06 September 2019

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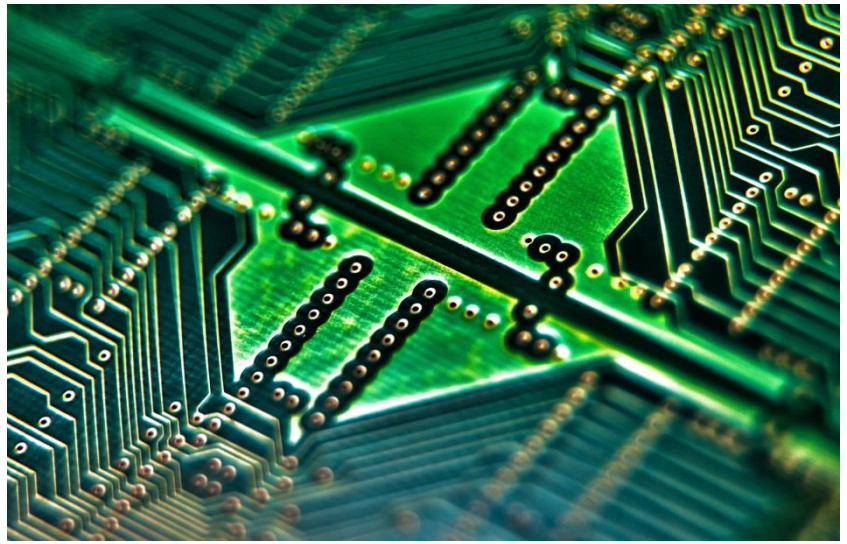
Ministry of Defence

EW: a critical contest in the Information Age?



Dr Paul Kealey

Division Head - Cyber and Information Systems

pgkealey@dstl.gov.uk

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EW for Information Advantage

EW impacts through all 4 lenses of Information Advantage

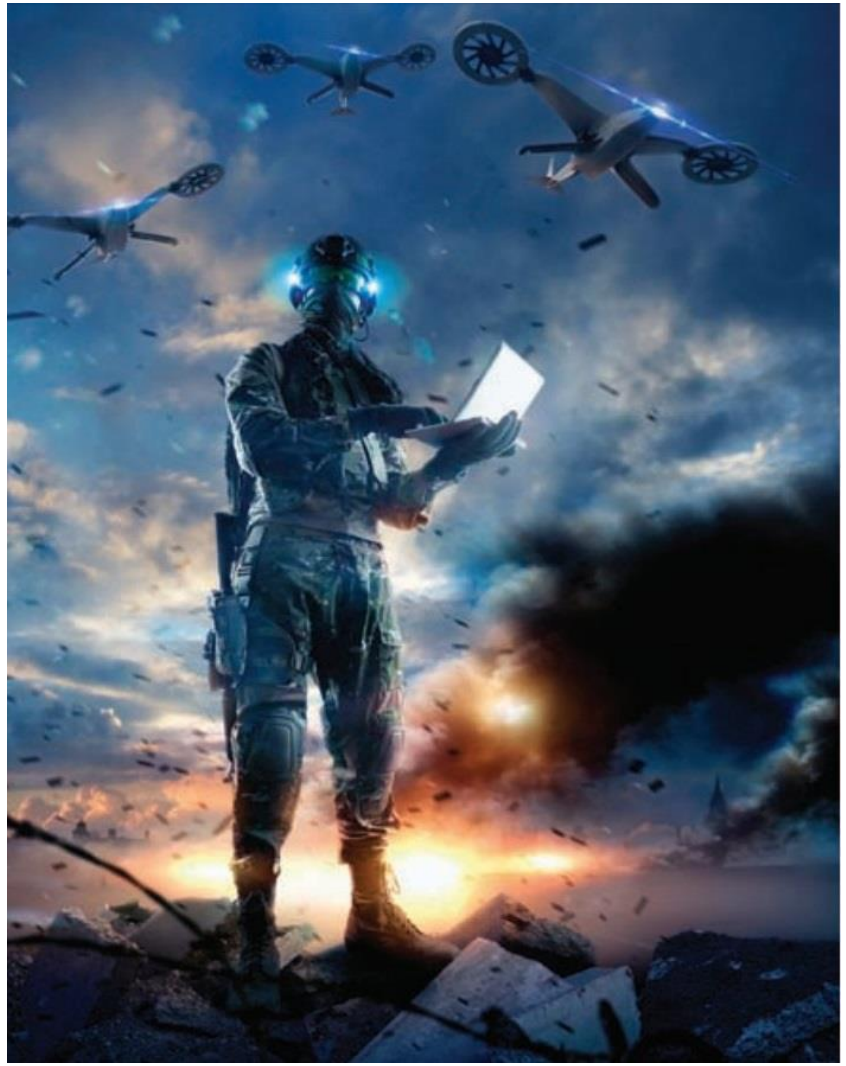
- *enabler, resilience, denial and effector*

