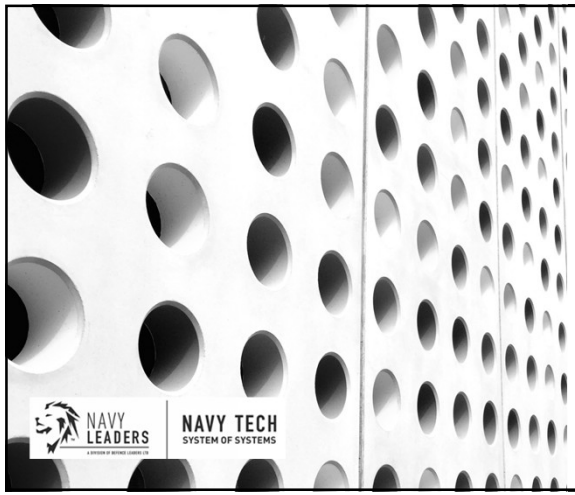


Strength in Numbers

Multi-mission, Multi-Sensor single operator dilemma

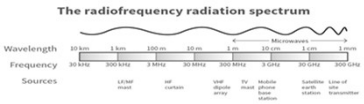
George DeCock
12 February 2025

▷ BASIC HISTORY OF DLCI

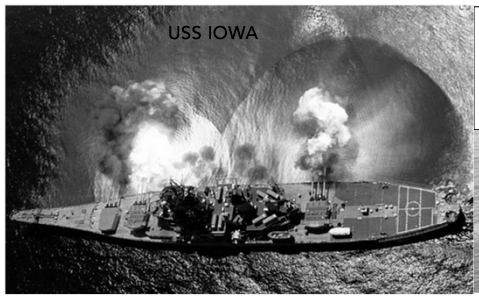
- Early Exploitation: all visual/audio signals
  - Get intel
  - Do countermeasures
- Evolving Wish List:
  - Detect
  - Locate/Track
  - Classify
  - Identify
  - Take Action
  - Analyze
  - Distribute
- Implementation:
  - Manpower intensive
  - Dangerous
  - Many 'man in the middle'

▷ EARLY DLCI APPLICATIONS - ISR

- Unchanged Definition: EXPLOIT ALL EM Signals (or absence thereof…)
- Uncommon beginnings: - W.Churchill /Baden Powell: 1899 Boer War
  - Detection/Jamming of …Light Beams (heliograph…)
  - Pedro LANDELL – modulated light beam patent 1900
- Search Lights 1910s: - Detecting/Tracking Zeppelins
- Battle of Beams 1940s: - Detecting Bombers
  - W.Churchill Radars/Jammers/Chaff
- Vietnam 1968: - Radar/Missiles/APR25
- Unchanged for ~80 years:

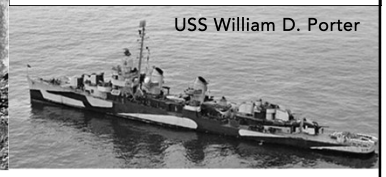


▷ THE DAY THAT WOULDNT LIVE IN INFAMY...



1943 November 14 14:36

Just another day without airborne naval ISR



▷ BASIC HISTORY I

Unchanged Definition: EW/ ISR EXPLOIT ALL EM SIGNALS

- Common Beginnings: Horizon (tower, crow's nest) 3.5Km
  - Visual
- 1798 Battle of Fleuris l'Entreprise… 15Km
  - Visual – Downlinking
- Early 1900s: Die Taube - the bird ATPF
  - Unmanned – Photographic
- WW1 Die Taube – the plane Ehrlin 30Km+
  - Manned – Photographic – Stealth
- WW2 Coastal – Shipbased – MPA 50Km+
  - RF – Photographic

