Australian Government
Department of Defence
Science and Technology

National Security and Intelligence, Surveillance and Reconnaissance Division




Strategic Plan 2016-2020

DST GROUP | Science and Technology for Safeguarding Australia

CDS Foreword

The National Security and Intelligence, Surveillance and Reconnaissance Division (NSID), while relatively young, is steeped in deep defence science and technology history and tradition. For more than four decades, its antecedents have delivered world-leading research results and experimentation in high-frequency radar.

The signature outcome of this research is the famed Jindalee Operational Radar Network or JORN which provides wide area surveillance of aircraft and surface vessels in Australia's northern and western approaches.

The key elements that contributed to the success of JORN are embedded in the NSID Strategic Plan 2016-2020, and indeed in the Defence Science and Technology Strategic Plan. They include: delivering excellent and world-leading science; embracing collaboration; and pursuing and translating big ideas to make an impact that often cannot be foreseen.

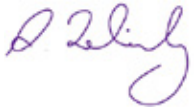
By taking this approach, NSID is well-equipped to achieve its mission objectives. The Division will continue the traditional roles of producing information that enables superior decision-making by Defence, and building unique defence capabilities, including through space-based technologies. The NSID's expanded whole-of-government role to support national security is paving the way for a close working relationship with other government departments and agencies, with the Division kicking early goals using its data analytics capabilities.

The Defence White Paper 2016 sets a strategic context in which NSID can become an increasingly prominent player. This is reflected in the considerable investment committed to intelligence, surveillance and reconnaissance-related projects. The challenge for NSID is to make greater use of partnering and collaboration to build not only a stellar research team within DST, but also as a highly valued partner working with Australian industry and academia.

I welcome the NSID strategic plan and thank Dr Tony Lindsay and his team for developing it.

I am confident that this plan will guide NSID beyond where the division imagines itself to be in 2020.

I look forward to watching how this journey unfolds.



Dr Alex Zelinsky

Chief Defence Scientist
25 August 2016

Chief Foreword

The National Security and Intelligence, Surveillance and Reconnaissance Division (NSID), while only three years old in its current form, nonetheless has a proud history of world-class technological achievement and of delivering significant operational capability.

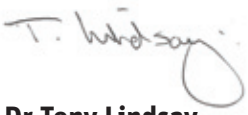
In fields ranging from space-based imaging to computational linguistics; from hyperspectral sensing to multi-hypothesis tracking; from facial biometrics to space-time adaptive radar processing; from electronic protection to first-order logics for symbolic reasoning – the Division continues to make fundamental, world-class contributions to science and technology applied to the defence of Australia and its national interests.

The 2016 Defence White Paper provides an analysis of our strategic environment to 2035. Essential to achieving the vision of a capable, agile and potent future force is a significant enhancement of Defence's ISR capabilities, including the formal acknowledgement of Defence's national security role in domestic counter-terrorism support. More than $25bn in ISR-related projects is identified in the Defence Integrated Investment Program in order to realise Defence's vision.

NSID has a central role to play in helping Defence achieve its aims. Exciting new opportunities in sovereign capabilities for space-based sensing, space situational awareness systems, wide-area surveillance systems, intelligence systems, advanced ISR platforms, and a commitment to develop truly enterprise-level ISR information architectures are all identified. The allocation of $730M of funding directed at partnerships for next-generation technologies is unprecedented, and will enable a rapid acceleration of the development of advanced ISR capabilities for the nation.

The NSID Strategic Plan 2016-2020 seeks to provide guidance on how the Division will approach these opportunities and challenges. Irrespective of the particular technological area, we will achieve our goals through maintaining our commitment to scientific and technical excellence, transition through demonstration, delivery through partnerships, and leverage through global collaboration.

My thanks to all those who provided guidance and assisted in the preparation of this plan, and to the highly talented staff of NSID who continue to re-define the limits on what we think is possible.



Dr Tony Lindsay

Chief National Security & Intelligence, Surveillance and Reconnaissance Division
25 August 2016

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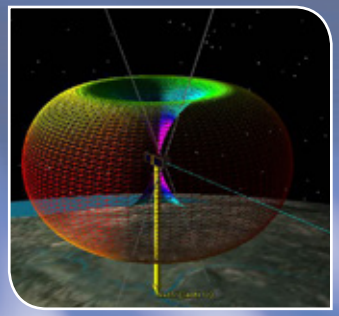

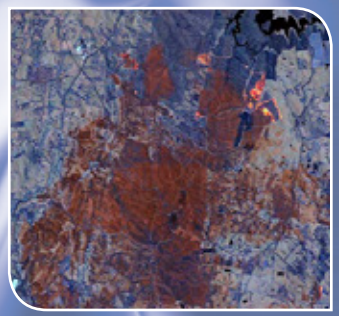

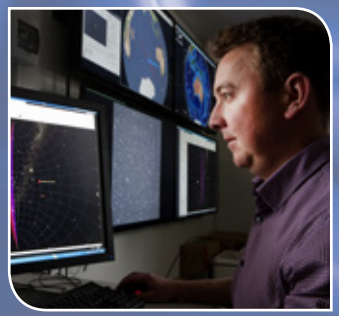

Introduction

We live in a world of increasing strategic complexity, in a region undergoing massive social and economic change. Disruptive technology is a feature of modern life, enabling new capabilities for Defence, but potentially creating new threats and vulnerabilities.

The 2016 Defence White Paper describes Australia's strategic outlook, and outlines Defence's strategy in responding to the security challenges we face. For the first time, the White Paper is accompanied by an Integrated Investment Program, setting out the plan to develop a more capable, agile and potent future Defence force. Science and technology is recognised as a core capability that is integral to achieving Defence's strategic aims.

The Defence White Paper stresses the importance of intelligence, surveillance and reconnaissance (ISR) in providing Defence with the comprehensive situation awareness that enables decision superiority. In partnership with industrial, academic and international collaborators, the role of the National Security and Intelligence, Surveillance and Reconnaissance Division (NSID) is to provide leadership in ISR science and technology to enhance Defence and national security capabilities.

In implementing its Strategic Plan, Defence Science and Technology (DST) Group is undergoing the most significant transformation in decades. DST has been restructured, is developing improved processes for setting investment priorities and is committed to a series of Strategic Initiatives to build on its strengths as a valued adviser, collaborative partner and innovation integrator for Defence.

As part of the DST Strategic Plan, NSID was formed three years ago, with the aim of merging the science and technology capabilities related to ISR sensing, processing and exploitation, within an integrated ISR enterprise. NSID was also given responsibility for whole-of-government national security science and technology policy development and program coordination.

This Strategic Plan sets out the mission, structure and roles of NSID, and outlines the strategic directions the Division will take in developing and applying science and technology for the Defence of Australia and its national interests. The Plan describes four Strategic Research Themes that span divisional structures, and outlines DST Strategic Research Initiatives in Integrated ISR and Space Systems led by NSID. The Plan shows how NSID will deliver its science and technology programs through collaborative partnerships, transitioning research excellence through to Defence capabilities.

> "To provide our forces with comprehensive situation awareness, the Government is strengthening Defence's intelligence, surveillance and reconnaissance capabilities. Defence's imagery and targeting capacity will be enhanced through greater access to strengthened analytical capability, enhanced support and space-based capabilities".
>
> **2016 Defence White Paper**


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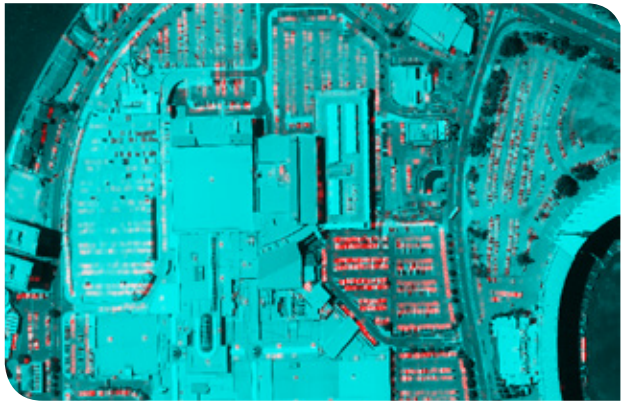


Strategic Context

Strategic Drivers and Technology Trends

Australia's strategic outlook and defence strategy are set out in the 2016 Defence White Paper. The DST Strategic Plan 2013-2018 provides the direction for Defence science and technology within this strategic context. These key documents, outline the strategic drivers and technology trends that shape the NSID research program.

