Remote Undersea Surveillance

Drive a paradigm shift for undersea surveillance to generate mass, tempo and scale that could not be achieved through crewed platforms alone
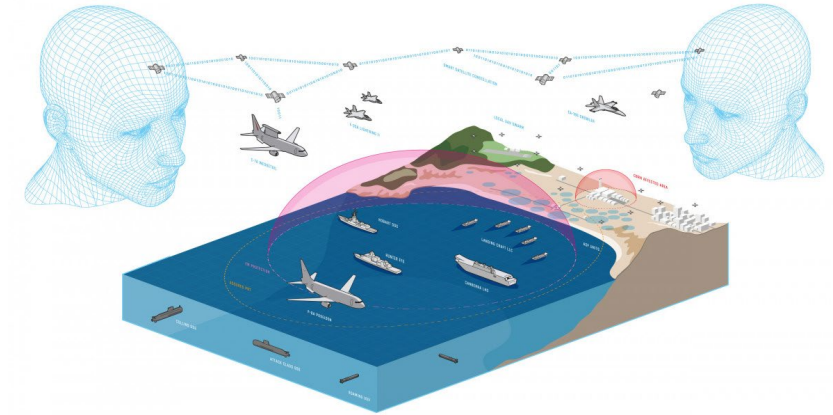
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Defending Australia and its National Interests
www.defence.gov.au

Remote Undersea Surveillance

Overview

- Strategic context
- System challenges facing undersea surveillance
- Scenarios
- Remote Undersea Surveillance STaR Shot
- Technology challenges
 - scope of the Activator theme

Defence Strategy and Undersea Warfare

"undersea warfare capabilities (crewed and uncrewed) optimised for persistent, long-range sub-surface intelligence, surveillance and reconnaissance and strike"

"enhanced, all-domain, maritime capabilities for sea denial operations and localised sea control"

*"To further safeguard Australia's undersea capability, the Government will also invest in an **integrated undersea surveillance system** (including exploration of optionally crewed and/or un-crewed surface systems and un-crewed undersea systems), and expanded undersea warfare facilities and infrastructure."*

*"**Further priorities** for investment in the undersea domain include **persistent undersea surveillance**; undersea combat; command, control, communications; support; sustainment; and training sub-systems."*
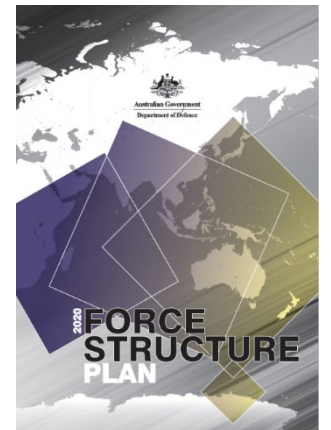
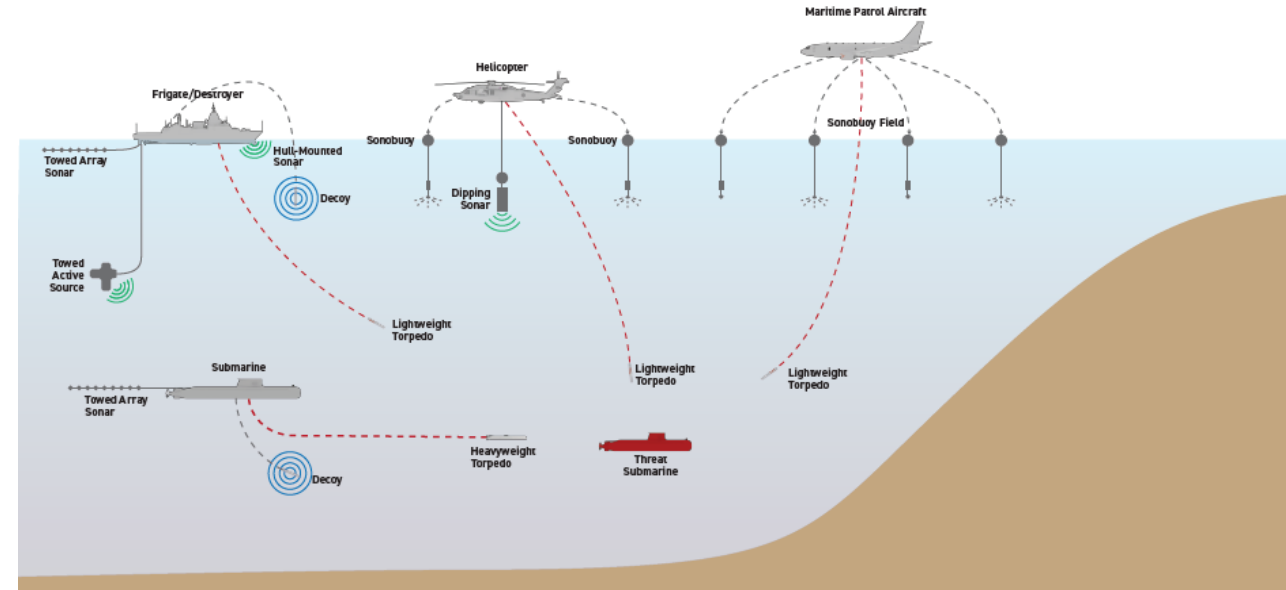MERCATOR
Maritime Domain Strategy 2040

