WOOMERA

TEST RANGE

(CTU 646.7.3)

The Woomera Test Range in 2020

-Tester Perspectives

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Content

- Introduction
- Current Operations
- Future Concept of Operations
- Maintenance & Support Concepts
- Questions and discussion

Purpose - Outcomes

- Purpose
- What's important in establishing a world class test range
- Outcome
- An understanding of key issues and challenges for Defence & Industry

Some Challenge Primers

- People/Organisational
  - DSTO/AOSG/ARDU Heritage
  - Current workforce profile – techos are operaters
  - No WTR T&E specialists – testers come to test
  - Industry base limited – commercialisation tried
  - Concurrent trials limited by 1960'2 technology and 1980's trials manning
  - Support Model
- Policy/Political/Financial
  - National Security
  - Self-reliance – good Coalition Partner
  - WPA
  - WTR business model
- Technological
  - 1960s instrumentation dragged into 1990s
  - Range instrumentation
  - NCW instrumentation
  - Spectrum
  - Concurrent trials?
- 'Socio-economic'
  - Native Title / Resource Sector
  - COTS / MOTS acquisitions without trials planning and depth

INTRODUCTION

In brief...

The Woomera Test Range exists to:

"provide Australia with its own ability to conduct world-leading research and experimentation, and leading-edge operational test and evaluation of air, space and land technologies in support of national defence objectives"

CAF's Capability Intent is for the WTR to:

<u>Enable</u> the 'testing of war material' by our warfighters.

The Woomera Test Range is operated by the RAAF Aerospace Operational Support Group (AOSG), an operational Force Element Group of the Royal Australian Air Force.

Headquarters Woomera Test Range (HQ WTR), is the Wing-level element within HQAOSG (CTU 646.7.3) and is responsible for the day to day management of the Range. HQ WTR is located at RAAF Base Edinburgh just north of Adelaide, South Australia.

The Woomera Test Range is located approximately 450km north-east of Adelaide.

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Historical and Current:

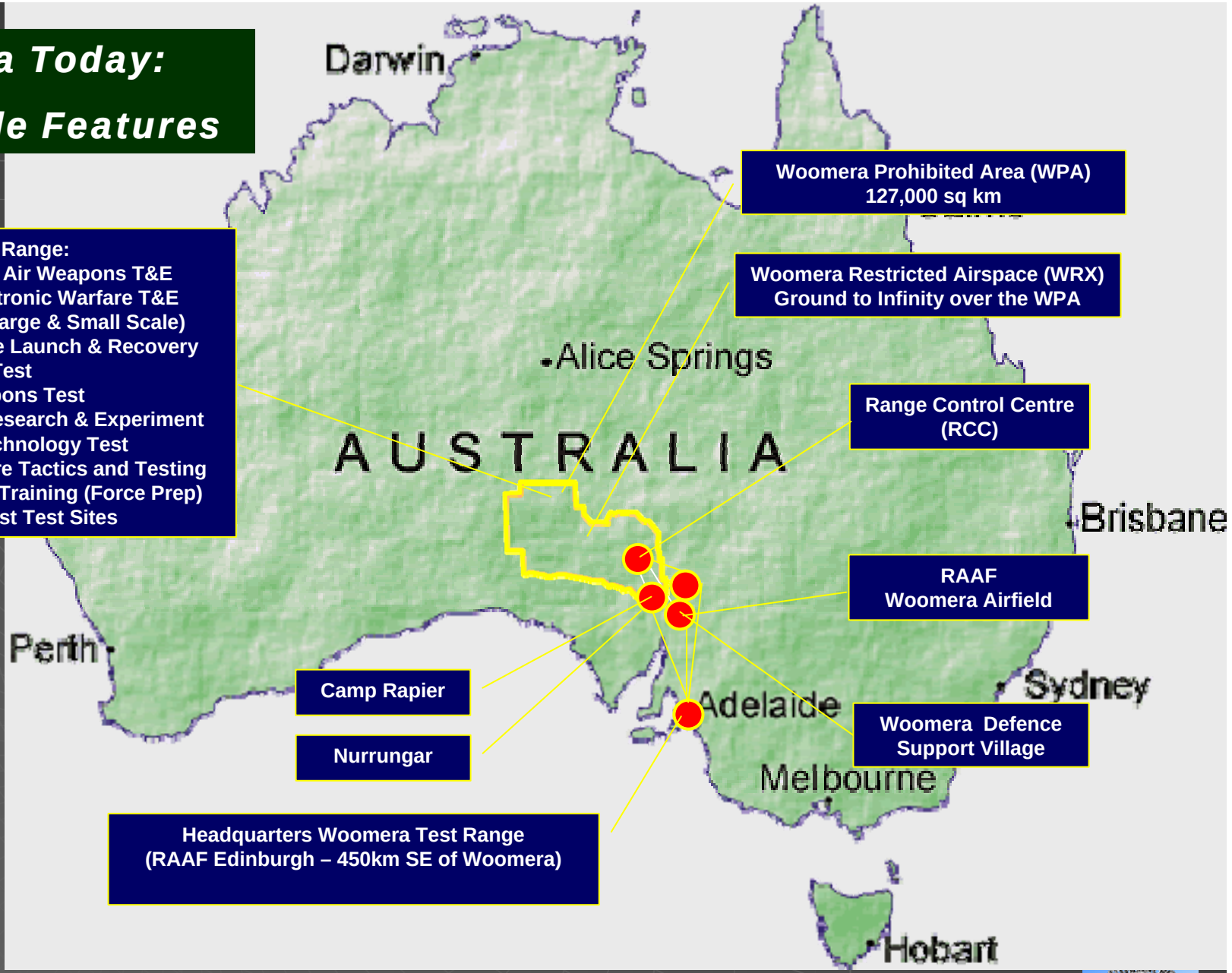
1947 – 1980 **Anglo-Australian Project**

1980 – 1991 **DSTO Ranges Branch** – Minor level of activities supporting Defence T&E objectives

1991 – 2003 **ARDU** – Increased level of aerospace T&E activities with DSTO continuing as major user

2003 - **AOSG / WTR** – substantial increase in all forms of T&E activities. Range currently operating at beyond its resourced capacity with, annually, around 100 significant trials and other events, over 1800 days annually of testing, around 70-90,000 bed-nights needed each year, and the airfield hosting over 1200 sorties per year, including over 200 heavy aircraft movements (greater than Darwin)