The development of more capable regional military forces, the enduring threat of terrorism and the pace of global technological change are driving a greater emphasis on integrated ISR to provide battle-space awareness and enable superior Defence decision-making in the face of increasing complexity.

The strategic drivers and technology trends include:

- Advances in sensing, including passive radar, hyper-spectral sensing, imaging radar and next-generation high frequency radar offering new opportunities to detect and identify stealthy and low observable targets, with precision and at greater ranges;
- Increases in the volume, velocity and variety of data generated by networked sensors and systems, and the need to assure the veracity of data inputs, requiring "big data" analytics and automated sense making;
- Networked and integrated ISR systems that fully exploit both legacy Defence capabilities and new capabilities providing the force multiplier effect required by a joint force;
- Future military operations both at distance and in congested urban areas requiring persistent, pervasive and timely ISR over wide geographic areas and in complex and contested environments;
- The threat of terrorism, where non-State actors have ready access to advanced technology and global influence, continuing to draw on Defence to support whole-of-government counter-terrorism efforts;
- Assured access to space-based capabilities demanding a greater Australian contribution to collaborative space surveillance as the space environment becomes increasingly crowded and contested;
- Advances in small satellite technology, including miniaturised payloads with low power requirements and low-cost launch options, potentially providing new options for specialised capabilities, and assuring or maintaining access to space-based capabilities;
- Interoperability with the US and other allies, and access to US strategic surveillance systems, remaining vital for Australian Defence; and
- The delivery of niche, advanced Defence capabilities requiring collaborative partnerships with Australian industry, academia and international Defence research agencies.

Division Overview

Vision and Mission

NSID undertakes internationally recognised research and development with the intent to enhance Australia's capability to produce accurate, relevant, timely and actionable information for Defence warfighters and decision makers.

The NSID research program is driven by the capability needs of Defence. The 2016 Defence White Paper recognises that innovation drives Defence capability, and that Australia must harness and maximise the use of technology and novel solutions to meet future strategic challenges.

NSID research covers a broad range of disciplines from fundamental phenomenology studies through to advanced sensing and sensor processing, multi-source information fusion, data analytics, information integration, biometrics, computational linguistics, machine cognition and social networks analysis. NSID also leads the policy development for the coordination of Australia's science and technology program supporting non-Defence national security agencies across a wide spectrum of technology domains.

In partnership with Australian industry, academia and with international Defence research collaborators, NSID delivers science and technology to enhance the situation awareness - and hence the precision, lethality and survivability - of Australia's Defence Forces.

NSID Vision

To be the valued and trusted leader for intelligence, surveillance and reconnaissance research and development for the defence of Australia and its national interests

NSID Mission

To enhance Australia's capability to produce accurate, relevant, timely and actionable information to enable decision-making superiority for Defence, and to support whole-of-Government national security science and technology coordination and delivery.

Values

NSID embraces the Defence values of **professionalism, loyalty, integrity, courage, innovation and teamwork**.

Within NSID, these values underpin a particular approach to science and technology characterised by:

- **Technical Excellence:** stewardship of world-class science in niche sovereign capabilities, being recognised as a partner of choice within the global Defence research enterprise, with a reputation underpinned by quality peer-reviewed scientific publications combined with a practical ability to design and field world-leading technology demonstrators;

- **Openness:** within security constraints, encouraging free information exchange and research collaboration across organisational boundaries - locally, nationally and internationally - enabling new capabilities for the benefit of Australian Defence and national security; and

- **Imagination:** embracing risk in the pursuit of high impact innovation, accepting and learning from failure as well as success, in encouraging staff to re-define our understanding of the limits of the possible.

NSID Values

Together with the DST Values, NSID nurtures world-class technical excellence, openness to collaboration across technology domains, and imagination in the pursuit of high-impact innovation.

History and Achievements

NSID was formed in July 2013 through the merger of several research groups supporting Defence ISR capability development, together with DST's recently adopted national security science and technology program management and coordination functions.

NSID boasts a proud history of Defence scientific achievement.

Over four decades of research and experimentation in high-frequency radar underpin Australia's Jindalee Operational Radar Network (JORN). NSID continues to enhance the performance and mission effectiveness of JORN through capability upgrade project support and the development of new, advanced radar capabilities.

For almost two decades, NSID researchers have been developing automated processing and exploitation techniques for surveillance imagery and geospatial intelligence. The Analysts' Detection Support System (ADSS) has achieved international recognition for accelerating the transition of image processing algorithms to operational maturity.

NSID researchers have provided expert technical advice to numerous major Defence acquisition projects, enhancing capabilities and mitigating project technical risk. For example, NSID advice related to the electronically scanned radar and multi-sensor integration aspects of Australia's Wedgetail Airborne Early Warning and Control aircraft over more than 17 years has been crucial in realising the world-leading capabilities of the Wedgetail platform today.

NSID researchers have led the way for Australian Defence and national security in all-source intelligence analytics, ISR integration, biometric systems analysis, social network analysis, passive radar development, space situation awareness, and small satellite engineering and mission development. The NSID research program will continue to evolve and adapt in response to technology change and the priority capability needs of Defence.

[1] HMAS Darwin treated for first Gulf War;
[2] Automated feature extraction,
[3] Hornet radar/EW integration testing;
[4] Advanced multichannel HF radar equipment;
[5] Flight trial with divisional aircraft
Previous page [top] JORN Alice Springs receiver array;
[bottom] RAAF Wedgetail aircraft

