TRUSTED AUTONOMOUS SYSTEMS
DEFENCE CRC

Current Initiatives & Opportunities

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NEXT GENERATION TECHNOLOGIES FUND

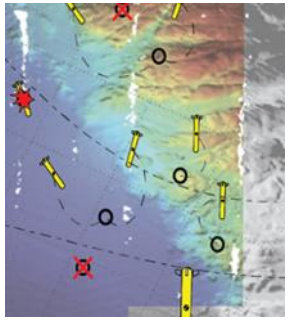
AUSTRALIAN DEFENCE FORCE

Queensland Government

ADVANCE QUEENSLAND
made for innovation

What is TAS?

- Trusted innovation leader & broker of industry & research for the ADF
- A Defence initiative to leverage strong commercial technology drivers, solve the long-term challenges experienced by the Department to deliver targeted, agile, risk-taking, non-competitive, fast engagement with a view to pull forward game-changing technologies needed by the ADF.
- Not for profit, limited by guarantee, board-governed
- Announced July 2017, company started mid-2018
- Commonwealth NGTF, Queensland gov, Direct ADF funded



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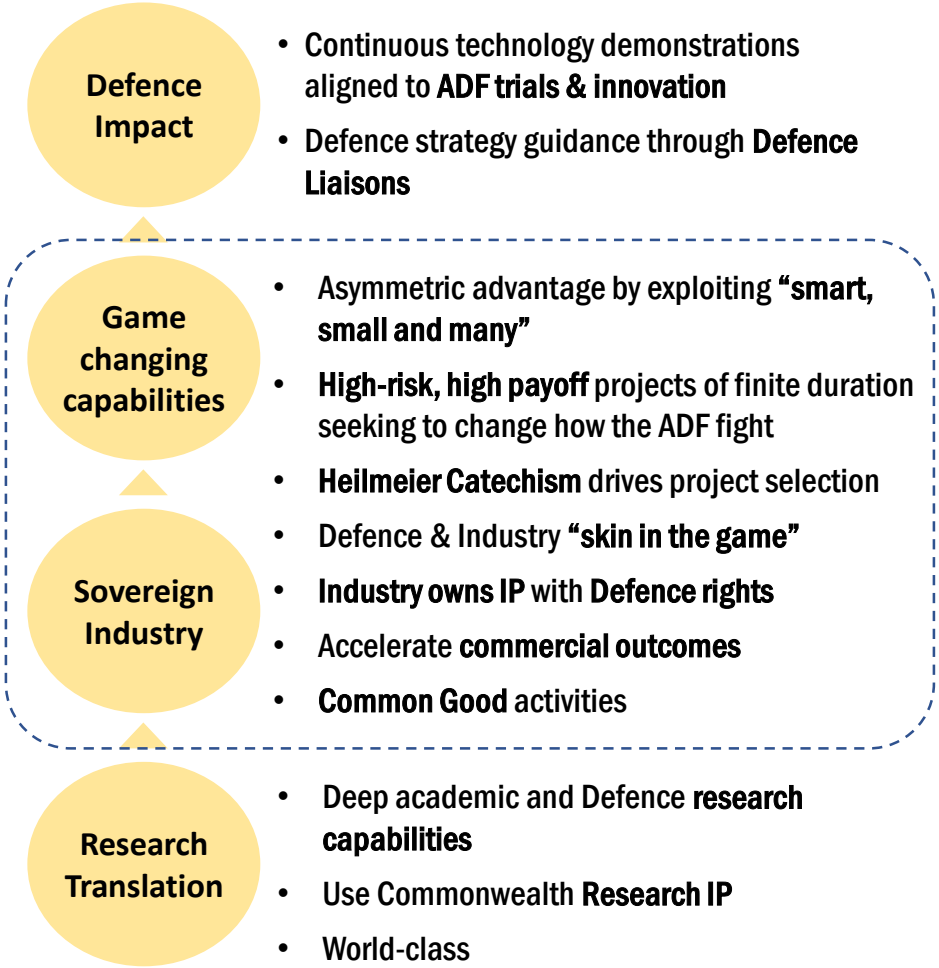
TAS Purpose

- Advance trusted autonomous systems technologies for asymmetric advantage so the ADF can fight and win
- Create & foster game-changing research, of world standing, that pushes theoretical & practical boundaries of future trusted autonomous systems
- Deliver autonomous systems & robotics technology with clear translation into deployable defence programs & capabilities for Australian Defence
- Build an environment in which Australian industry has the capacity & skills to deliver complex autonomous systems both to Australian Defence & as integral members of the global defence supply chain



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Asymmetric Advantage (Air examples)

TAS will enhance not replace capability

Enabled by...