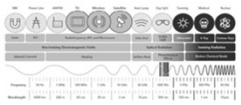
▷ BASIC HISTORY II

- Cold War — Large antennae – Towers – Aircraft 100Km+
  - RF – Photographic
- Vietnam — Specialized Aircraft 100Km+
  - RF – RWR - Photographic
- 1980s — Sophisticated aircraft - steal th 200Km
  - RF wide – LOROP
- 2000s — Add mil satellites 200Km+
  - RF total – EOIR –
- 2020 — Add commercial satellites 200Km+
- 2025+ — Add AI and Neuralink
  - Multi-sensor simultaneous analysis

- Steady rise in altitude/coverage/bandwidth/real-time analysis

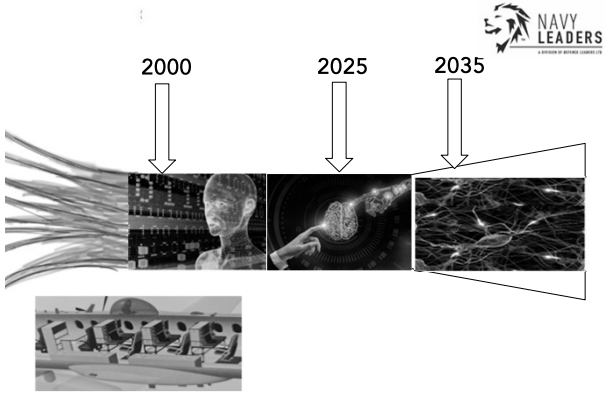
▷ FROM BASIC TO UBIQUITOUS

- Mostly a Single purpose detector/operator: RF for comms & radar
- 1980s: exploit wavelengths beyond traditional RF
  -InfraRed -Visual -UV
- 1990s: Eyes-in-the-Sky: more sensors/detail = more operators
- 2010s: ISR Combining Information from all Sensors (strength in numbers…)
  - covers the complete EM Spectrum (finally….)
  - looks for anomalies (total spectrum + chemical)
  - goes 24/7 worldwide (space-based: HawkEye360, Amber, etc.)
  - combines individual spectra data to form a single decision
  - expands usage to para-military & civilian use
  - data storage & long-term analysis (24/7 sensor inputs)
- 2020s: ISR enters every day life (police, SAR, GPS, cyber, etc.)
  - Data & operator saturation; need for real-time analysis…



▷ EVOLUTION OF OPERATOR WORKLOAD

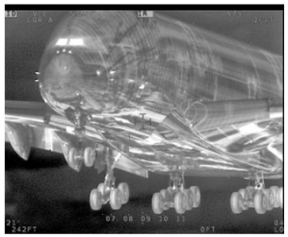
- **EOIR**
- **RADAR**
- **LIDAR**
- **VIDAR**
- **LASER**
  - **point**
  - **designate**
- **MOVING MAP**
- **ARS**
- **AIS**
- **RECORDERS**
- **RF DOWN LINK**
- **SAT UP/DOWN LINK**
- **GSM DETECT**
- **SATPHONE DETECT**
- **EW SENSORS**
- **COUNTERMEASURES**
- **TACTICAL RADIOS**
- **OBSERVERS**



▷ ISR: ALWAYS REACTIVE… TILL NOW

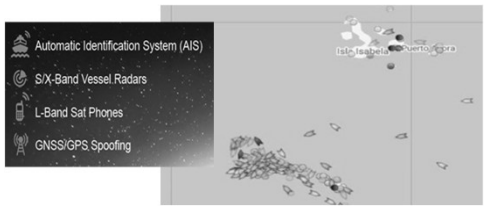
In The Past: Reactive…

- Visual spectrum
- Visual + EM Spectrum
- If it wasn't for radar, we wouldn't have a job…
- Traditionally always starting too late, or stop too late, or don't change lanes



Shifting to Anticipatory…

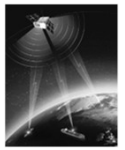
- Special mission ISR/EW aircraft
- Establishment of Space-based detection:
  - Hi-Res earth mapping satellites (visual/IR/etc.)
  - HawkEye360 & Horizon Amber (RF only)
- Forming specific data base