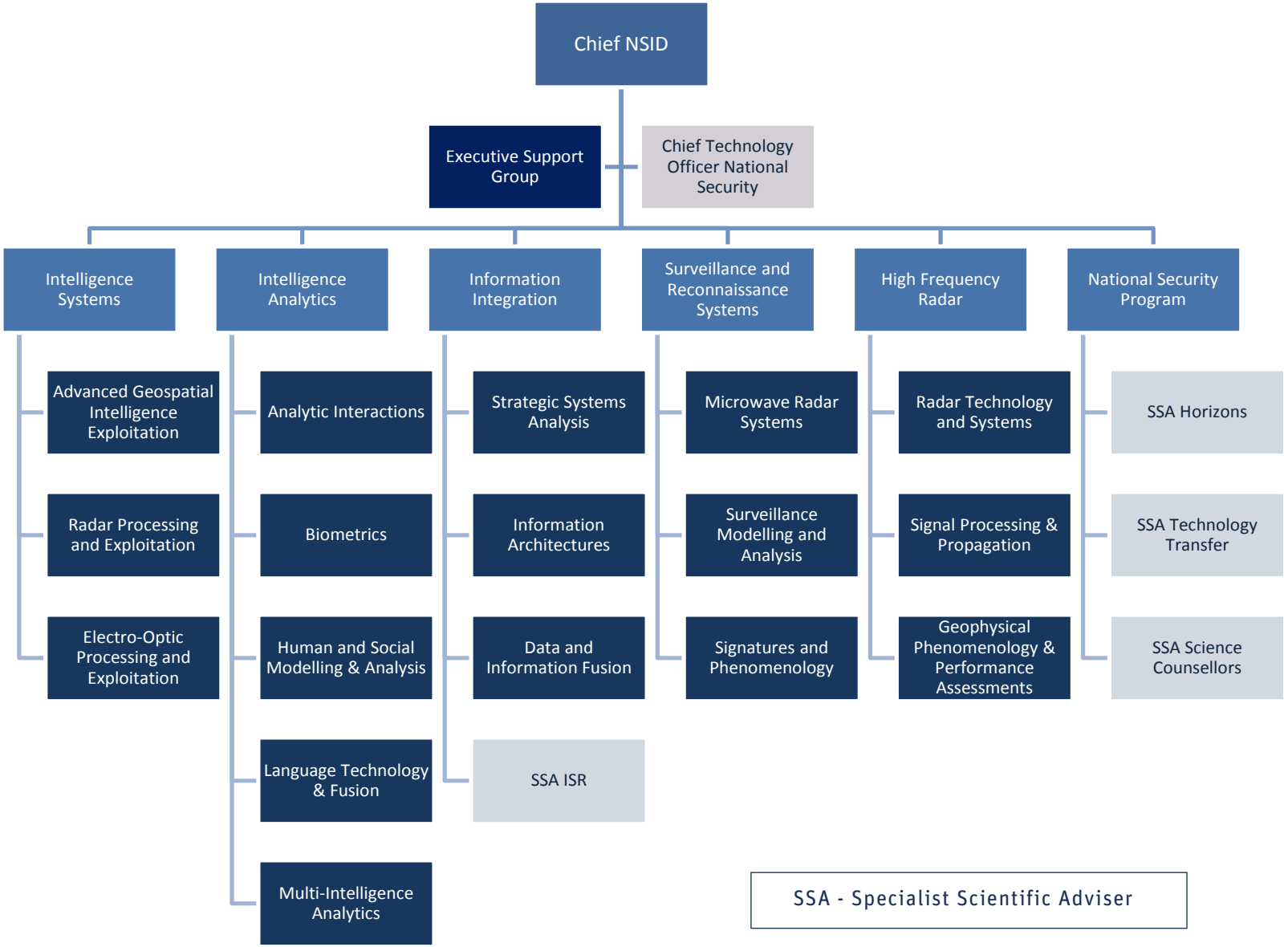
Division Core Roles

DST Role	NSID Role	Example
Operations	As its highest priority role, NSID responds immediately to urgent Defence and national security requests for operations support related to ISR capabilities.	NSID supported deployed airborne surveillance in Afghanistan to combat the threat posed by improvised explosive devices.
Sustainment	NSID supports the sustainment, improvement and operational effectiveness of Defence ISR systems, and provides scientific advice to enhance ISR system utilisation.	NSID has supported successive upgrades of JORN over two decades, introducing new capabilities developed through the NSID high-frequency radar research program.
Acquisition	NSID provides technical advice on ISR systems, system integration and the introduction into service for major Defence acquisition projects.	NSID leads DST's support in radar and sensor integration aspects of the Wedgetail AEW&C, Joint Strike Fighter and AIR 7000 Maritime Surveillance acquisition projects, providing science and technology advice into all project phases, from requirements definition through to introduction into service.
Future Proofing	NSID develops new or enhanced ISR capabilities for Defence and national security over the medium to longer-term timeframe, filling anticipated gaps in future capabilities.	NSID undertakes world-class research supporting the Australian Intelligence Community to automate the extraction of actionable intelligence from multiple data sources.

Extended and Supporting Roles

DST Role	NSID Role	Example
Advice to Government	NSID informs Defence and national security policy and strategy, providing evidence-based expert advice related to ISR systems, including airborne and space-based capabilities, ISR integration, and whole-of-government national security science and technology.	NSID has undertaken detailed analysis of surveillance and communications data from the final flight of MH370, assisting international search efforts in the Southern Indian Ocean.
National Security	NSID leads the coordination and delivery of national security science and technology, including the management of the DST National Security Program, with research in intelligence exploitation, biometrics and ISR systems supporting non-Defence national security agencies.	NSID consults widely with stakeholders in the national security community to develop whole-of-government national security science and technology policy and a delivery coordination framework.
Strategic Research	NSID undertakes strategic research into high-impact areas for future Defence ISR capability.	NSID leads DST's ISR Strategic Research Initiative (SRI) to enhance future Defence ISR integration and exploitation capabilities, and is developing a Space Systems SRI to enhance the Australian Defence Forces (ADF's) capabilities in space-related ISR systems.
Emerging Futures	Within its science and technology domain, NSID conducts horizon scanning to gain knowledge and understanding of emerging threats and opportunities for Defence and national security.	NSID has identified the game-changing potential for Defence of emerging passive radar technologies, and is seeking to develop capabilities and characterise vulnerabilities arising from passive radar.
Partnerships	NSID leverages world-leading ISR and national security science and technology through collaboration with industry and with domestic and international research partners.	NSID undertakes transformational research and development with five-eyes partners in geospatial intelligence, and measurement and signature intelligence, under the SQUAREDANCE Memorandum of Understanding (MoU).
Outreach	NSID participates in the promotion of defence science and education in the broader Australian community.	NSID hosts science, technology, engineering and mathematics (STEM) students in work placements and vacation scholarships.

Division Structure



Major Science and Technology Capabilities

NSID maintains five Major Science and Technology Capabilities (MSTCs) and the National Security Science and Technology Centre, together with divisional executive and support functions.

MSTCs are defined by their science and technology expertise, Defence and national security domain knowledge, specialist facilities and research infrastructure, and external research partnerships. The MSTCs are managed collectively as branches of NSID with each led by a Research Leader.

The MSTCs are:

- Intelligence Systems
- Intelligence Analytics
- Information Integration
- Surveillance and Reconnaissance Systems
- High Frequency Radar

The National Security Science and Technology Centre is led by a Program Leader, working with the Chief Technology Officer National Security, who is responsible for strategic policy development and leadership of the DST T2 Strategic Initiative to invigorate Australia's national security science and technology.

Intelligence Systems (IS):

Conducts research and development into systems for geospatial intelligence (GEOINT), electro-optical and radar measurement and signature intelligence (MASINT), and imagery-based capabilities, with a focus on strategic intelligence systems and space-based sensors.

The branch leverages extensive research collaboration with international partners. The research and development within the IS MSTC covers phenomenology measurement and modelling, sensor system design, and data processing and exploitation in a multi-source/multi-INTframework.

There is an emphasis in the research program on persistent surveillance, the detection of subtle signatures, and the automated processing and exploitation of large data volumes using advanced algorithms such as deep learning for automated imagery analysis and feature extraction.

MSTC Goals:

- Advanced Imagery Sensing
- Geospatial Intelligence Automation
- Future Geospatial Concepts and Experimentation

Major Science and Technology Capabilities

Intelligence Analytics (IA):

Conducts applied research in data and human sciences to extract, fuse and disseminate meaningful content from intelligence data to improve the situation awareness of analysts within the Australian Intelligence Community. Data science applications include information extraction from unstructured linguistic data, text analytics, speech and audio analytics, image and video biometrics, data mining and symbolically based high-level information fusion.

Human science capabilities comprise social and cultural analysis, cognitive and behavioural analysis, and the mathematical and computational modelling of these elements. Cross-disciplinary data and human science capabilities are applied to research, develop and evaluate human-computer environments, including for information retrieval, exploratory visualisation, visual analytics, and biometrics applications.

The IA MSTC distinctively addresses the Human Intelligence (HUMINT), Open Source intelligence (OSINT) and All-Source Intelligence (ASINT) aspects of the intelligence space.

MSTC Goals:

- Identity Intelligence
- All Source Intelligence Analytics
- Social Influence

Information Integration (II):

Conducts research and development that spans Defence enterprise ISR systems analysis, integrated ISR exemplar development, geospatial information architectures, and multi-sensor data and information fusion.

The II MSTC develops and applies ISR systems assessment techniques, software constructs for Integrated ISR Enterprise, and target tracking and multi-sensor fusion algorithms, with an emphasis on aerospace applications.

The II MSTC includes space situation awareness (SSA) research in collaboration with international partners, and leads DST's research efforts in small satellite development for Defence applications. A major focus of the II MSTC is the iterative development and operational trialling of ELIIXAR, the Evolutionary Layered ISR Integration Architecture.

MSTC Goals:

- Integrated ISR Enterprise Analysis and Experimentation
- Multi Source Data Analysis and Information Fusion
- Integrated ISR Architecture Development and Demonstration

Major Science and Technology Capabilities

Surveillance and Reconnaissance Systems (SRS):

Conducts research into advanced technologies for operational surveillance and reconnaissance sensor systems, the associated signatures and phenomenology; and sensor system performance assessment and protection in Defence and national security applications.

Technologies include active and passive radar (excluding HF radar), radar discrimination, radar image based techniques, electro-optical and infra-red sensing, multi-spectral and hyper-spectral sensing, incorporating the associated sensor signal processing, electronic protection, data processing, sensor control and system interfaces.

The SRS MSTC includes the sovereign capability for radar signature prediction and measurement.

MSTC Goals:

- Countermeasures to Low Observables
- Radar System Electronic Protection
- Advanced Radar Target Classification
- Passive Radar Capability Demonstration
- Sensor System Integration

High Frequency Radar (HFR):

Conducts research and development into all facets of the science and technology of radar operating in the high frequency and low very-high frequency bands (3-45 MHz). This includes sky wave, surface wave, line-of-sight, passive, and hybrid high frequency radar systems, in mono-static, bi-static and multi-static configurations.