Human Machine Teaming

Sovereign Common Control System

Spectrum Agility

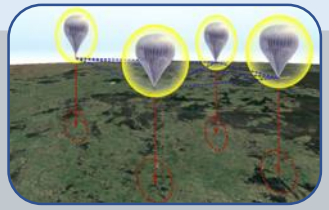
Images are for illustrative purposes only

Potent manned & optionally-manned platforms

Complex, Large & Few

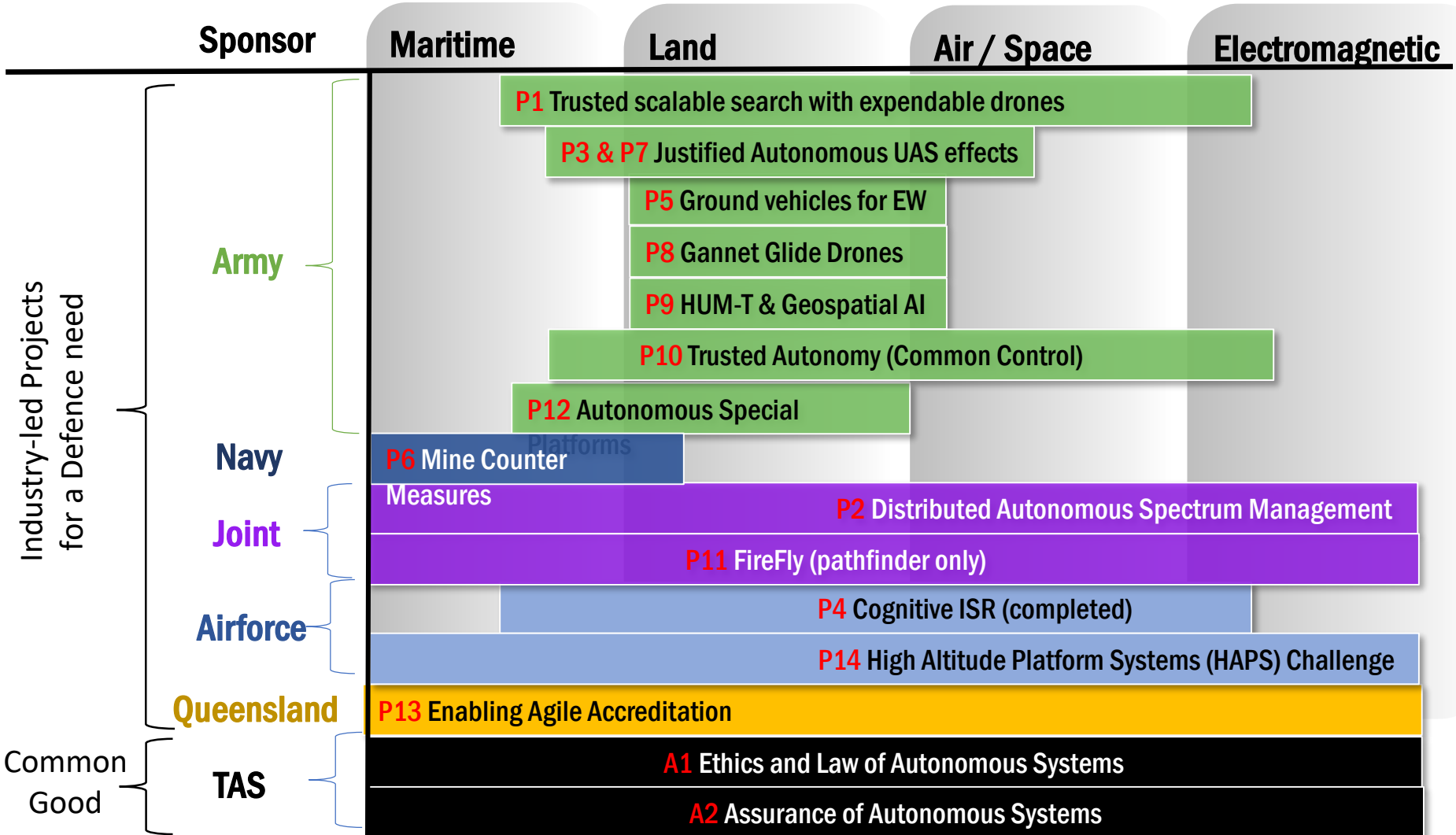
Autonomous & unmanned

Autonomous, attritable, flexible, low-cost mass



Smart, Small & Many

Asymmetric Manoeuvre


Sponsor
Maritime
Land
Air / Space
Electromagnetic
Industry-led Projects for a Defence need
Army
Navy
Joint
Airforce
Queensland
Common Good
TAS
P1 Trusted scalable search with expendable drones
P3 & P7 Justified Autonomous UAS effects
P5 Ground vehicles for EW
P8 Gannet Glide Drones
P9 HUM-T & Geospatial AI
P10 Trusted Autonomy (Common Control)
P12 Autonomous Special Platforms
P6 Mine Counter Measures
P2 Distributed Autonomous Spectrum Management
P11 FireFly (pathfinder only)
P4 Cognitive ISR (completed)
P14 High Altitude Platform Systems (HAPS) Challenge
P13 Enabling Agile Accreditation
A1 Ethics and Law of Autonomous Systems
A2 Assurance of Autonomous Systems

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TAS will enhance not replace capability

Enabled by...

Human Machine Teaming P9

Sovereign Common Control System P10

Spectrum Agility P2

Images are for illustrative purposes only