Undersea Warfare Platforms & Systems

## Paradigm shift in undersea sensing

Tactical platforms

- Maritime patrol aircraft — 14 P-8A Poseidon
  3 MQ-4C Triton
- Surface combatants — 3 Hobart DDG
  8 Anzac FFH → 9 Hunter FFG
- Helicopters — 24 MH-60R Seahawk
- Submarines — 6 Collins SSG → 8 SSN

Surveillance systems

- Fixed surveillance systems — SEA 5012 IUSS
- Mobile surveillance systems
- Deployable surveillance systems
- Robotic and autonomous systems
- Distributed undersea sensor networks

Research, development & innovation opportunities
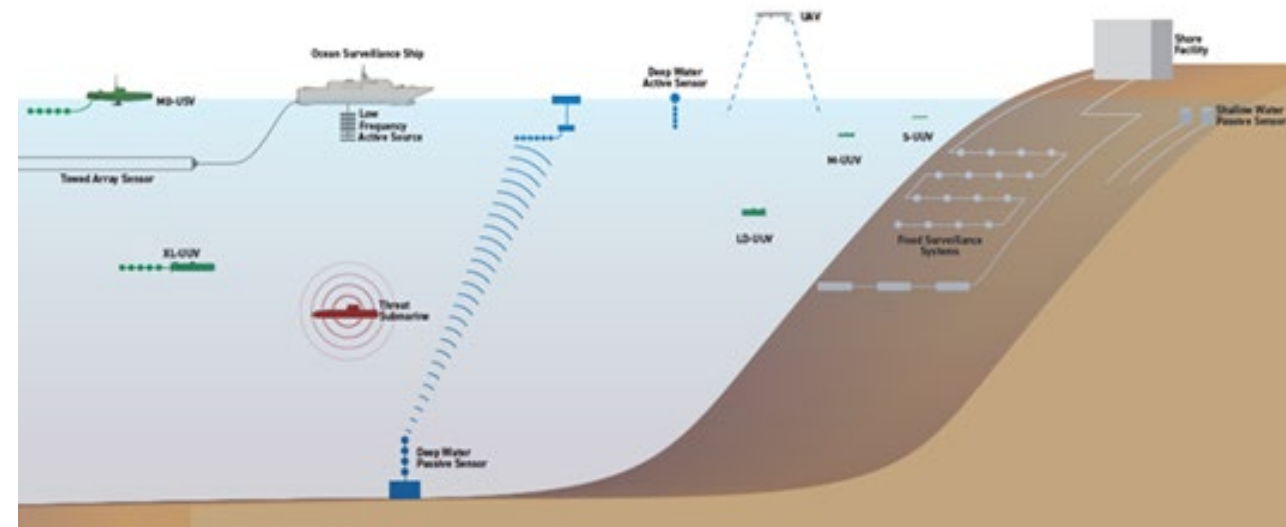
Sensing in the Ocean