Application areas include wide area surveillance for air and surface targets, high frequency measurement and signature intelligence (HF-MASINT) and high frequency electronic intelligence (HF-ELINT) functions, missile detection and tracking, and the surveillance of space.

MSTC Goals:

- HF Radar Design and Operations
- HF Performance Analysis and Ionospheric Effects
- HF Signal Detection and Electronic Warfare
- Advanced HF Radar Experimentation
- Future HF Radar Concepts

Facilities and Infrastructure

NSID maintains a wide range of specialist research facilities and infrastructure that are integral to its MSTCs, and which support the NSID mission to develop and enhance Defence ISR capabilities. These facilities include:

- The Defence Experimentation Airborne Platform (DEAP), a Beech 1900C aircraft configurable with a range of sensors including high-resolution motion imagery sensors, hyperspectral sensors and imaging radar, to trial and experiment with airborne ISR processing, exploitation and dissemination;
- The Virtual Laboratory supporting international research collaboration in strategic ISR systems exploitation;
- An anechoic chamber for far-field radar signature measurement and characterisation;
- The ISR Analysis and Integration Laboratory (ISRAIL) together with the Deployable ISR Container Environment (DICE), to demonstrate and operationally trial integrated ISR concepts for Defence;
- A suite of in-situ and deployable high-performance HF radar experimental hardware, systems assembly and test facilities, including an HF antenna test field, HF spectrum monitoring equipment and long-baseline HF environment measurement databases;
- Space Situation Awareness telescopes and supporting infrastructure;
- Electro-optical sensor characterisation, calibration and field trials facilities; and
- Radar research and experimentation infrastructure, including the Ingara imaging radar, a deployable passive radar capability demonstrator, antenna and radar test facilities and radar signature field measurement systems.

NSID will develop its research facilities and infrastructure guided by the Defence ISR capability needs outlined in the 2016 Defence Integrated Investment Program plan. Given the strategic drivers and technology trends identified earlier, anticipated areas for research infrastructure investment are:

- Security accredited facilities for all-source intelligence analytics and exploitation for Defence and national security agencies;
- Strategic integrated ISR research facilities, supporting cross-domain, and multi-level security strategic-to-tactical ISR integration, to develop and demonstrate enhanced situation awareness for warfighters and intelligence analysts;
- Advanced sensors research facilities, supporting electronic protection, passive sensing, imagery intelligence, electro-optical and radar systems development and evaluation; and
- Facilities for space situation awareness and exploitation of space-based capabilities, including small satellite mission development and control.

Investment in enhanced research facilities will complement access to research infrastructure achieved through partnerships with Australian industry and academia, and with international Defence research partners.

Strategic Research Themes

Essential Program Characteristics and Strategic Themes

In charting the future direction for NSID to 2020 and beyond, four **Essential Characteristics** of the NSID research program are highlighted. These are:

- **Science and technology excellence,** demonstrated by peer reviewed publications and international technical benchmarking, supporting the NSID reputation as a valued adviser and a trusted partner of choice for research collaboration;
- **Transition of research through to capability** via operational demonstration within standard ISR integration architectures, with transition plans tailored for individual ISR stakeholders, and with early consideration given to the "cost of success" of ongoing capability support requirements;
- **Delivering through partnerships** with Australian industry and academia, to bolster the breadth of science and technology that may be harnessed for Defence and national security, and facilitate the maturing of research to Defence capability; and
- **Strength of international research collaboration** with the United States and other allies, with collaborative research and development of advanced ISR systems, and joint development of ISR capabilities supporting shared strategic interests.

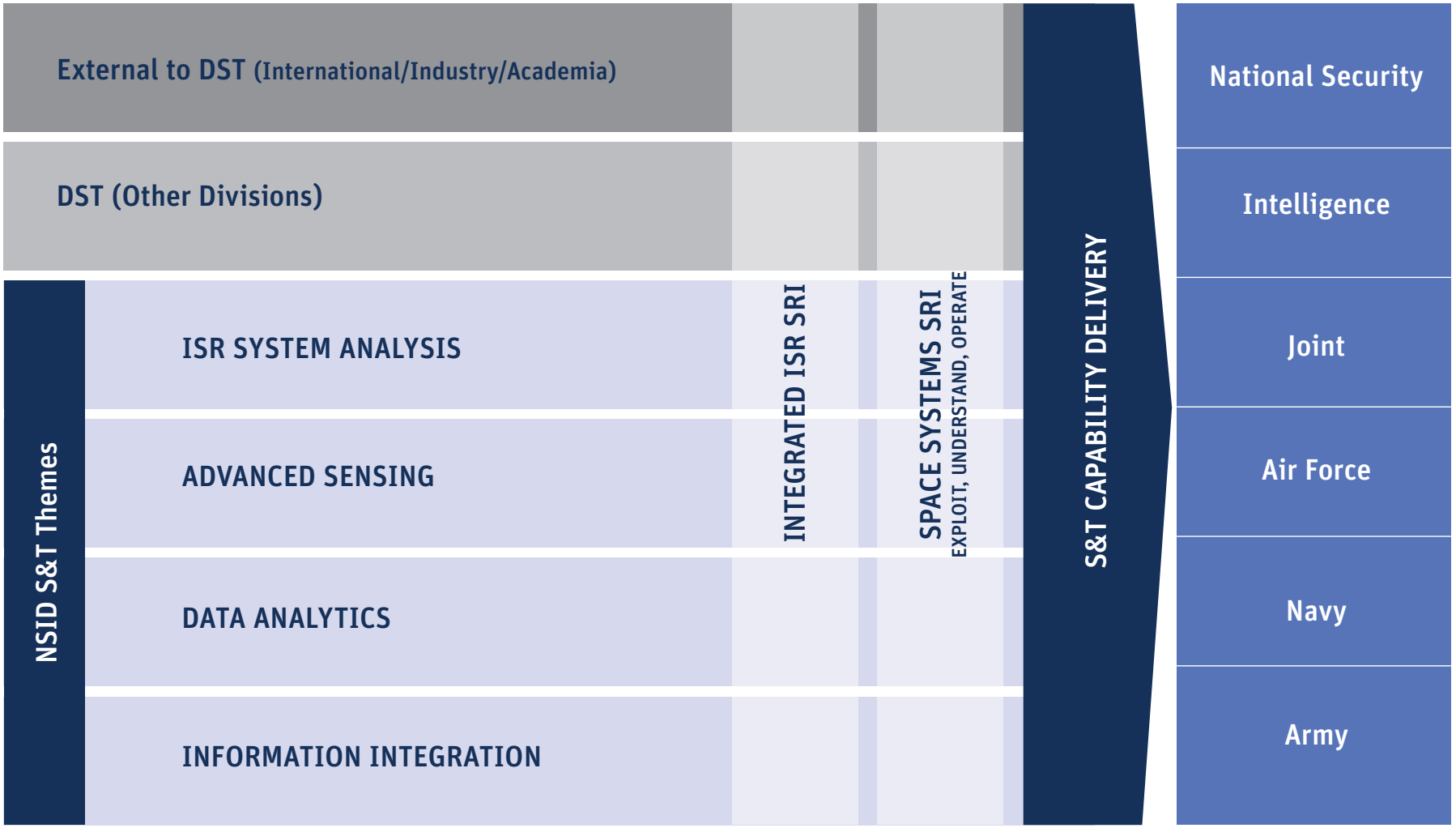
Science and technology excellence underpins the credibility and value of all NSID's support to Defence and national security agencies. Through high quality research, NSID gains access to sensitive defence science programs in the United States and other allied nations, thereby significantly leveraging Defence's science and technology investment. Through collaborative research partnerships with universities and industry, NSID is able to harness national and international expertise to maximise the impact of its science and technology to Defence, and to facilitate the transition of research into operational capability for Defence and the national security agencies.

In response to the strategic outlook articulated in the 2016 Defence White Paper and the Defence Integrated Investment Program, four integrating Strategic Research Themes have been identified for NSID science and technology, each drawing on the major science and technology capabilities (MSTCs) in NSID and partnering with MSTCs in other DST divisions. The Strategic Research Themes are:

- ISR Systems Analysis
- Advanced Sensing
- Data Analytics
- Information Integration

NSID also leads two DST Strategic Research Initiatives (SRIs), the Integrated ISR SRI and the Space Systems SRI.