Woomera Today:
- Principle Features



Woomera Test Range:
- Instrumented Air Weapons T&E
- National Electronic Warfare T&E
- Demolition (Large & Small Scale)
- Space Vehicle Launch & Recovery
- Air Platform Test
- Ground Weapons Test
- Aerospace Research & Experiment
- Emerging Technology Test
- Desert Warfare Tactics and Testing
- Simulation & Training (Force Prep)
- CIED Specialist Test Sites

Woomera Prohibited Area (WPA)
127,000 sq km

Woomera Restricted Airspace (WRX)
Ground to Infinity over the WPA

Range Control Centre (RCC)

RAAF Woomera Airfield

Woomera Defence Support Village

Camp Rapier

Nurrungar

Headquarters Woomera Test Range
(RAAF Edinburgh – 450km SE of Woomera)

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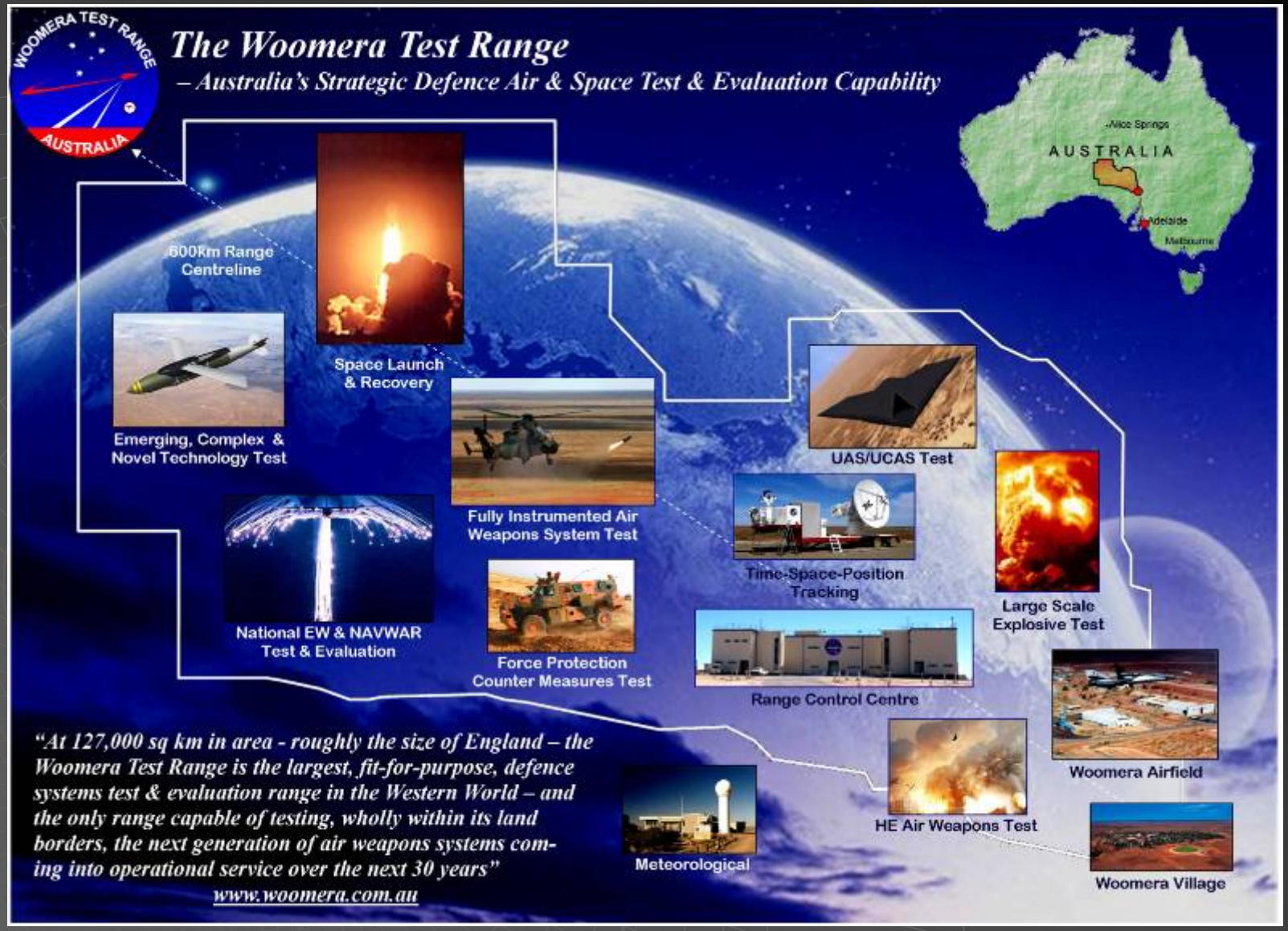

Overview – "The Woomera Capability"

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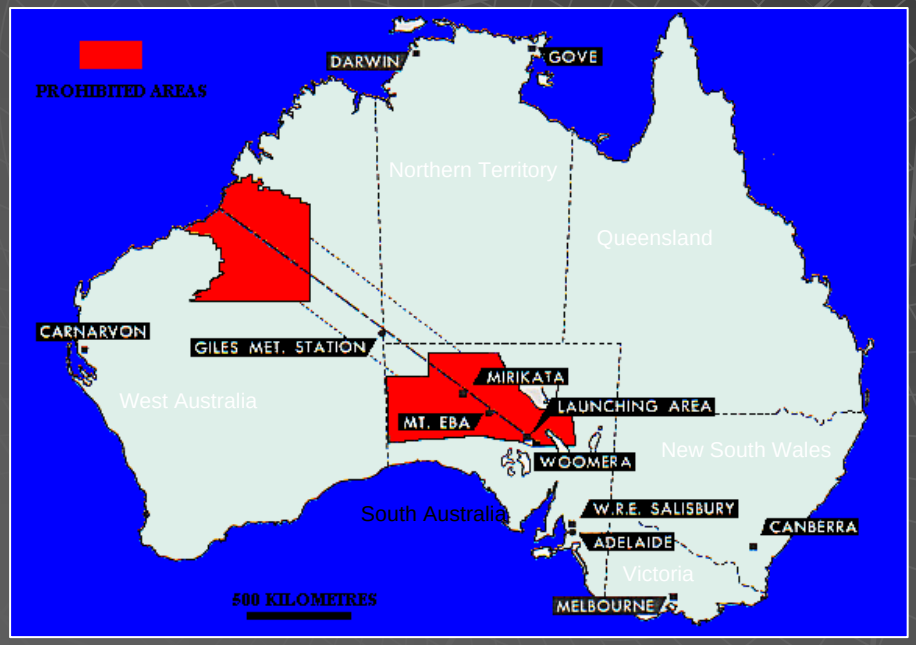
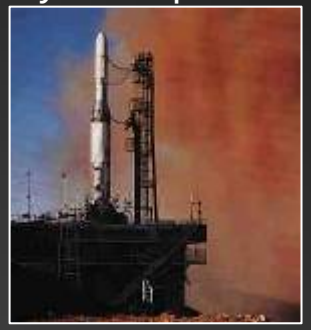
Establishment of the Range:

The Woomera Test Range corresponds physically with the Woomera Prohibited Area (WPA), which was established in 1947 under the Anglo-Australian Joint Project to support the testing of British and Australian short and long range Missiles. While the range has downsized, with the closure of the West Australian section in the early 1970's, today it is still roughly the size of England or, the State of Florida. The Range today covers 127,000 sq km (49,000 sq ml). In its heyday in the 1950s and 60s, Woomera was the second busiest rocket range in the world – second only to Cape Canaveral in the USA.