Foreign/Multi-national Primes

Potent manned platforms & dismounted combatants

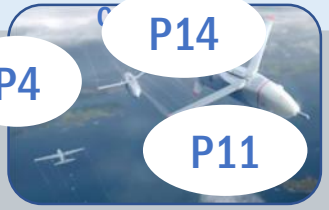
Complex, Large & Few

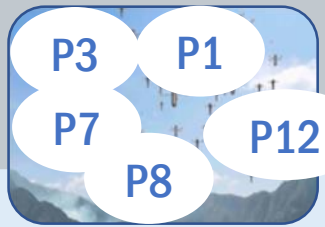
Sovereign + O/S Primes in Australia

Autonomous, Unmanned & optionally-manned

Sovereign SMEs

Autonomous, attritable, flexible, low-





Smart, Small & Many

A1

Asymmetric Manoeuvre

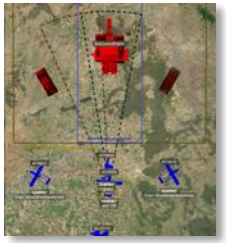
A2

P13

Example – P4 Cognitive ISR

Scope

- High levels of team autonomy to enable tasking versus control
- Dynamic mitigation of mission impediments eg. task failure or external threats
- On board target detection through image processing
- Machine Vision training utilising synthetic environments



Execution

- Created digital twin environment for synthetic development and testing
- Full virtual capability demonstration using Hardware in the Loop (HWIL) components
- Successful real world end to end demonstration

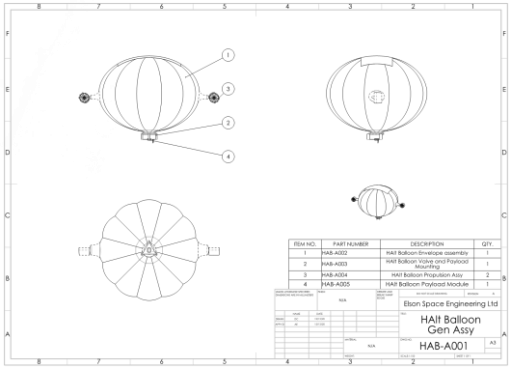
Future development

- Extend the capability & adaptability of the Behaviour tree-based autonomy
- Further exploration of development & integration of mitigation capabilities
- Extend & refine onboard image processing
- Shorten the Machine Learning training cycle to meet real world timelines