Acoustic Propagation

- Direct Path
- Surface Duct
- Surface & Bottom Bounce
- Shadow Zones
- Shallow-Water Multipath
- Convergence Zone
- Deep Sound Channel
- Reliable Acoustic Path
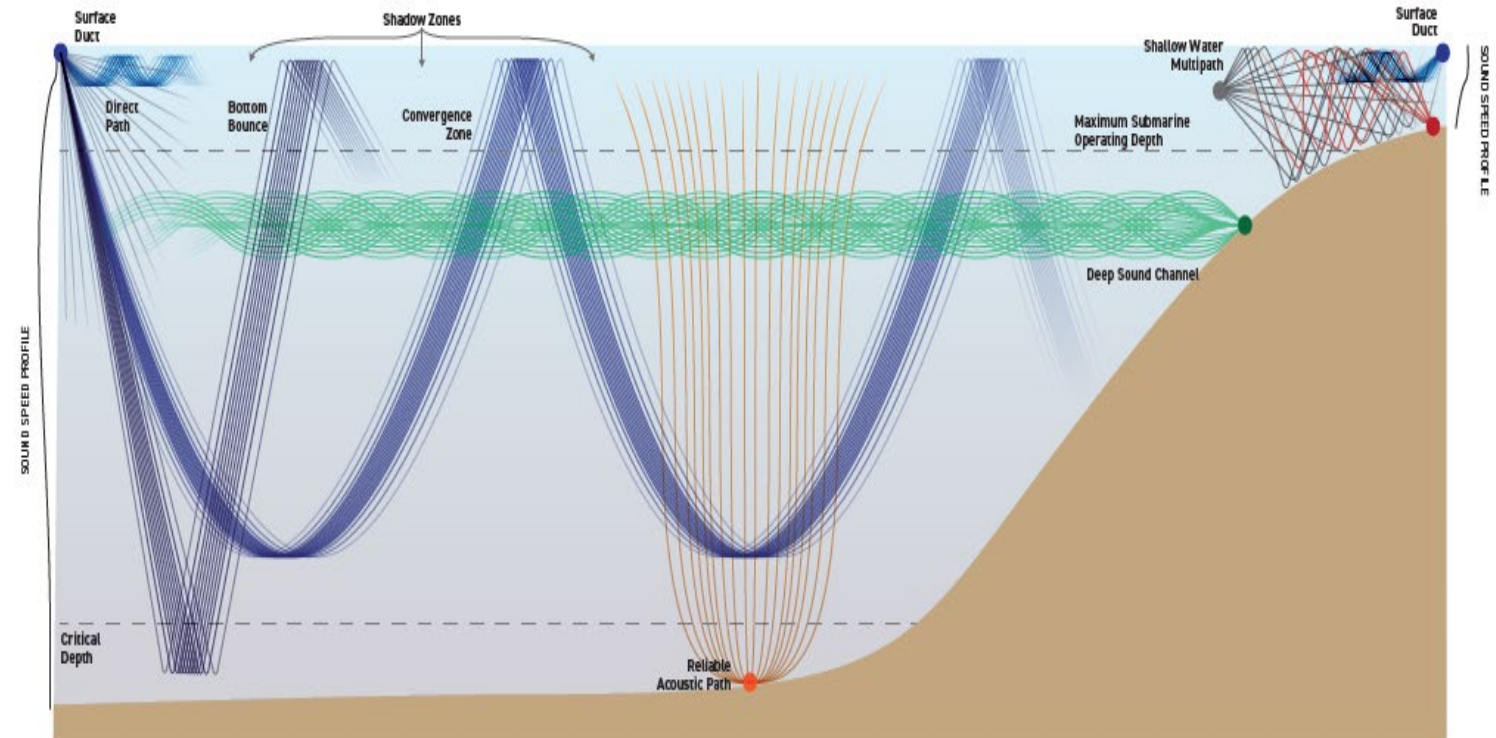
Non-Acoustic Sensing

- LF EM – Magnetic & Electric Fields, Communications Intercept
- HF EM – Radar, Periscope Detection, Optical, LIDAR, Infra-Red, Thermal, Night Vision, Hyperspectral
- Gravitational
- Hydrodynamics & Wakes
- Chemical & Nuclear
- Biological

System Characteristics

- Hull-mounted, towed & deployed sensors
- Acoustic, non-acoustic or multi-mode sensors
- Active and/or passive sensing
- Single or multiple distributed sensors
- Sensor array size, frequency & directionality
- Other system design characteristics

Operation

- Find
- Fix
- Track
- Target
- Engage
- Assess

Data Processing, Analysis & Networks

Sensors

- Quiet low-SNR targets
- Non-acoustics are challenging
- Complex & noisy environments