Strategic Research Themes and Initiatives



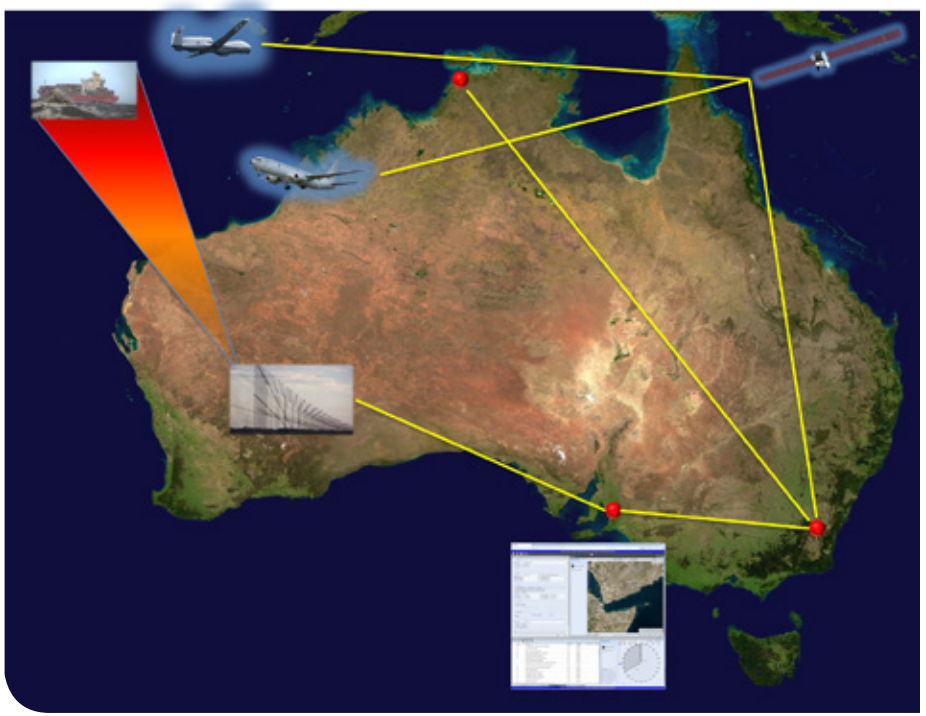
ISR Systems Analysis Theme

The Defence ISR enterprise comprises sensors, data sources, network links, data processing, and decision or command nodes, supporting a range of military operational and intelligence functions. The 2016 Defence White Paper identifies integrated ISR as a core enabling capability underpinning decision superiority for the warfighter.

The ISR Systems Analysis Theme will apply systems engineering, modelling and analysis to inform Defence enterprise integrated ISR capability development. An emphasis for the theme will be on **cross-domain strategic-to-tactical ISR integration and space-enabled capabilities**. The theme will provide Defence with well-informed, coherent, cross-domain technical support to realise the potential of major ISR systems in acquisition, and enable superior exploitation of space-based and intelligence sources for Defence operations. The theme will also provide guidance for DST research contributing to ISR systems integration and exploitation.

The ISR Systems Analysis theme will take a campaign approach to enterprise integrated ISR systems modelling and analysis, leveraging international research collaboration in concept development and demonstration to enhance the exploitation of strategic systems (including space-based systems) by the warfighter. The theme will develop and foster technical skills in systems engineering, systems architectures, modeling and simulation, network and complexity theory, and conceptual analysis for the integrated ISR enterprise.

The ISR Systems Analysis theme will inform major Defence programs delivering the future networked joint force (e.g., Air Force Plan Jericho, Army Plan Beersheba, Navy Plan Pelorus); support the integration of new ISR platforms into the Defence enterprise, advise the Vice Chief of Defence Force Group as the authority for joint capability development, and explore new game-changing Defence ISR systems concepts.



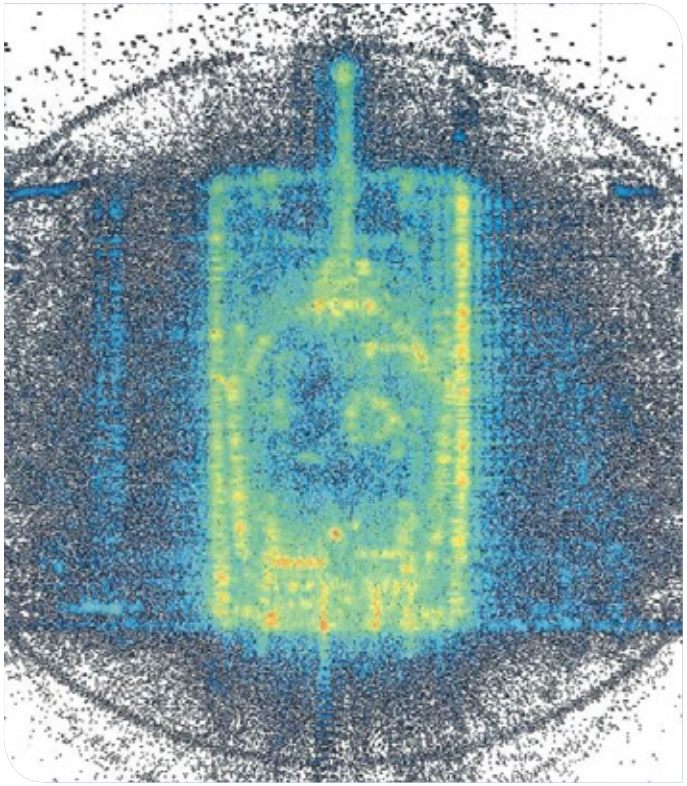
Advanced Sensing Theme

Advances in sensor technology offer new opportunities to detect, identify and infer the intent of subtle and low observable targets in challenging and cluttered environments. Advanced sensors in the service of potential adversaries increase own-force vulnerability. More capable sensors contribute to an enhanced situational awareness picture at extended ranges, thereby addressing area denial and anti-access challenges.

The Advanced Sensing theme will integrate NSID expertise in sensor technology across the electromagnetic spectrum, to **address complex sensing challenges facing the ADF and national security agencies**. Activities will include sensor system design and development, research into physical phenomenology impacting sensor system performance, and operational trials of new sensor capabilities.

The Advanced Sensing theme supports research that will:

- Develop the next generation of high-frequency radar capabilities and applications, including improving the detection of small fast targets in poor ionospheric propagation conditions, tracking slow targets in distributed clutter, investigate new radar applications of emerging ultra-low phase noise high stability oscillator technology, and demonstrate new line-of-sight high frequency radar applications for space surveillance and missile defence;
- Research and develop novel approaches for countering low-observable targets and achieving non-cooperative target recognition in electronically contested environments, through the application of advanced waveforms, signal processing and electronic protection methods, supported by a multifunction active electronically scanned array (AESA) radar test bed;
- Develop and assess Defence applications for passive coherent location using electromagnetic transmissions of opportunity, with an emphasis on utilising globally available signals, and demonstrate passive radar concepts using operational test beds; and
- Develop and characterise advanced processing and intelligence exploitation techniques for imaging radar, hyper-spectral and hyper- temporal sensors, foliage penetrating radar and full motion video surveillance.