EW is critical to

- *decision making*
- *understanding*
- *adversary perception*

Military will not dominate the EM spectrum, but must

- *maintain freedom of manoeuvre*
- *achieve intelligent, adaptive management of the contested EM spectrum*
- *shift from defensive to proactive and offensive*



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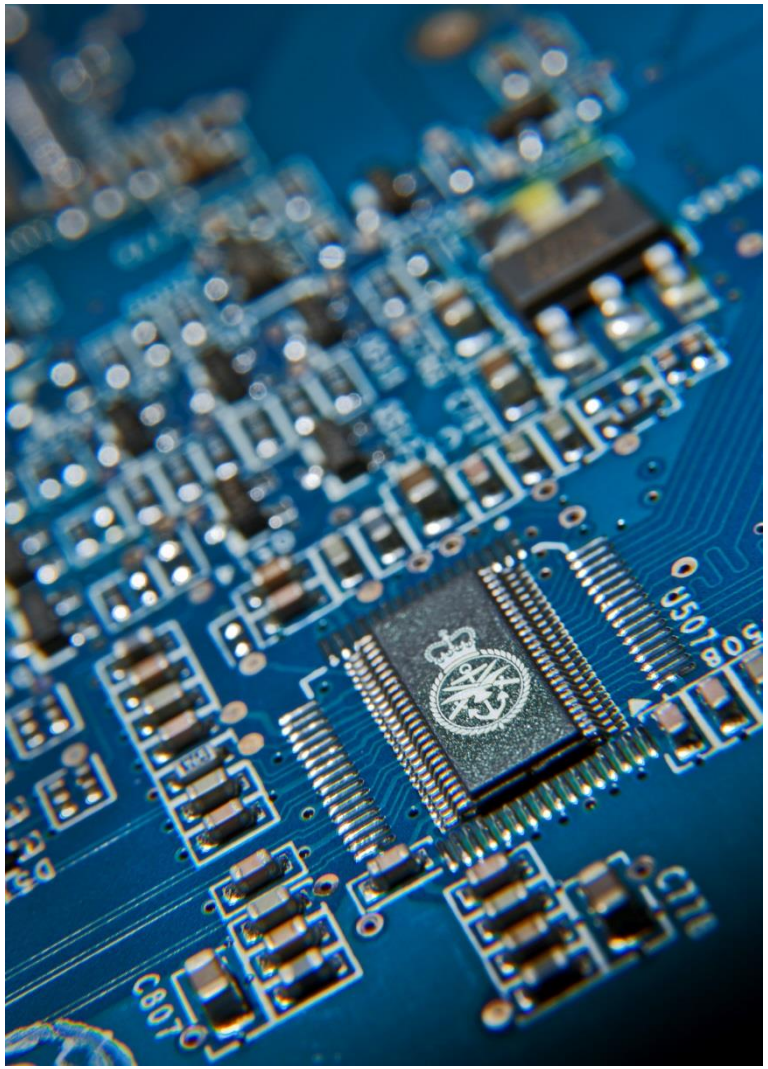
What is the challenge?