The 'original' Range layout

'PROSPERO' – launched from Lake Hart



'ELDO' – launched from Lake Hart

'Blue Streak' – launched from Lake Hart

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Operations – testing tomorrow's systems today..

- ***Deep Space Mission Recovery - Hayabusa***

In June 2010, Woomera was again part of space history as a Japanese mission into deep space to bring the first ever samples of an asteroid back to Earth reached the end of its 7 year mission to the Itokawa Asteroid. The successful return of the Japanese Experimental Space Agency (JAXA) **Hayabusa** probe underlined the special attributes of Woomera's vast, empty, but highly secure and safe, air and ground spaces to support space-based activities.

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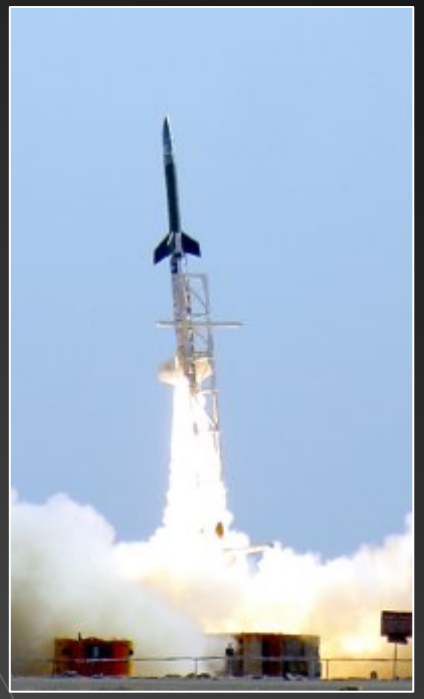
Operations – testing tomorrow's systems today..

- ***Space Vehicles – test bed of the Hypersonics programs:***



Australia's Defence Science and Technology Organisation (DSTO), in partnership with the United States Air Force, the University of Queensland, Boeing and BAE Systems are developing the technologies needed for sustained flight at Mach 8. The 'HiFIRE' test program launches from Woomera to over 330kms out into space before landing back well within the land boarders of the Range.

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Objectives:

Strategic:

- *Meet CAF's Capability Intent for the WTR*
- *Professionalise the operation of the range to world-class standards*
- *Assist the implementation of JP 3024 – Remediation of the WTR*
- *Assist the implementation of the DSG Range Infrastructure Project*

Operational:

- *Enhance the ADF's warfighting capabilities through on-going direct support to ADF T&E and other directed national objectives*

Tactical:

- **Within available resources,** *daily provide a fit-for-purpose test range capability the operates safely, efficiently, and in accordance with directed ADF priorities*

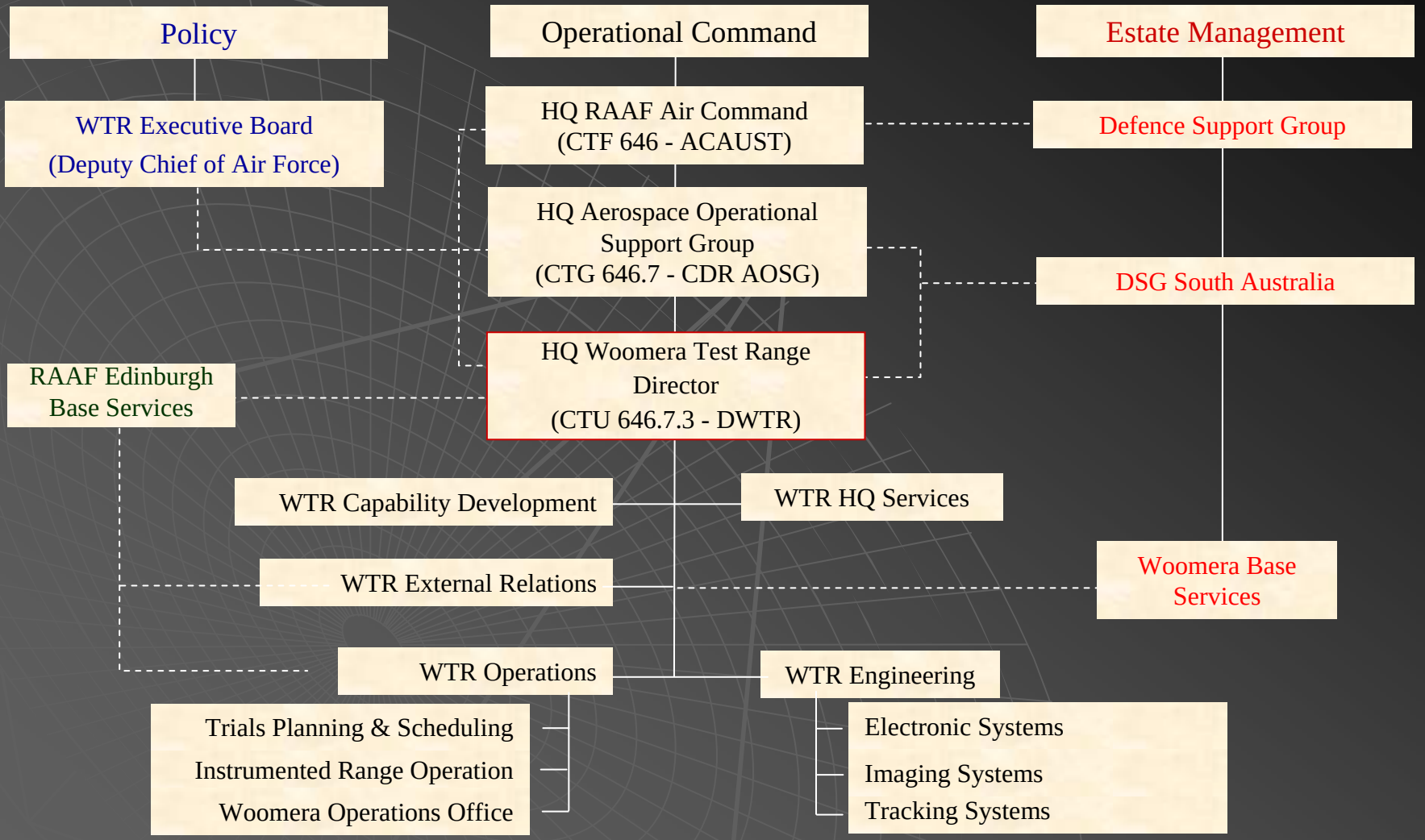
CAF's Capability Intent for the WTR:

"The WTR will have sufficient funding allocated to meet the intended RoE of:

- *an **instrumented range service** available for **24 weeks per year**,*
- *a **non-instrumented range service** supporting seven to ten small scale training and evaluation activities available for **14 weeks per year**,*
- *a concurrent instrumented and non-instrumented **range services available for 40 weeks per year**,*
- *a support service available for 52 weeks, and*
- *a 24 hour day/night 'on call' airfield service structured to support 1200 air movements per year.*

CURRENT OPERATIONS

Functional Organisation:



Service Provider – dotted lines

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Operations – testing tomorrow's systems today..

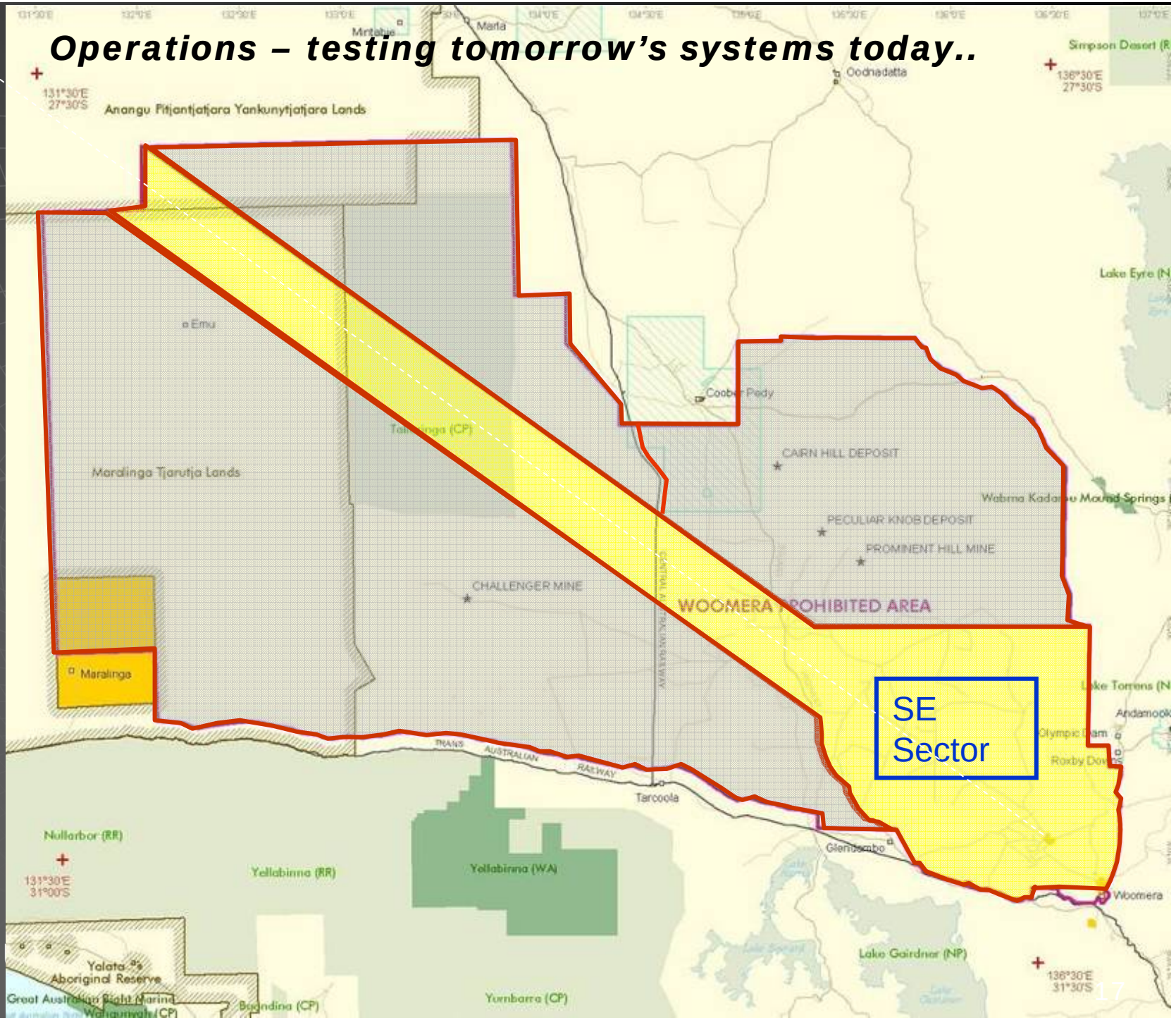
WTR Core Area of Operations

Note:

The centreline origin is taken from the Range Reference Point at:
E30 56 34.652,
S136 31 14.8307.

The centreline bearing is:
304.7 True.

The CAO centreline extends approx 600km and 10 nm either side of centreline bearing.