Data Analytics Theme

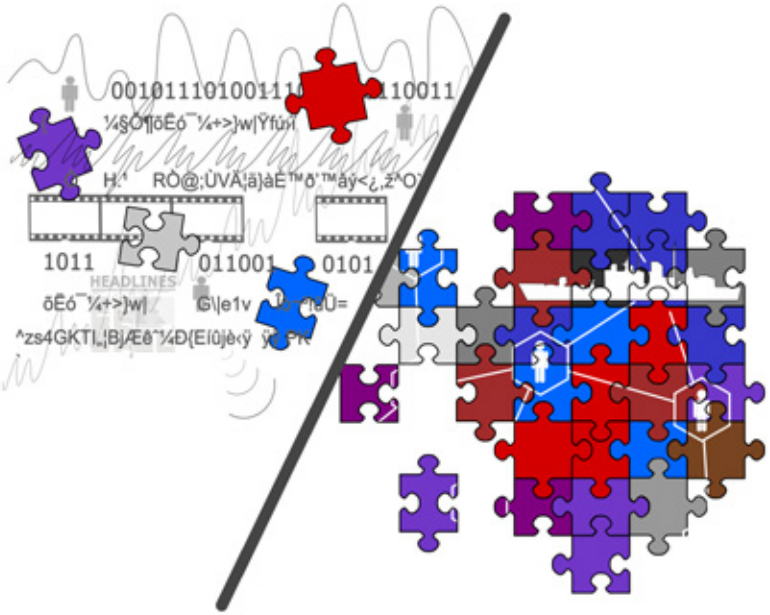
To achieve decision superiority, Defence must effectively exploit large volumes of ISR data from multiple sensor sources, together with open source and contextual information to enhance situation awareness. The deluge of data and wide variety of information available challenges the capacity of intelligence analysts and warfighters to generate timely, actionable intelligence tailored to operational needs. The planned acquisition and utilisation by Defence of more capable ISR platforms promises enhanced situation awareness, but exacerbates the data processing and exploitation challenge. Effective exploitation of wide-area surveillance imagery obtained from air and space platforms, and the vast volume of intelligence data obtainable through the Internet and other sources, demands Defence implement automated data processing and decision support.

The Data Analytics theme will **develop and demonstrate advanced techniques for automated processing, exploitation and dissemination (PED) of ISR data and all-source intelligence information**.

The Data Analytics theme supports research that will:

- Develop techniques for automated reasoning, machine-assisted inference and data visualisation applied to imagery intelligence (IMINT), measurement and signatures intelligence (MASINT), human intelligence (HUMINT), geospatial intelligence (GEOINT) and the automated fusion of multi-INT sources;
- Develop and apply techniques for identity intelligence, including natural language processing, speech recognition, text processing and biometrics data analysis;
- Develop and demonstrate multi-source tracking and identification algorithms utilising data from heterogeneous networked ISR sensors from ground, maritime, air and space platforms; and
- Apply human and social modelling and analysis techniques to understand social networks, social influence, sentiment, motivation and intent.

The Data Analytics theme will support Defence intelligence and national security agencies to enhance their capabilities to process and exploit multi-source intelligence. The Theme will demonstrate automated PED for the Defence ISR enterprise, with an emphasis on the enhanced exploitation of strategic ISR for Defence operations.



Information Integration Theme

Defence and intelligence ISR integration is inherently dynamic and complex, requiring agility to meet changing user requirements, address emerging threats, accommodate new ISR systems, and effectively exploit rapidly advancing ICT technology. Conventional Defence acquisition models are ill suited to deliver integrated ISR capability.

Defence is acquiring new capabilities that will generate ISR data in far greater volumes than was previously available. The intelligence community accesses data from multiple disparate intelligence sources, together with open source intelligence and contextual information, from which actionable intelligence must be derived. The efficient exploitation of imagery intelligence from air and space platforms presents particular challenges, where the data deluge overwhelms analyst processing capacity.

The Information Integration theme, informed by the enterprise ISR Systems Analysis theme, **will develop and demonstrate the critical enterprise ISR information integration architectures**, that will:

- Inform military and intelligence concepts and user requirements through operational trials;
- Demonstrate cross-agency and coalition ISR integration through service-oriented and cloud-based architectures and standards, accommodating multi-level security and decentralised operations;
- Demonstrate timely and effective processing, exploitation and dissemination (PED) of information across an integrated ISR enterprise, including the data fusion, data visualisation and automated reasoning developed under the Data Analytics theme; and
- Exercise agile and incremental development processes for Defence and national security ISR systems to explore alternative integrated ISR acquisition methodologies.

The Information Integration theme will inform Defence enterprise ISR integration acquisition projects (e.g., JP2096, JP2064), support service-specific PED programs (e.g. Air Force DGS-AUS, Army deployable ISR PED), and demonstrate exemplar all-source and geospatial information infrastructure and services for military operations and intelligence analysis.

Program and Partnerships

Defence Program

The NSID science and technology program comprises:

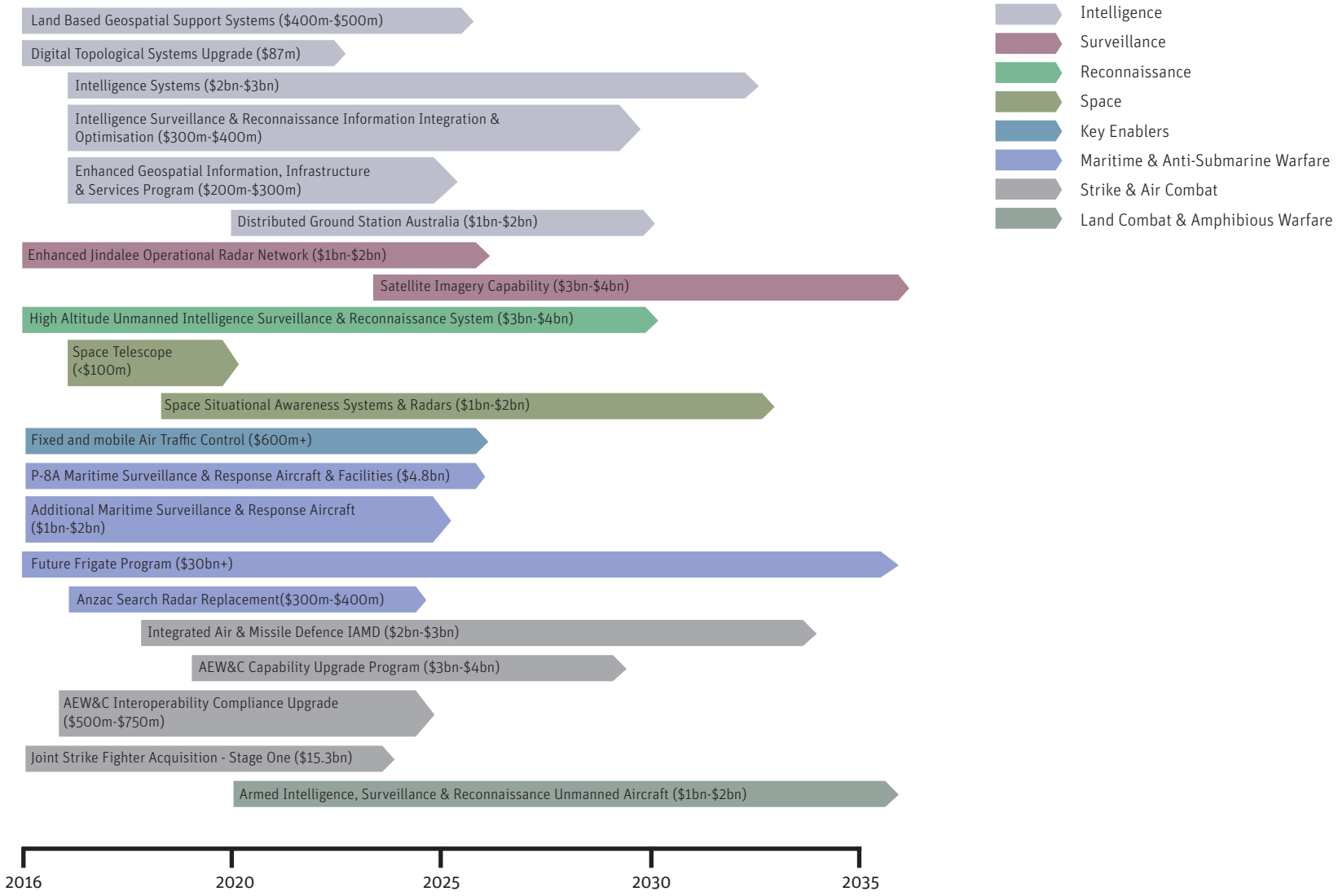
- the **Defence Program** meeting Defence client requirements articulated in consultation with Defence stakeholders through DST's program management processes;
- Contributions to DST **Strategic Research Initiatives** to deliver game-changing Defence capabilities over the medium to long term; and
- Research contributing to the **National Security Program** benefiting non-Defence national security agencies.

The Defence White Paper provides the strategic context and capability development framework for the NSID science and technology program for Defence. The White Paper outlines six Defence capability streams that will be strengthened to achieve the Defence objectives. Within DST, NSID takes the lead in the ISR and Space components of the **ISR, Electronic Warfare, Space and Cyber** capability stream that will ensure superior situational awareness, and supports the ISR aspects of the **Maritime and Anti-Submarine Warfare, Strike and Air Combat**, and **Land Combat and Amphibious Warfare** capability streams (excluding under-sea ISR systems, for which Maritime Division is the research program lead).