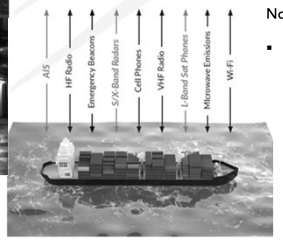


▷ ISR: ALWAYS SURFACE BASED…TILL NOW

In The Past: Ground/Surface based

- Large Multiple Antennae
- Voluminous low-sensitive receivers
- Processor heat
- Heavy CRT displays





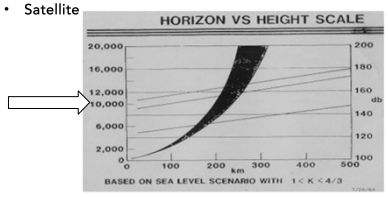
Now and Tomorrow: 24/7

- Mapping/Detecting/Tracking/Identifying/CCD will force pro-activity (?)
  - 24/7 data gathering & storage
  - Tracing of event origins (location, time, method, etc.)
  - Document violations of int'l agreements (missile test, AIS, fishing, etc.)
  - Discover use of new technologies over complete EM spectrum
  - Long-term storage of peta/exa-bytes of data

▷ ISR: ALWAYS SURFACE SHIP BASED…TILL NOW

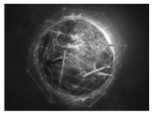
Rule #1: Altitude, Altitude, Altitude…
Literally Broadening your Horizon

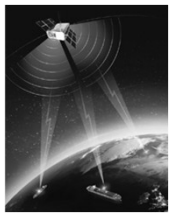
- Balloons – tethered
- Limitations of shipbased detection
  - Enter small ISR UAV
- Aircraft
  - Civilian new/used aircraft
  - UAV
- Satellite



Rule #2: Detection/Process Power,
Hardware and Software

- Sensors
  - Traditional RF band receivers
    - Airborne antenna farm
    - + IR, UV, Laser
  - EOIR turrets
    - Visual/NIR/SWIR/MW/LW
    - Laser, UV
  - Civilian Comms Detectors
    - GSM detection
    - SatCom intercept
- Processing
  - Speed
  - Smarts
- AI
- Neuralink





▷ ISR: CHANGING FACE OF THE SURFACE NAVY AIR ARM

- From Crows' Nest to Manned aircraft to Drones to Satellites
- Remember 1943 November 14…WHAT IF….

- From land: 1890 Clement Ader/Paris; 1903 Wright Bros
  - 1918: First Air Force: Royal Air Force
  - First ac take off from USS Pensylvania 1910 November
  - 1911: Naval Aviation; 1947: Navy Air Force
  - William Moffett: US architect Naval Aviation

- 1917: Naval Air Force takes shape: HMS Argus; Japan Hosyo/1922
- 1944: First helicopter TO/L on ship: Sikorsky YR-4B

Most shipbased platforms used for active roles

▷ ISR: DOUBLE EDGED SWORD

- Own Navy ship multi-EM signatures: almost an open book
  - operational transmissions (radar, comms, etc.)
  - maintenance emissions
  - crew errors
  - UAV control signals / RF downlink
- BLOS potential problems
- Laser comms: non-jammable, non-visible, high data rate, LoS
- Laser weapons: HELIOS – use beyond original purpose

▷ ISR: MULTIPLE SENSOR/MISSION VS. SINGLE OPERATOR DILEMMA

With a little help from your Industry…

- EOIR: with 10 built-in sensors & >2,000 HW/SW configurations
- Still-cameras: with >90 million pixels
- RADAR: with >500 targets, AIS, SAR, ISAR, MTI, CCD, etc…
- Moving Maps: with ARS, GPS, TED, Fencing, Speed Measurement, Tracking, Mapping, etc…
- GSM detection systems: with receive AND transmit capability
- SatCom phone detection: covering up to 40,000 Km² … in less than 100mseconds
- ELINT systems: listening to ~3 billion frequencies… at once
- Small Target Detection: finding <1m² floating 'objects' … 'on the fly'…day/night…SS3**
- SVP Video Downlink that transmit up to 5 HD signals… on a single RF frequency (DVB-T2)
- Mission Plethora: SAR, Surveillance, anti-narco, illegal immigration/fishing, ASW, EW. etc…

The 'one-man' horror show

▷ ISR: OPERATOR RESCUED BY TECHNOLOGY… AND TRAINING !