Tasking

- Space and other Rocket Launch/Recovery Trials
- Missile, Bombing, and other Air Trials except UAV
- EO, Gun, Force Prep, and other special weapons trials
- UAS/UCAS Flight Test and Cruise Missile Trials
- Interference and other EW Trials
- Laser and other specialised technology Trials
- Visits and other operational and support Tasks

DSTO HiFire

AMRAAM Program

AGM-142 Program

Tiger & Hellfire Program

PzH 2000 Howitzer Program

ADF Electronic Warfare Programs

TRIGAT Program

Hayabusa Program

USAF Combat Sent RC-135U GPS Jamming Program

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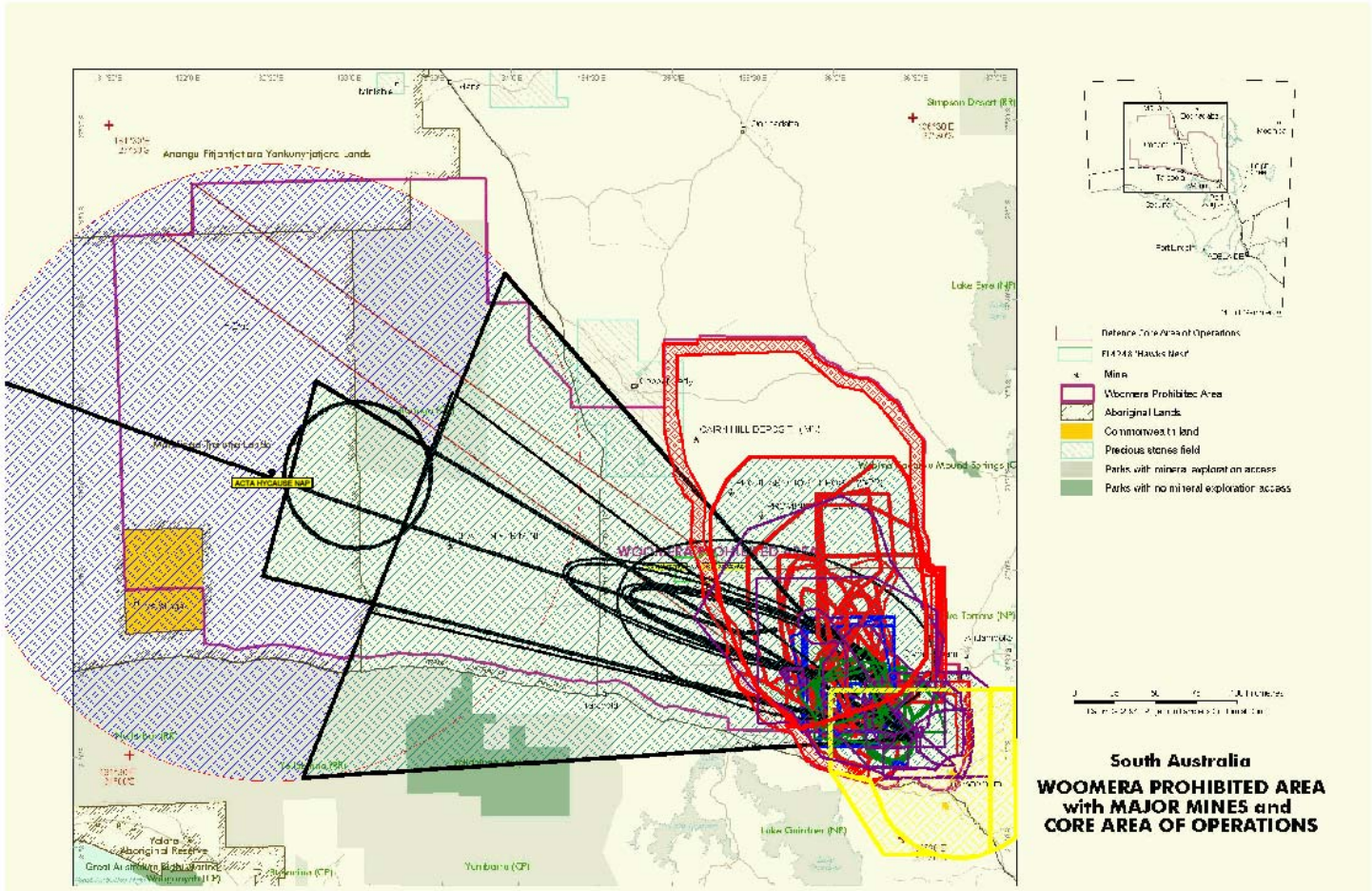
Rate of Effort:

Operational Tempo is very high. *Missile and Air Weapons testing are often back to back. Supported instrumented range time is in high demand with bookings now stretching well into the foreseeable future. Strong programs around rocket-based activities, electronic warfare testing, weapons and ordnance testing from all platforms round out a full annual schedule of activities. Full airbase activation supporting heavy and fast jet operations is a regular occurrence. Woomera is the recognised home of military UAV testing in Australia - and is fast becoming the destination of choice for our allies.*

Heron UAV

Super Hornet - JSOW

Usage 2005 - 2010



Weapon and Electromagnetic Danger Areas affecting the Continuous Use Zone (Electromagnetic / GPS Denial in Yellow and Weapons: Red - Missiles, Blue - Bombs, Purple - UAS's and Black - Space / Rocket Research)

The Challenges:

- *Obsolescence of Systems – JP 3024 to remedy*
- *'Orphan' perceptions – aim is to 'mainstream' operations and operational support*
- *Ageing Infrastructure – DSG Infrastructure Remediation Project to start to address*
- *Workforce – staff to handle dramatically increased demand for range services*
- *Encroachment by Mining – Hawke Review and implications (control/security/staff)*
- *Pastoralists, Environmental, and Indigenous – continued liaison and management*
- *Garrison Support – contract due for change over at end of 2011*
- *Future configuration of Range – where best to locate range resources (esp. 'people')*
- *Operating and Funding Model – further review by Defence?*
- *The Village Sustainment Model – critical support element of range operations*

RAAF Woomera Test Range – Summary of Outputs

Purpose

- *Support whole of Defence aerospace T&E*
- *Defence Capability Program (DCP) projects*
- *Explosive Ordnance storage, maintenance, testing and demolition*
- *Surface-surface ammunition testing*
- *Electronic Warfare Trials*
- *Hazards of Electromagnetic Radiation to Ordnance (HERO) testing*
- *Small scale training activities*
- *Special Forces activities*
- *Research activities (University and Special Interest Groups)*
- *Support to Defence Industry aerospace T&E and space activities*

Defence Users

- *Australian Defence - approx 44 weeks per year*
- *Approx 24 weeks are for complex trials*
- *Approx 22 weeks of activities are in direct support of the force-in-being (i.e. RAAF Force Element Groups and Australian Army Aviation)*
- *ADTEO (formally 'DTRIALS') and DSTO also significant users - approx 15-20 weeks per year.*

FUTURE OPERATIONS

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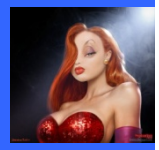
Network
1 Multiple Sensors Execute Fused Track of Identified Target
4 Weapon Release
3 Periodic Target Track Update
5 Continuous Data Exchange Between C2 Node/Weapon
6 Weapon Acquires & Guides to Target; BIA
2 C2 Node Tasking Pairs Shooter / Weapon To Target
Weapon Grids Collaboratively Address Find, Fix, Track, Target, Engage and Assess Kill Chain
Approved For Public Release