- Electromagnetic environment has changed
  - Pace of technology development has changed, e.g. software defined radios
  - Complexity through novel algorithms, e.g. Artificial Intelligence
  - Contested warfighting environment

Ambitious end-state

- UK Defence has a single **coherent EM operating capability (CEMOC)**
  - integrated with partners across government (PAG)
  - fully interoperable with coalition/NATO partners
  - capable of operating independently when necessary
- Convergence of technologies / capabilities
  - Sensing and Communications alongside EW
  - SDR enabled



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Current status

- EW has had significant impact in Ukrainian and Syrian conflicts
- UK Defence is investing in both equipment programmes and S&T to **maintain advantage**

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Contested EM Environment Programme

Vision ‘S&T has changed the way defence operates in the contested electromagnetic environment and revitalised Electronic Warfare’

CEMA

Electronic Defence

CIED

Electronic Attack

Stealth and Camouflage

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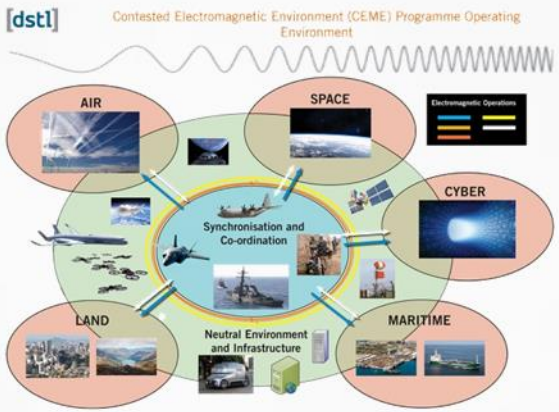

Enable Decision Makers

To legitimately operate in the electromagnetic environment in order to act with free will

Sense and Understand

To sense and understand the electromagnetic environment in order to operate

Synchronise and Co-ordinate

To synchronise and co-ordinate ourselves in order to act coherently in the electromagnetic environment

Take Initiative

To seize the initiative when operating in the electromagnetic environment

Be Resilient

To maintain our ability to operate in the electromagnetic environment

The Electromagnetic Environment — *The totality of electromagnetic phenomena existing at a given location*

Transducers — *Device to convert physical quantities into an electrical signal or visa versa*

Signal Conversion — *Changing signals from one form to another*

Processing — *Perform operations in order to change or preserve something*

Machine Interface — *Point(s) at which machine interacts with something, i.e. another machine or person*

Power — *Capacity to do something*

People — *Anyone associated with the machine*

Systems and Concepts — *Defined sets of things working together and abstraction of an idea or ideas*

Technical Themes

Sub-Challenges

- Smith institute — Mathematics
- SP for EME
- ML: EM SA
- THALES
- Xenint Ltd — High-order ISR
- ML Protocol ID
- Roke
- QINETIQ — Sig Subspace
- QT: Rydberg Atoms
- PA
- mm-wave SA
- Science & Technology Facilities Council
- ML: Dynamic EM SA BSM
- University of Hull
- BLUEBEAR — Fractionated EM SA
- Super Resolution
- Imperial College London
- Multirole Xilinx RFSoC
- UCL Engineering
- ML Emitter ID
- Rowden Technologies
- Roke — STAR
- QT: Ultra-low phase noise LO
- University of Birmingham
- Raytheon — Meshed Network Battlefield
- 3Systems Consulting Ltd — EMO BM Aid
- Raytheon — Smart CEMA Nodes
- Fractionated Effects at Range
- BLUEBEAR
- Filamentation
- LumOptica
- Roke — Swarms for EA
- Antenna Metamaterials
- University of Exeter
- TRW
- MBDA
- THALES — ML: ECM Optimisation
- THALES — MIMO Radar threat & opp.
- IQHQ — Radio Deception
- TransEON — GO MOSFET
- Roke — Rapid Threat Sig Detection
- BLUEBEAR — Comms for Fractionated Sys
- Roke — Spatial Mod & pre-coding
- decisionLab — Channel Allocation
- Plextek — mm-wave Comms
- Roke — ML: Anti-jam applique
- MassiveAnalytic — AI: Dyn Spec Access