- Operator/Industry Brainstorming (RFI, RFQ, Tenders, etc.)
- Smart integration of all sensor operations
- Smart display of combined sensor data on each target
- The MMU versus the 'smart MMU': Airborne LINX
- Inflight operator manual: Airborne LINX
- Provide better life-long training (for seasoned and new ASOs):
  - Simulator
  - Emphasize yearly operator refresher training
  - Inflight training…
  - Instructor feedback & student records
- Ground-assisted in-flight training…the Virtual Inflight Trainer?

▷ ASO TRAINING: LIFE-LONG EFFICIENCY PRESERVATION

Pilot training

- Mandatory training
- Frequent check-ups,
- Recorded flying hours

ASO training

- Most Important but Most Neglected
- No written requirements…
- Training-on-the-job (remember USS IOWA)
- No re-fresher training…ever…
- Hand-me-down Training Fiasco
- ISR sensor simulator training:
  - no real hardware 'wear'…
  - much less expensive…24/7…
  - Instructor feedback & student records
  - It's PC…it's GREEN…

Hourly cost of in-flight training:
- From $1,000 to >$180,000/hr….
- The 'Virtual Inflight Trainer' solution

"Your ISR mission aircraft is only as good as your ISR Operator" (see article on ASOG website)

▷ ISR: PRESENT MULTI-MISSION/SENSOR NIGHTMARE

But STILL: the operator workload and knowledge need are continuously stressed…

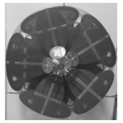
- Todays' ISR operator expected to master all sensors and specific mission-oriented techniques:
  - Orchestra of Sensors
  - Operator playing every instrument
  - Human brain insufficient in speed and memory

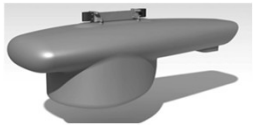
- Introduction of AI in sensor operation:
  - AI masters every sensors and mission profile
  - Operator now becomes orchestra director

- AI operates with a playbook that's constantly updated (losing control?)
- AI/Neuralink: operator now IS the AI playbook with constant control

▷ 2025 AIRBORNE ISR: SAMPLE SENSOR INNOVATIONS

- Wideband Antenna Farm
  - Traditional blade/dipole wideband antennae aligned on aircraft belly
  - Complicated design & installation
  - Costly error correction
  - Too long for small aircraft/pods





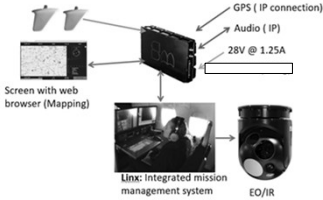
- Single wideband antenna (FlashHawk)
  - Bandwidth: 30MHz – 6+GHz
  - 15Kg / 800mm dia / 400mm depth
  - SCARpod wing mount - Aircraft belly mount

▷ 2025 AIRBORNE ISR: ON SHIPBOARD GSM PHONES

Output complete phone IMSI data and location

- GSM Phone Detect/Locate/Track/etc.
  - 2 blade antennas
  - Single Processor
  - G2, G3, G4, G5, …?
  - Detection from 3Kft: >60Km diameter

Identify Specific Handsets
Mass Mapping of All Handsets
GPS Location Technique
Auto Triangulation
Geofencing
Voice Calls to Handset
SMS to Handset
Extended Ranges (+30Km)
Built-in AIS
Built-in COSPAS SARSAT
Mission System Integration
Automatically Steer EO/IR
Simulator