The 2016 Integrated Investment Program sets out the plan to acquire and enhance Defence capability over the next 10 years. NSID will lead DST support for several major projects, including JORN upgrades, air defence network enhancements, new space situational awareness systems, the modernisation of all-source intelligence systems supported by advanced processing capabilities, an enhanced capacity to generate and exploit satellite and geospatial imagery, new and enhanced unmanned ISR capabilities, and ISR systems integration and optimisation. NSID will also support the ISR aspects of major air, land and maritime projects, including the P-8A Poseidon and MQ-4C Triton maritime patrol aircraft, the F-35A Joint Strike Fighter, major maritime surface combatants, upgrades to the Wedgetail airborne early warning and control aircraft, integrated air and missile defence, and enhanced battlespace awareness for land and amphibious forces. The combined proposed investment in major ISR-specific systems is in excess of $25bn.

The Integrated Investment Program also identifies a number of priority areas for Defence science and technology investment. NSID takes the lead in two of these priority areas aligned with DST Strategic Research Initiatives, namely **Integrated ISR** for battlespace awareness and decision superiority, and **Space Systems** to improve the resilience of Defence's access to space derived information, including operational imagery and targeting. **Advanced Sensors** are also identified among new technologies presenting potential future threats or opportunities, where NSID will make a significant contribution.

Defence Integrated Investment Program: Programs supported by NSID



Integrated ISR Strategic Research Initiative

Defence is acquiring new ISR systems through a number of major projects and is seeking to integrate these systems with extant Defence capabilities.

In a region with increasing platform parity, long-range threat systems and capabilities for area denial, situational awareness with "strategic reach" becomes essential. This requires effective enterprise ISR integration and interoperability both within the ADF and with allies. Increasing data volumes, reduced decision timelines and the wide variety of data available exacerbates the challenge. By actively developing and trialling end-to-end exemplar ISR systems, DST is well-positioned to provide informed advice for the acquisition and integration of current and future operational ISR systems.

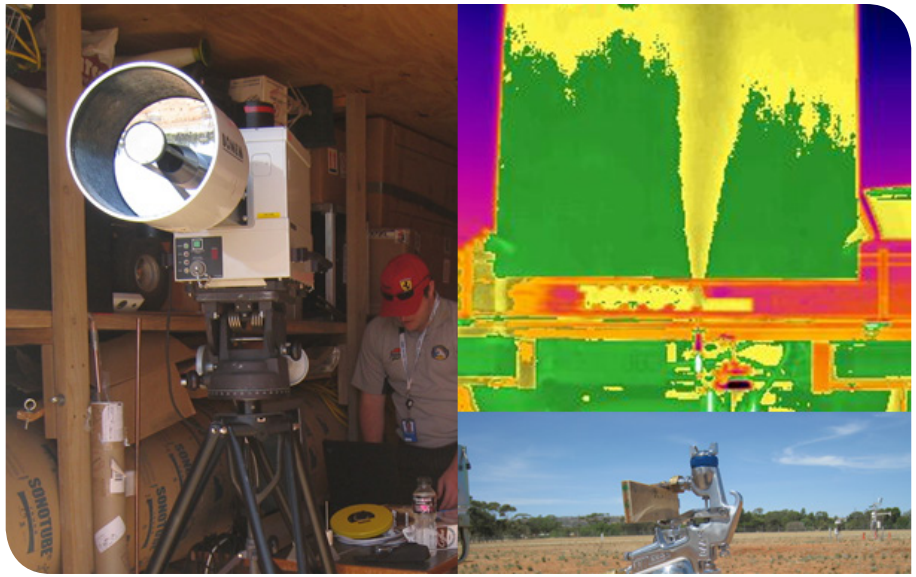
The Integrated ISR SRI demonstrates advanced ISR integration concepts, including sensing technologies, exploitation algorithms and enterprise integration approaches. **One capability vision is to enable routine long range situational awareness, threat detection, attribution of intent, and targeting**.

The Integrated ISR SRI focuses on:

- **Advanced sensing technologies**: developing concepts for the exploitation of emerging electro-optic sensors, including hyper-spectral and hyper-temporal imaging and imaging radar, and passive radar development and demonstration.
- **Data analytics**: automating sense-making from large volumes of heterogeneous ISR data, including unstructured text, biometrics, and multi-source intelligence.
- **Integrated enterprise ISR architectures**: developing and operationally trialing exemplar systems to integrate ISR data to support the war fighter, intelligence analyst and Defence decision-maker.

The Defence Airborne Experimental Platform (DEAP) will be enhanced to incorporate high resolution wide-area electro-optic sensor capabilities, together with ground-based exploitation facilities, to operationally trial and demonstrate large-volume intelligence data exploitation.

The Evolutionary Layered ISR Integration Architecture (ELIIXAR) will be developed and trialled as an exemplar architecture for Defence enterprise ISR integration. Planned ELIIXAR enhancements include the ingestion of new data types, the exploration of multi-level security models and cloud-based architectures, operational trialling against new priority Defence mission threads, application to strategic and space-based ISR systems, and demonstrating the tactical exploitation of national capabilities.

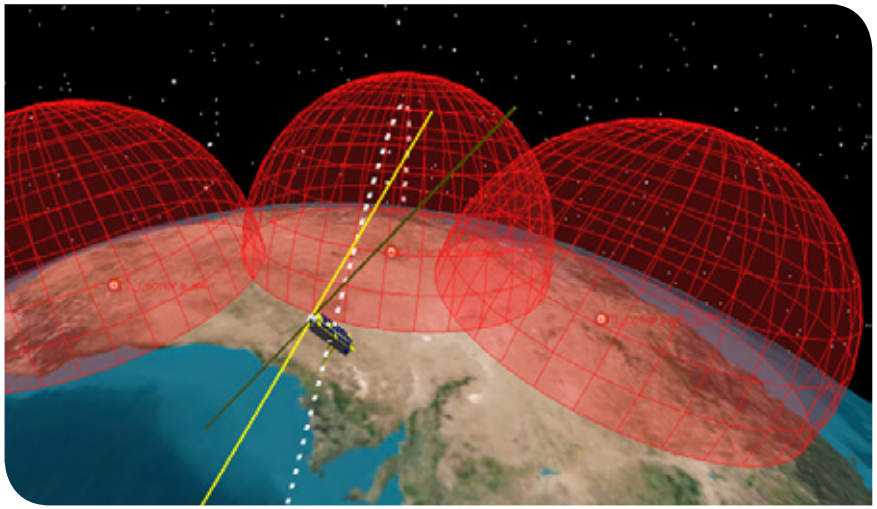


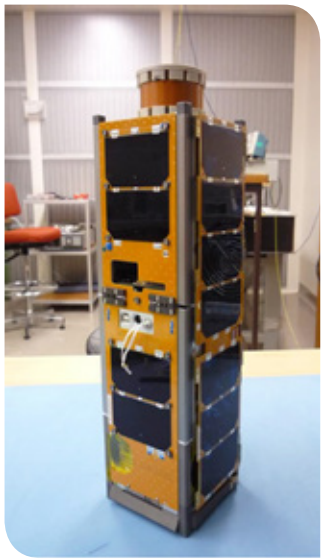
Space Systems Strategic Research Initiative

Both the 2016 Defence White Paper and the Defence Space Policy recognise that access to space-based capabilities is a national strategic priority for day-to-day functions across the community. Defence has a significant dependence on and enduring requirement for space-based capabilities that provide “strategic reach”. Defence needs to develop a deeper understanding of the science and technology of space systems, and have a workforce with knowledge and experience across the domain to underpin investment decisions in space-based capabilities.