- Optimal sensor placement & control
- Target classification & feature extraction
- Threat characteristics & databases
- Multi-sensor & distributed data fusion
- Situation awareness & contextual information
- Mission planning & decision support

Analysis

Processing

- Slow speed of sound → Long sensing delays
- Lower frequencies → Lower information content
- Large sensors arrays vs distributed sensors
- Edge sensor processing vs cooperative processing
- Automated detection, classification & localisation
- Noise & clutter rejection
- Low false contact rates
- Reporting channels & time delays

Networking

- Command & control functions
- Communications & data sharing
- Edge vs centralised modes of operation

Undersea Surveillance Challenges

Technology
– Evolution, disruption or convergence

System
– Affordable, scalable & effective
– Proactive deployment, recovery & operation
– Payload space, weight, power & cooling
– Robust, survivable & secure
– Reliable, trustworthy & autonomous
– Processing, communications & data transfer

Operation
– Deployment & response options
– Surveillance area & search times
– Persistent & wide-area coverage in diverse ocean environments
– Distributed, networked sensors integrated with platforms and command, control & communication systems
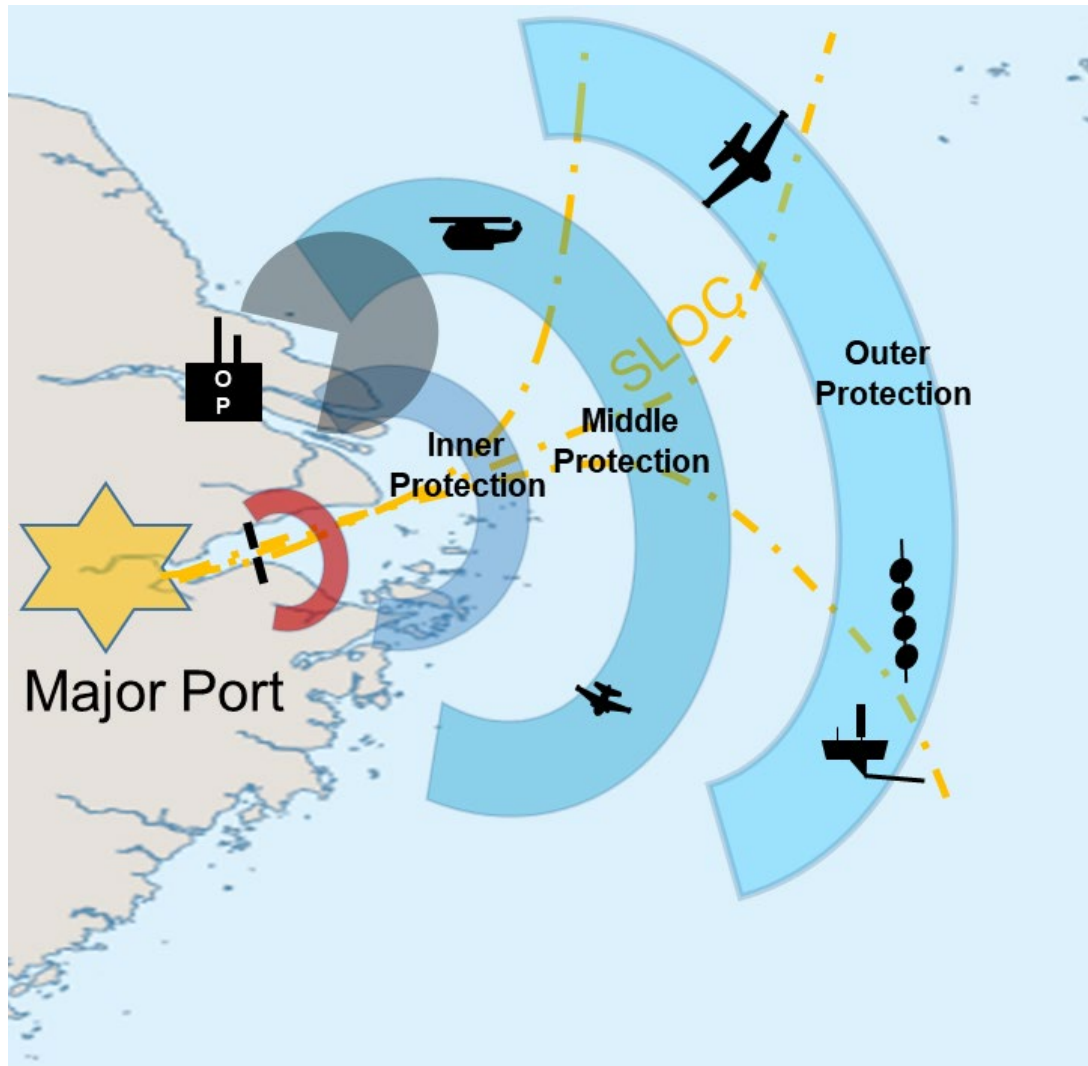– Adverse environments: counter surveillance, degraded networks & restricted/denied access