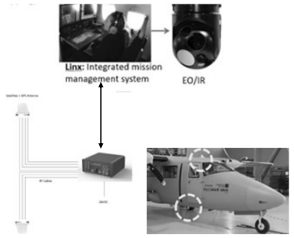
- 3 main suppliers in Europe

- Every ship-based Mobile Phone becomes a beacon:
- Detected, Located, Tracked, Exploited, Archived
- Applies equally to own-ship and targeted ship…

▷ 2025 AIRBORNE ISR: ON SHIPBOARD SATPHONES

Output complete Sat phone IMSI data and location

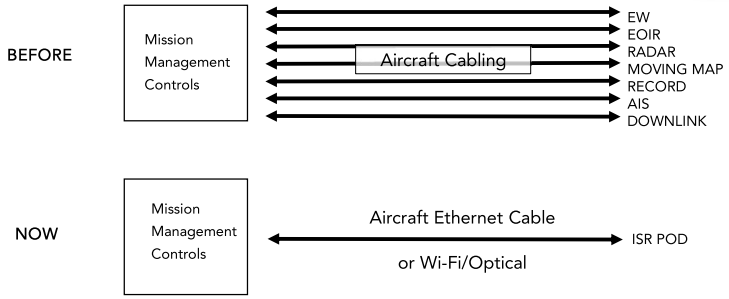
- SatCom Phone Detect/Locate/Track/etc.
  - 2 blade antennas
  - Single Processor
  - Simultaneous Thuraya, InmarSat, Irridium
  - Detection from 10Kft: >400Km diameter



- Dual function GSM/SAT…

- Every ship-based SatPhone becomes a beacon:
- Detected, Located, Tracked, Exploited, Archived
- Applies equally to own-ship and targeted ship…

▷ AIRBORNE EW/ISR: INSTALLATION ON SHIPBASED AIRCRAFT



ALL ISR & Targeting Sensors that can be integrated individually in an aircraft, can be integrated in a removable SCAR-Pod

▷ AIRBORNE EW/ISR: COST-SAVINGS ON SHIPBOARD AIRCRAFT

- **Fixed** permanent installations
  - Full sensor suite per aircraft
  - Costly, not flexible
- **Swappable** installations
  - Ro-Ro
  - Limited to same aircraft type/model
  - Less expensive, time consuming
- **Podded** Installations
  - 30-minute sensor/console exchange between aircraft
  - Instant >30% sensor acquisition cost savings
  - >90% reduction in aircraft sensor installation cost
  - Immediate exchange **between**:
    - FXW and RW installs
    - NATO 14" mount
    - Applicable to UAV

Example:
3 ISR A/C need only 2 ISR SCAR-Pods
5 ISR A/C need only 3 ISR SCAR-Pods
10 ISR A/C need only 7 ISR SCAR-Pods

▷ AIRBORNE EW/ISR: COST-SAVINGS ON SHIPBOARD AIRCRAFT

- Cost-savings
- Time savings
- Mission Readiness
- Aircraft of Opportunity

- Logistics
  - Any aircraft will do *
  - Training ground/air
  - Sensor test flights
  - Sensor comparisons
  - Out of home-base
  - Repairs
  - Mid-Life upgrades
  - Emergencies
  - EMI/EMC test
  - EASA/FAA Certification

Installation Type	Traditional ISR Sensor Kit Installation	SCAR-pod ISR Installation
Installation Time: Aircraft Hangar Time per A/C	60days +15 days test	30 minutes +15 days test

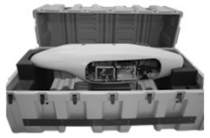
Summary of savings compared to fixed installation:
- hardware saving: >30%
- installation saving: >90%