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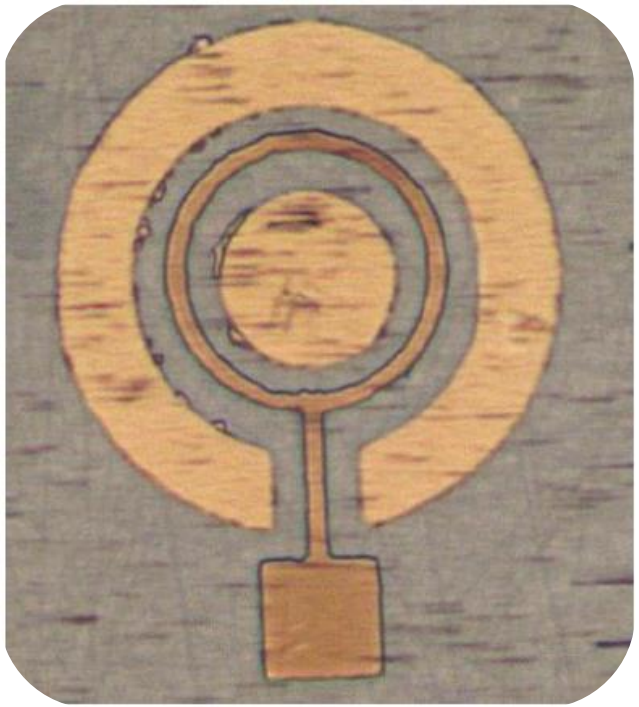
Ga_2O_3 MOSFETs for Next-Gen Jamming-Resistant Monolithic Microwave ICs

Development and manufacture of Gallium oxide, a semiconductor material with a bandgap greater than Silicon, Gallium nitride, and Silicon carbide.

High-quality oxide-semiconductor interface engineered using available atomic layer deposition techniques.

Will have a major impact in power electronics.

Much higher power signals in the mm-wave and below leading to increased attack vector options and greater resilience in communications.



TransEON

Investigating Device Topologies

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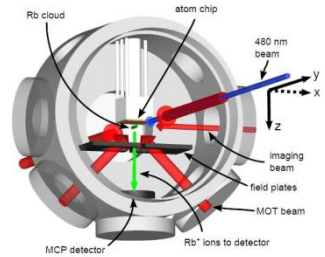
Quantum Technology: EM Sensing

Rydberg atoms are highly excited atoms that display extreme sensitivity to Radio Frequency (RF), microwave and TeraHertz (THz) radiation

Investigates the potential applications of Rydberg atoms in glass encased vapour cells for **realising novel Electro-Magnetic (EM) sensors that may surpass capabilities of conventional EM sensors.**

- **Very wide band EM Surveillance receiver, with potentially low scattering and self-emission signatures;**
- **Near-undetectable, passive, low radar cross-section antenna receiver;**
- **Narrowband LPI communications receiver, that would be capable of selecting very narrow band signals embedded in wide-band noise;**
- **Non-invasive explosive detection using a field deployable THz sensor; and**
- **Hidden device detection and classification THz sensor with an imaging capability.**



The theoretical performance of a Rydberg based RF sensor is at least an order of magnitude superior to that of standard RF sensing.

PA

Durham University

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Summary

- New capabilities are being fielded now to maintain advantage
- Dstl is leading innovative EW capability development
- Join us on the journey, developing capabilities inc. people
  - *Future Electromagnetic Environment Symposium 19-20 November*

Dr Paul Kealey, Division Head
pgkealey@dstl.gov.uk

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