Example – P11 High Altitude Balloon Constellation

VALUE

- **Runway independent** delivery of Air Power
- **Sovereign capability** with **local supply chains**
- **Agile payload development** opportunity
- **Persistence and satellite-like capabilities** launched at time and place of our choosing in hours/days not months/years for CubeSats
- Payloads can be modified and relaunched (vs satellites)
- **Low cost and expendable**/"attritable" for contested ops
- **Edge intelligence**, multi-sensor, heterogenous sensing capabilities
- **Strategic deployment** (launch in one theatre, user in another)
- **Pre-qualify** CubeSats **for space**



Elson Self-propelled assembly

Danfield 'Pebble' in flight

APPLICATIONS

- "FireFly Pathfinder" Emergency Services – Bushfire Intelligence, autonomous detection, fuel load measurement, recovery support, comms relay
- "FireFly Phase 2" – Operational surveillance, deployed force communications, robust PNT, payload delivery, other applications
- Other applications – Search and rescue, marine environmental monitoring

LUX gondola

Opportunity: High Altitude Pseudo Satellite (HAPS) Challenge

Stimulating and supporting Australian sovereign industry development of a HAPS capability with accurate **station-keeping**, **stable payload control** and **long-endurance flight** at low cost

"This challenge is an exciting new way to contribute to Australia's security and defence"
GPCAPT Bearman, Air Warfare Centre

Open to Australian based businesses and Australian research organisations

Further information:
www.rmit.edu.au/defence-aerospace/haps-challenge

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SMARTSAT COOPERATIVE RESEARCH CENTRE

Sir Lawrence Wackett Defence & Aerospace Centre

AIR WARFARE CENTRE ROYAL AUSTRALIAN AIR FORCE READY THE WARFIGHTER

Opportunity: Sovereign "Common Control"

Purpose: Achieve multiple, simultaneous kill-chain options

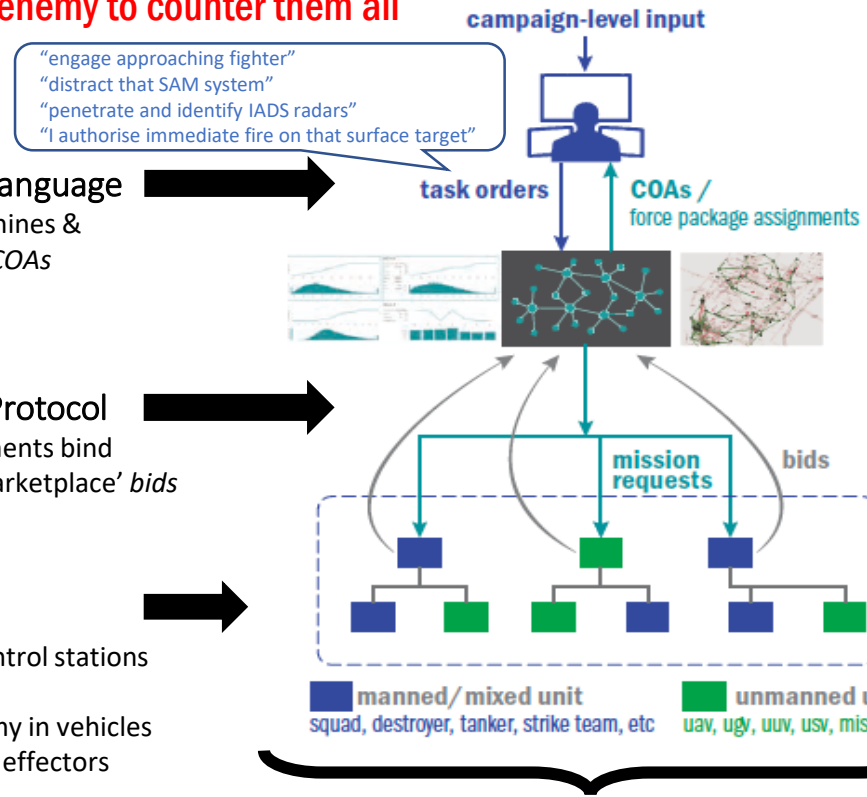
Outcome: Poses dilemmas on enemy to counter them all