▷ 2024 AIRBORNE SCAR-POD INSTALLATIONS





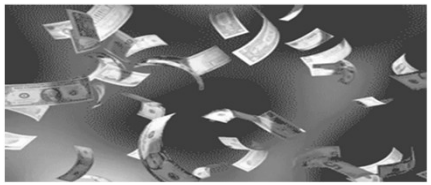




- Flexible RW/FXW
- Ship-based aircraft
  - FXW & RW
  - UAV

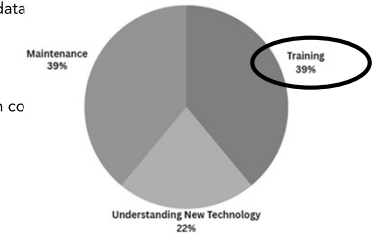
▷ SUMMARY: FUTURE-PROOFING NAVAL AIRBORNE ISR

- Historically Single sensor - Single Operator
- Evolution Several 'single sensors' - Single Operator
- Tomorrow AI becomes the multi-sensor operator for total EM spectrum?
- Robotic Decision Operator?
  Human Neuralinked Operator?
- Budget-wise....



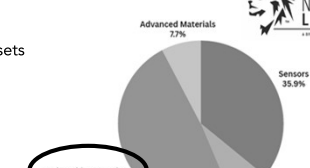
▷ ISR BUDGET: CYCLES AND AFFORDABILITY

- Most EW/ISR budgets treated like forest fire budgets
- **Present budgets:** still focused on acquisition of hardware/software solutions
  - Perfect for immediate tactical needs
  - Shortcomings for long-term decision making
- **Future budgets:** rely on acquisition of both hardware and data
  - Space-based <u>hardware</u>: if you can afford it…
  - Satellite 24/7 <u>data</u> for your country/area if you cannot
  - Via military alliances
    - Via commercial satellite EM/EOIR data providers
    - "Develop" historical EM/ISR footprint for your own co
  - The hidden costs:
    - Getting the right new technology for the task
    - Finding & keeping personnel for it
    - Decide on who does the maintenance
    - Continuous operator training
- In the mean time....
  - We're stuck in 2025…



▷ 2025 …ROADMAP TO FUTURE-PROOF AIRBORNE ISR FOR SURFACE FLEET

- Tactical Needs/Solutions
  - Land/Maritime based stations
  - AVIATION: Multi-mission/Multi-Purpose Airborne Assets
    - Swapping sensors/suites
    - Small 'ISR UAV'
- Strategic Needs/Solutions
  - Permanent Large Ground Receive Stations
  - SPACE: Satellite-based EM/EOIR data collection
    - <u>Live</u> Integration with Airborne/Ship ISR Assets
  - Data storage/analysis center
- Long-term Needs/Solutions
  - AI: "To see that what no man has seen before"
  - Neuralink: "To be what no man has been before"
- Power of country alliances and shared information
  - Dependency
  - Trust



The maritime EM spectrum is a naval goldmine waiting to be explored and analyzed.

▷ SINGLE OPERATOR: MULTI-SENSOR & MULTI-MISSION AIRBORNE NAVAL ISR

	SEARCH & RESCUE	MARITIME Surveillance	OIL Slick Map	TARGET detect	TARGET recognize	TARGET identify	TARGET track	VIDEO Distribute	FIRE Map
EOIR	●	●	●	●	●	●	●		●
RADAR		●	●	●			●		
VIDAR	●			●	●				
MMAP/ASR	●	●	●				●		●
RECORDER	●	●	●	●	●	●	●	●	●
AIS	●	●	●	●	●	●			
SAT UPLINK								●	
RF DOWNLINK	●	●						●	
GSM D&L	●	●		●	●	●	●		
SATCOM D&L		●		●	●	●	●		
HI-RES STILL				●	●	●			
MMU	●	●	●	●	●	●	●	●	●
CONSOLE	●	●	●	●	●	●	●	●	●
SCARPOD	●	●	●	●	●	●	●	●	●

Multiple reasons for sensor budget justification.

▷ THANK YOU!!

AIRBORNE TECHNOLOGIES

NAVY LEADERS

The time to install airborne ISR on every ship is NOW!