Delivering Joint Context



Joint LVC Testing & Training Environment

Synthetic Battlespace

TENA & CRIS

Instrumentation

Global Information Grid

Virtual

Embedded Training Systems

Constructive

Live

Integrating Architecture

Planners & Designers

AAR

Opposing Force (OPFOR)

User Services

Response Cells

Role Players

Exercise Control

Design

Plan

Prepare

Execute

Analyze Evaluate

Knowledge Management Assets

Authoritative Sources

C4I & Combat Systems

Key Players:
JMETC
InterTEC
Test Community
Training Community

Testing & Training Audience















Joint, Multinational, & Coalition Partners

Network-enabled weapons test & training

RAAF Major Base FDR

RAAF AWR / DPA

ADF TA / DPA Used

Mega Base / Range

NAXA

Darwin AWR

Darwin

Mt Bundey TA

Bradshaw FTA & EW Range

Tindal

Delamere Range Facility

Yampi Sound DPA ?

Curtin

Saumerez Reef AWR

Townsville Field FTA & STAR

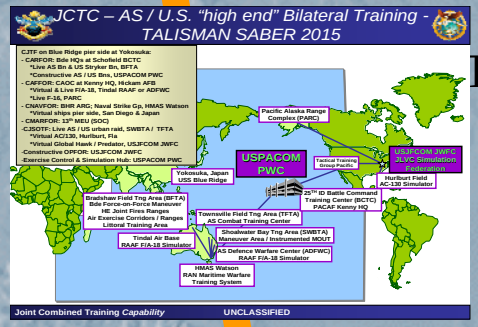
Halifax Bay DPA

Townsville

US PACOM & JTEN

Learmonth

Learmonth AWR



Shoalwater Bay TA

Amberley

Woomera Test Range

Lake Hart AWR

Muchea AWR or WATA

Pearce

Cultana

Edinburgh

Singleton TA

Williamtown AWR

Williamtown

EAXA

Jervis Bay

UWTR

WAXA

North Northeast Rocks AWR

Kangaroo Island South DPA

SAXA

JOC - JCTC

Puckapunyal

Dutson DPA

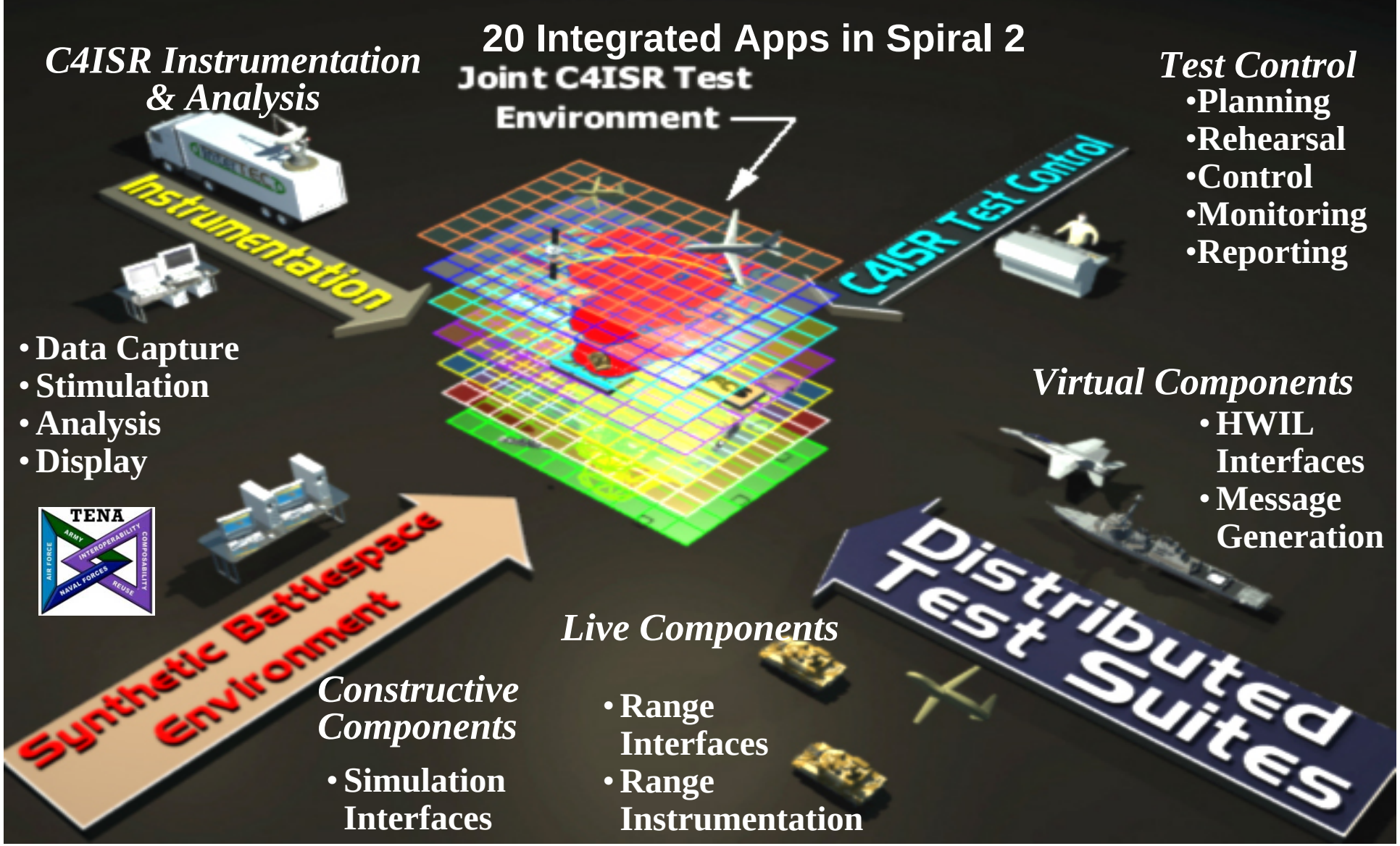
East Sale

DSTO ABC

WTR RCC is now connected to JOC JCTC for key AS - US trials

InterTEC Operational View-1

TENA-Based Integrated Test Tool Applications



Woomera – moving forward to 2015

In April 2009, the Federal Government announced a massive remediation program to upgrade the WTR infrastructure through the Defence Capability Plan (DCP 2009-2019) and Major Capital Facilities Program.