AUS Ubiquitous Command and Control
(Lambert, Scholz 1999, 2005, 2007)

Common Control Language
Commanders *task* machines &
(explainable) AI offers *COAs*

Common Control Protocol
Electronic legal agreements bind
mission requests to 'marketplace' *bids*

Bridges & Agents
Surface proprietary control stations
for common control.
Uses available autonomy in vehicles
and controls sensors & effectors



Human command
- develop operational plans
- craft task orders
- identify marketplace of capabilities

Machine-assisted control
- issues request for bids to accomplish task orders
- constructs kill chain sets from available capabilities

Manned and unmanned units available for tasking
- capabilities bid on orders
- quality of bid depends on ability to contribute to an effective kill chain (i.e. proximity, speed, material condition, key functions, success likelihood, efficiency of capability)
- nominate and refine execution tactics

Common Spectrum Management Protocol

Background diagram from DARPA 'Mosaic Warfare', Feb 2020

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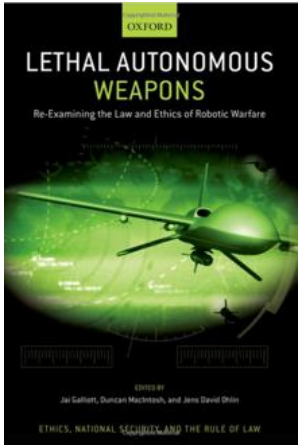
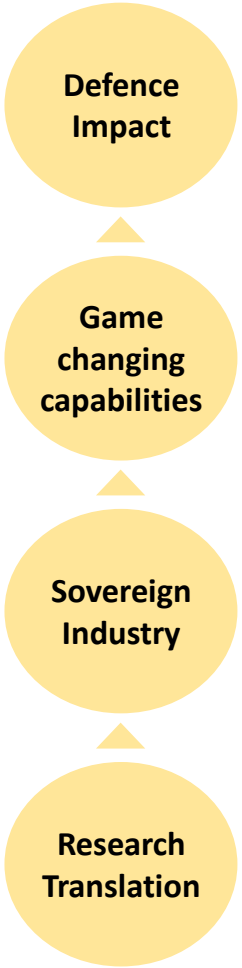
Common-good Activities

- **Building trust** in Robotic, AI, C2 and HUM-T systems with autonomy
- **Regulatory** – National accreditation support for industry. Identify gaps in processes, capture new knowledge, best practice, develop new standards, V&V
  - Air - demonstrate safe Detect and Avoid (DAA) at Queensland test range (CASA, FAA, Industry)
  - Maritime - small USVs (SEA1905, AMSA), New course launched for marine surveyors with AIMS
- **Legal** – LAWS CCW GGE, Article 36 reviews, legal status of uncrewed aerial & vessels, liability, export controls, ...
- **Ethics** – Aligning RAS-AI with Defence values, National level policy, Advice on ethics by design, ...
  - "AI Ethics for Defence" (with DSTG & Jericho)



Conclusion

- Described current initiatives in Trusted Autonomous Systems
- Outlined a future of “smart, small and many” to achieve ADF RAS-AI Concepts and Strategies
- TAS complements Jericho’s focus on ‘innovation-to-capability’
- TAS achievements:
  - 14 projects, 2 activities established *fast* with >$250m total commitments
  - Successful external review by team chaired by Prof Ian Chubb
  - Established several pathways for industry transition to ADF projects
- Accepting game-changing proposals that fit ADF needs
- Stay in touch!
  - Defence-only project and activity updates
  - Defence, industry and academia weekly news



HIGH ALTITUDE AEROSPACE

Australian Government
Department of Defence
Defence Science and
Technology Group

Join us at...

'Accelerating Trusted Autonomous Systems' Symposium

Townsville + online
20-22 April 2021

https://tasdcrc.com.au/symposium2021/

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