Support
– Maintenance, logistics & sustainment
– Training
– Test & evaluation
– Warfare assessment

Sensors
Processing
Networked Systems

OFFICIAL
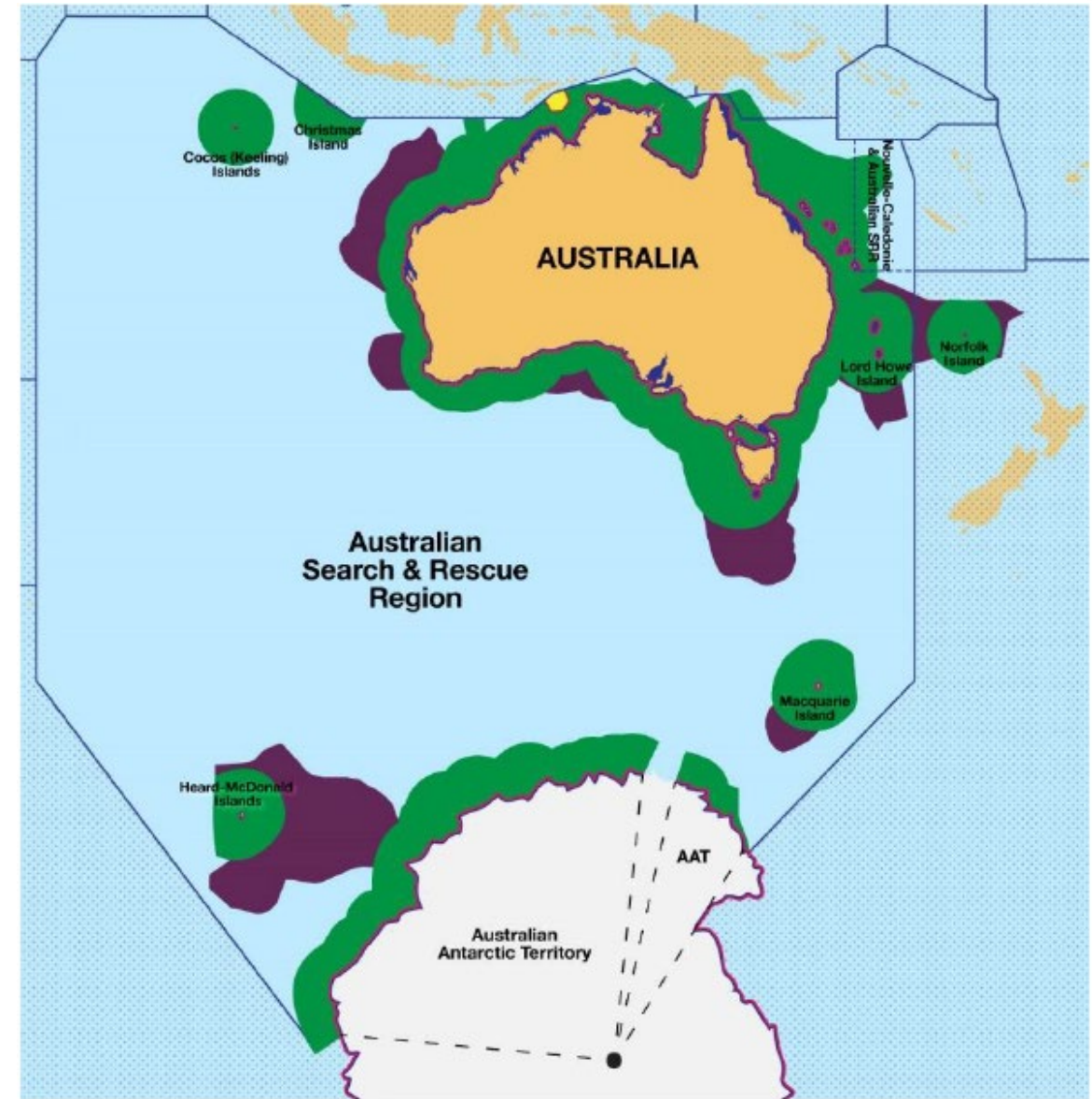
Domestic Critical Infrastructure Protection