- DCP - JP3024 as a $150M-$500M bracket project.
- MCFP is now $ 250m +
- Other Minors Works and Trials specific investment is now $ 50 - 100m +

20 April 2009 – Former Prime Minister Kevin Rudd with Group Captain Reg Carruthers, Commander AOSG, at RAAF Base Edinburgh following announcement of Woomera's operational capability upgrade funding (ie initial MCFP).

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What went to Committee

- Remediation of the major capital equipment and facilities at the WTR will enable Defence to:
  - gain confidence that the performance and safety of its weapons and intelligence capabilities will be acceptable when employing forces using an Australian approach to future warfare,
  - provide range control and safety in support of Defence and allied aerospace T&E and R&E of network enabled war material and
  - support a network enabled WTR with key air, land and maritime training areas and test ranges in-sync with Joint Combined Training Capability (JCTC) and allied Joint National Training Capabilities (JNTC).

- DCIC & FSR 2008

JP 3024 WOOMERA TEST RANGE REMEDIATION

- WTR RCSS Upgrade – August 2011
- Prime Minister Announces Facilities: $ 120m +
- DCP 09-19 ENTRY – JP 3024 Phase 1
  - Project seeks to replace the Aerospace T&E and R&E equipment at the Woomera Test Facility in order to effectively support Defence T&E and R&E activities in a reliable, controlled, secure and safe environment.
- ROM allocation of $150m +
- ORC 04 Nov 09 - 3 Options presented, two agreed
- 1st Pass – RFN & Phase 2 being scoped (Hawke Review)
- 2ND Pass - 2013
- ISD - 2015
- IOC - 2015/16 for 'simple' ITR
- FOC – 2020 for complex/concurrent

JP 3024 WOOMERA TEST RANGE REMEDIATION - OPTIONS

- 1 - Remediation
  - replace the functions that currently exist
  - Min risk and cost for systems, min capability
  - Needs to address personnel needing to support
- 2- Prioritised Integrated Solution
  - Asses the needs of future Defence activity
  - Contractor maintenance and support
  - Expend budget according to key priorities (watch this!)
  - Within budget option, increased capability

JP 3024 – Woomera Remediation

- Scenario 1 – Air to Air Weapons Test
- Scenario 2 – Long Range Stand-off Surface to Surface Weapons Test
- Scenario 3 - Long Range Stand-off Air to Surface Weapons Test
- Scenario 4 – Joint UAV Test
- Scenario 5 – Counter Improvised Explosive Device (IED) Test
- Scenario 6 – Non-Kinetic Electronic & Navigation Warfare Test
- Scenario 7 - DSTO Research Vehicle Test
- Scenario 8 - Concurrent Tests

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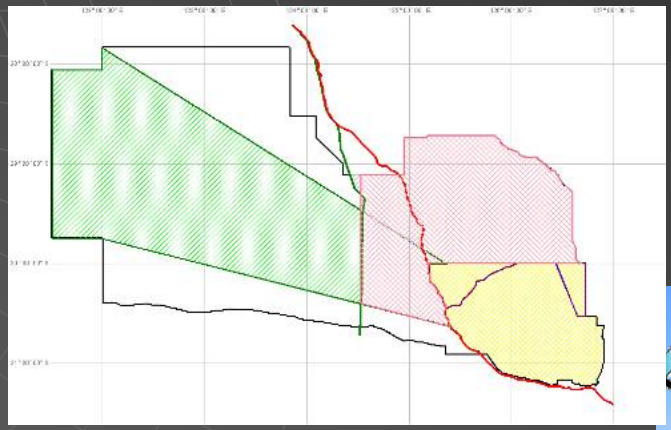
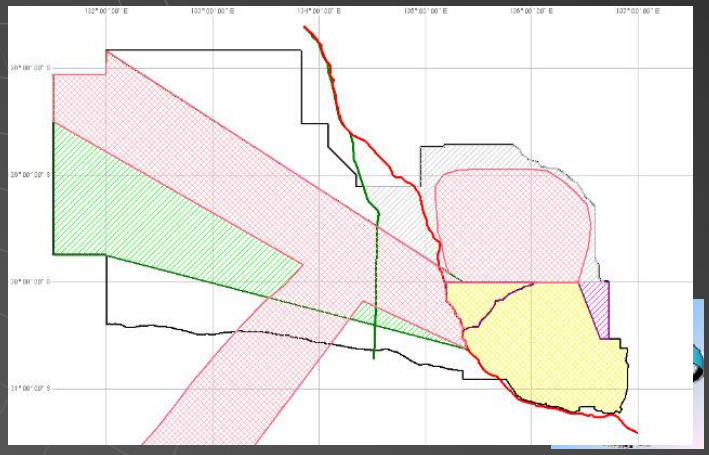
Scenario 1 – Air to Air Weapons Test

- The WTR has been tasked with the firing of an instrumented network enabled BVR missile with an inert telemetry warhead.
- The missile will be fired from a RAAF F-35, with an ARDU chase aircraft. The weapons launch will be conducted at medium altitude, between 10 000 and 25 000 feet.
- The target will be an ADTS.
- The launch will be conducted such that the flight of the missile takes place within the WTR; the safety template and impact site shall be contained within the WTR.
- The F-35s and the ADTS are based at Woomera.



Scenario 2 – Long Range Stand-off Surface to Surface Weapons Test

- The WTR has been tasked with conducting surface to surface missile test activity involving the firing of a network enabled instrumented stand-off missile with an inert warhead. The launch vehicle would be an AWD firing a naval weapon which would be launched off the coast to fly to impact on the WTR, with an ARDU safety chase aircraft as appropriate. The missile flight path is predominantly at low altitude.
- The target is an instrumented ground target constructed for the test moving under remote control.
- The missile path will be programmed such that the flight of the missile takes place from outside the WTR. The impact site and the safety template are within the WTR.
- The test objectives include testing C2 and reporting through a network. The test aircraft is connected to an ADF Operations Centre through Link 16. The test aircraft communicates with a ground based JTAC through VMF radio.
- The safety chase aircraft are based at Woomera Airfield.