DST will develop science and technology expertise in space systems through the Space Systems Strategic Research Initiative (SRI). Major themes of the Space Systems SRI are:

- **Understand** the space environment and objects in orbit. Defence has partnered with the United States Air Force in Space Situational Awareness with the hosting of US assets in Australia. The SRI will demonstrate new sensor cross cueing, data fusion and tracking methods to improve object orbit knowledge, research and develop new sensing approaches to expand surveillance and characterisation capabilities, and investigate system information architectures;
- **Operate** systems through a small satellite program supporting the research, development and operation of niche communications and surveillance capabilities. This program will leverage falling barriers to entry for small satellite systems, opportunities provided by international partners and the growing academic and industry programs in Australia. Over the next four years, DST will participate in at least four missions, leading the payload and mission aspects of two missions; and
- **Exploit** space-based ISR through processing automation, machine understanding approaches to mission optimisation and decision support tools. This program will demonstrate exemplar capabilities for transition, and in conjunction with the other themes, provide advice on future end-to-end capabilities for Australian mission scenarios.





National Security S&T Program

The National Security Science and Technology Centre (NSSTC) within NSID leads DST's efforts in whole-of-government national security science and technology coordination and leadership, including the development of strategic policy, program management processes and governance arrangements, and responding to Government's national security science and innovation priorities. These priorities are:

- Cyber and electronic security,
- Intelligence exploitation,
- Border security and identify management,
- Preparedness, protection and incident response, and
- Investigative support and forensics.

Through the NSSTC, NSID works with other DST divisions, external science and technology providers, national security agencies and government departments, to develop research programs addressing these priority areas. Specifically, NSID will:

- Seek government approval of national security science and innovation policy and priorities;
- Establish national security science and technology governance arrangements with key government agencies and stakeholder communities;
- Develop the DST National Security Program to effectively leverage Defence science to support non-Defence national security operations and capability development;
- Implement the approved National Security business model and plan for DST management of national security science and technology, including requirements elicitation processes, funding mechanisms, external agency partnership arrangements, project management and reporting obligations, utilising extant DST Defence program management processes where feasible;
- Foster international national security collaborative research agreements with the United States Department of Homeland Security, the United States Combating Terrorism Technical Support Office, the Home Office and Dstl in the United Kingdom, DRDC in Canada and with other nations through Defence science collaborative arrangements and in support of science diplomacy efforts in the region; and
- Support non-Defence national security agencies in developing cross-cutting, multi-agency funded science and technology programs aligned with Government priorities, in partnership with science and technology providers.

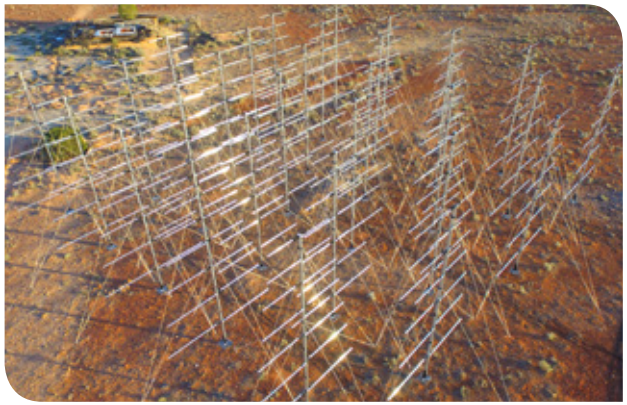
Through the NSSTC, NSID will partner with key Government agencies to achieve National Security S&T outcomes, including:

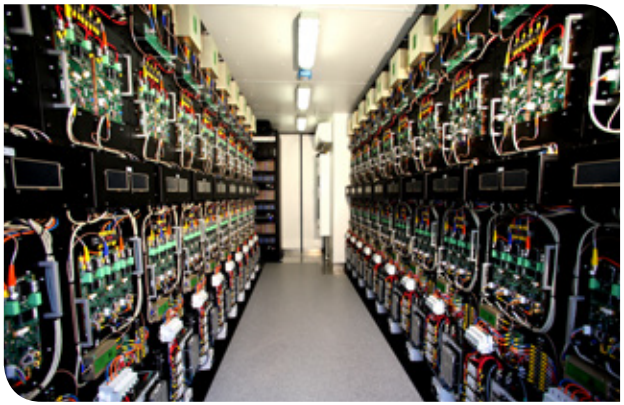
- Attorney-General's Department
- Department of Foreign Affairs and Trade
- Australian Federal Police
- Australian Criminal Intelligence Commission
- Department of Immigration and Border Protection
- The Australian Intelligence Community
- Commonwealth Scientific and Industrial Research Organisation
- Australian Nuclear Science and Technology Organisation

Defence ISR Support in DST

Every Division in DST contributes science and technology support to Defence's intelligence, surveillance and reconnaissance capabilities. The NSID program focuses on Defence enterprise integrated ISR, strategic and major operational sensors, and intelligence capabilities. NSID supports other DST Divisions who lead in the air, land, maritime and cyber domains, and draws on the expertise of other divisions in communications, tactical data links, mission systems, operational analysis, command and control, tactical ISR integration, signals intelligence, and platform integration.

DST Division	S&T Contributions to Defence ISR Capabilities
Cyber and Electronic Warfare Division	Cyber security, communications, signals intelligence (SIGINT) collection and processing, laser technologies
Weapons and Combat Systems Division	Tactical networks, combat mission system information integration, targeting systems
Joint and Operations Analysis Division	Joint capability analysis, operations analysis, command and control and decision sciences
Maritime Division	Acoustic intelligence (ACINT), under-sea sensing, materials, EO/IR, signatures
Land Division	Tactical networks, ISR systems information integration, niche ISR for Special Forces, tactical ISR sensors
Aerospace Division	Air platform integration, aircraft performance, materials, EO/IR signatures





People

Communication and Developing People

The technical and professional expertise of NSID staff, and their capacity to work together and with others, is vital for the delivery of science and technology for Defence and national security. Mechanisms to develop staff expertise and experience, and to enhance communication across organisational boundaries, are actively fostered throughout the Division.

Training and Career Development

All NSID staff are encouraged to take responsibility for managing their careers, utilising the corporate tools developed under the O2 DST Strategic Initiative, in consultation with supervisors, mentors and senior managers.

Staff training and mobility are encouraged, through professional development courses, the completion of postgraduate qualifications, temporary transfers to duties in other work areas, external staff placements and research fellowships with universities, industry and international collaborative partners. As staff traverse their career pathway, they may supplement their technical and professional depth in areas of enduring Defence demand with a breadth of management skill and leadership qualities vital for future senior corporate roles.

Diversity

Within NSID, the diverse range of people and roles contributing to Defence and national security science and technology outcomes is valued and recognised. Together with scientists, engineers and analysts, research support staff are critical for their contributions in a wide range of essential functions, including workplace health and safety, security, business and program management, finance and administration.

NSID values workplace diversity, encourages gender equity, and supports Defence and DST initiatives promoting indigenous engagement and community outreach supporting science, technology, engineering and mathematics (STEM) education and awareness.

Recognition and Rewards

NSID recognises and promotes the achievements of all staff, through nominations for DST and external awards, divisional awards and regular public acknowledgement of staff accomplishments and contributions.

Communication and Feedback

Effective communication across technology domains and throughout the NSID management structure is vital for the successful delivery of the NSID research program. Weekly NSID leadership meetings provide an informal link between the divisional senior managers and the DST Leadership Team. Research Leaders meet regularly with Group Leaders, who in turn discuss corporate and divisional issues with their work teams. Quarterly NSID Executive meetings and biannual Division meetings provide additional cross-divisional communication and information sharing opportunities.

Staff feedback is actively sought by NSID leaders, both through formal mechanisms such as corporate Insight Surveys, and through informal discussion. NSID senior leaders commit to consider and act on recommendations made by staff through Insight Action groups. The contributions of all staff are valued in enhancing the effectiveness of NSID management processes and in building a harmonious and productive workplace.

Executive Leadership Team

Dr Tony Lindsay,
Chief NSID

Chief Technology Officer,
National Security (vacant)

Dr Paul Johnson,
Program Leader
National Security Program

Dr Dale Lambert,
Research Leader
Intelligence Analytics

Mr Brenton Bennett,
A/Director S&T Programs

Dr Gordon Frazer,
Research Leader
High Frequency Radar

Dr John Percival,
Research Leader
Information Integration

Dr Jolanta Ciuk,
Director Coordination

Dr Andrew Shaw,
Research Leader
Surveillance and
Reconnaissance Systems

Dr Nick Stacy,
Research Leader
Intelligence Systems

For further information please contact:

Director Coordination, National Security & ISR Division

Tel: (08) 7389 6832

Email: NSIDDirCoord@dsto.defence.gov.au

Web: www.dst.defence.gov.au