Functions

- Protection of major ports, critical infrastructure & strategic locations against Submarines & Uncrewed Undersea Vehicles
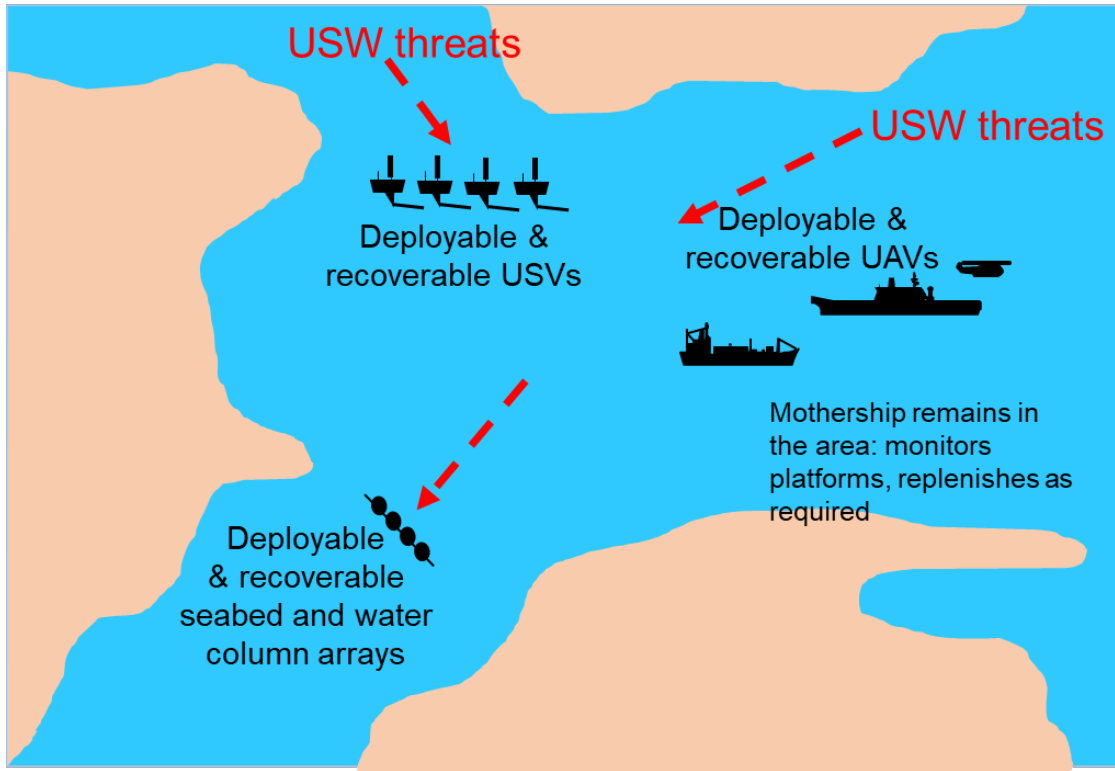- Provide secondary maritime surface ISR effect.

Characteristics

- Deliver detection & protection effects across coordination, competition and conflict spectrum
- Provide a layered defence using fixed, mobile, deployable, autonomous & networked systems
- Low training & operating overheads

Considerations

- Provide surveillance coverage for extended durations
- Enduring with scalable, deployable & attritable systems
- Prepare, transit, deploy & recover systems
- Operate & sustain to achieve surveillance functions
- Robust to operational & environmental constraints

Expeditionary Undersea Warfare

USW threats

USW threats

Deployable & recoverable USVs

Deployable & recoverable UAVs

Mothership remains in the area: monitors platforms, replenishes as required

Deployable & recoverable seabed and water column arrays

Functions
- Detect, monitor & report USW threats in the region

Characteristics
- Deliver surveillance & cueing effects across coordination, competition and conflict spectrum
- Provide a layered defence using deployable, autonomous and networked systems
- Distributed sensing of ocean environment with diverse environmental, acoustic & non-acoustic sensors
- Low operating & sustainment overheads

Considerations
- Provide surveillance coverage for limited durations
- Portable, deployable & recoverable/attritable systems
- Small, modular systems to achieve scale
- Prepare, transit, deploy & recover systems
- Space, weight, power & cooling (SWaP-C) constraints
- Robust to operational & environmental constraints

S&T Strategy and STaR Shots
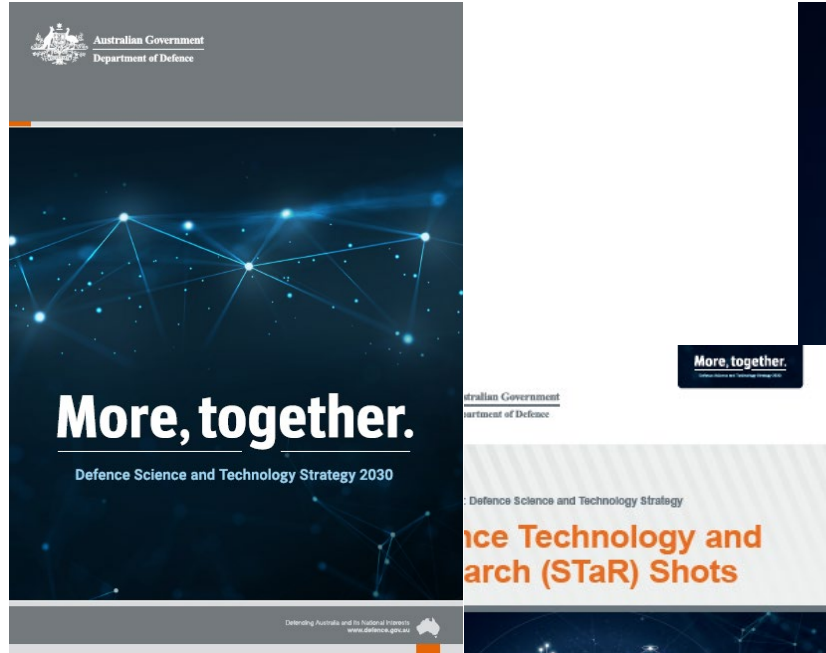
Remote undersea surveillance

Impact. drive a paradigm shift for undersea surveillance to generate **mass**, **tempo** and **scale** that could not be achieved through crewed platforms alone

Challenges.
- harsh environment
- vast expanses
- limited communications
- contested and congested

Outcome. IUSS exemplar demonstrate agile and persistent undersea surveillance technologies that feed future capability

Sponsor
VADM Mark Hammond
Chief of Navy

Lead DST Chief
Dr Anthony Szabo
Chief Maritime Division

Focus

environment

networks

sensors

autonomy

data processing

analysis

Underwater Environment

In Scope

- Anomaly detection
- Distribution of environmental data in support of sensing

Out of Scope

- Environmental sensing
    - e.g. sound profiles, sea state
- Models & forecast
- Physical effects
    - Waves, corrosion & biofouling

Sensors

In Scope

- Sensor specific processing
- Multi-influence system concepts
- Sensor deployment strategies

Out of Scope

- Sensor technology development
- Sensor system design

Data Processing

In Scope

- Detection & classification
- Localisation & tracking
- Data fusion
- Anomaly detection / pattern of life
- Sense-making & intent
- Decision support
  - Visualisation
  - Mission planning

Out of Scope

- Hardware design & optimisation
- Processing system architecture & implementation

Networks

In Scope

- Distributed sensor networks
  – decentralised decisions
  – handover
  – ad hoc connectivity
- Coordination & cooperation
- Message content optimisation
  – low rate unreliable bearers

Out of Scope

- In-water communications
  – bearers
  – standards

Autonomy

In Scope

- Mission autonomy
- Sensor deployment & scheduling
  - Surveillance & response

Out of Scope

- Platform development
  - navigation
  - task autonomy

Analysis

In Scope

- Experimentation
  - demonstration
- Proof of concept evaluation

Out of Scope

- Detailed modelling & simulation
- Options analysis

Questions?