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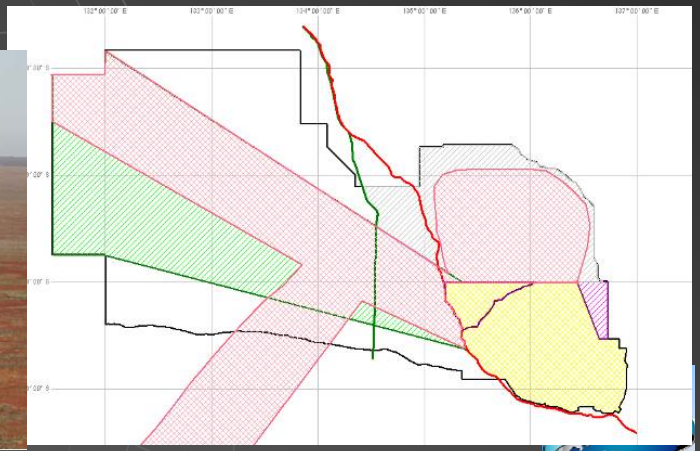
Scenario 3 - Long Range Stand-off Air to Surface Weapons Test

- The WTR has been tasked with conducting an air to ground missile test activity involving the firing of a network enabled instrumented stand-off missile with an inert warhead. The missile will be fired from an airborne launch platform, with chase aircraft as appropriate. The target is an instrumented ground target constructed for the test moving under remote control.
- The missile path will be programmed such that the flight of the missile takes place from outside the SE CAO of the WTR. The impact site and the safety template are within the SE CAO WTR. The missile flight path is predominantly at low altitude.
- The test objectives include testing C2 and reporting through a network. The test aircraft is connected to an ADF Operations Centre through Link 16. The test aircraft communicates with a ground based JTAC through VMF radio.
- The aircraft are based at Woomera Airfield.
- The considerations of this scenario are applicable to other air to ground weapons. The scenario also covers short range surface to surface missiles.



Scenario 4 – Joint UAV Test

- The WTR has been tasked with conducting a UAS test. The UAS will be launched from Woomera Airfield and complete an ISR and weapons effects mission within the WTR.
- The UAS is based at Woomera Airfield, and controlled from Nellis AFB CAOC-N as part of the USAF JUDIE program.
- The test objectives include testing C2 and reporting through network links. The UAS is connected to an ADF Operations Centre to JOIC JCTC and CAOC-N via the RCC through Link 16.

- MANTIS
- RAVEN
- TARANIS
- HERTI

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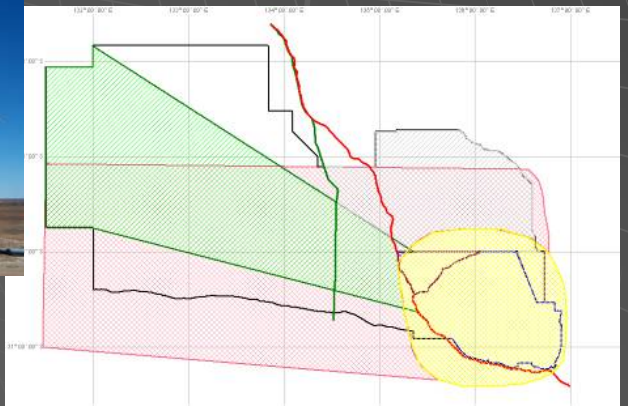
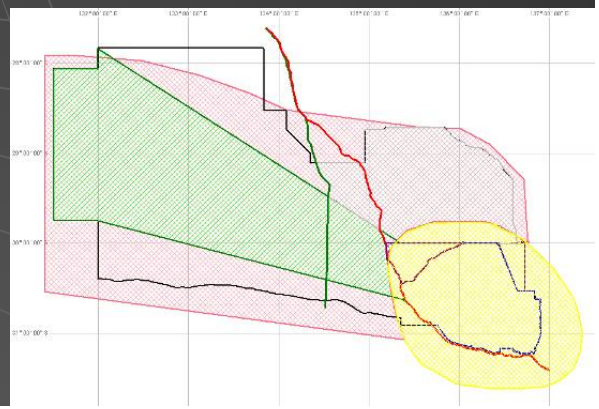
Scenario 5 – Counter Improvised Explosive Device (IED) Test

- The WTR is tasked with a wide variety of test activities which do not require the use of the instrumentation capabilities of the WTR, but exploit other advantages of the WTR such as isolation and security. Scenario has been selected as a representative non-instrumentation test, albeit a challenging one, since a CIED test does have the potential to interfere with other test activities on the range due to RF emissions; a Navigation Warfare test (eg GPS jamming) would be a similarly potentially disruptive, non-instrumented test.

Scenario 6 – Non-Kinetic Electronic & Navigation Warfare Test

- Similar to CIED Test Scenario, the WTR has been tasked to host another representative non-instrumentation test, a Navigation Warfare test (eg GPS jamming & denial).
- Navwar Tests are another similarly potentially disruptive, non-instrumented test with the almost guaranteed potential to interfere with other test activities on the range due to RF emissions.
- Note EA / DE use.





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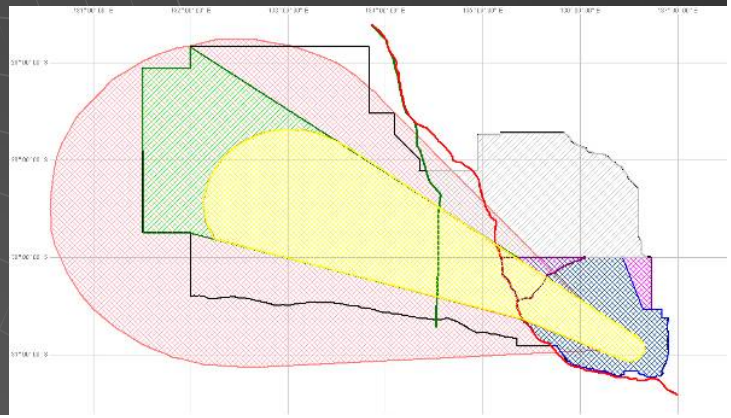
Scenario 7 - DSTO Research Vehicle Test

- The WTR has been tasked with conducting a launch test of a DSTO sponsorred AS – US hypersonic vehicle with a manoeuvring European-sourced software control test section.
- The launch will take place from a pad in the vicinity of the RCC firing through space at an expected impact point just within the WTR.
- The WDA extends significantly to the west and south west outside the WPA.



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Scenario 8 - Concurrency

- At FOC the WTR is to be able to:
  - Trials being set up while another trial is underway – the rolling test scenario to reduce the ‘dead’ time between trials.
  - Scenarios being able to be done together (such as a UAS providing targeting information to a air to ground missile firing in the presence of a CIED test) – driven by the amount of cooperative instrumentation available on test assets and the degree to which the LVC environment can simulate some element of the scenarios remotely via JCTC or other data/voice links;
  - Such scenarios conducted in parallel but with no interaction due to security / IP limitations.
  - Unlikely that long range weapons firings with high demand instrumentation is required for both trials together.

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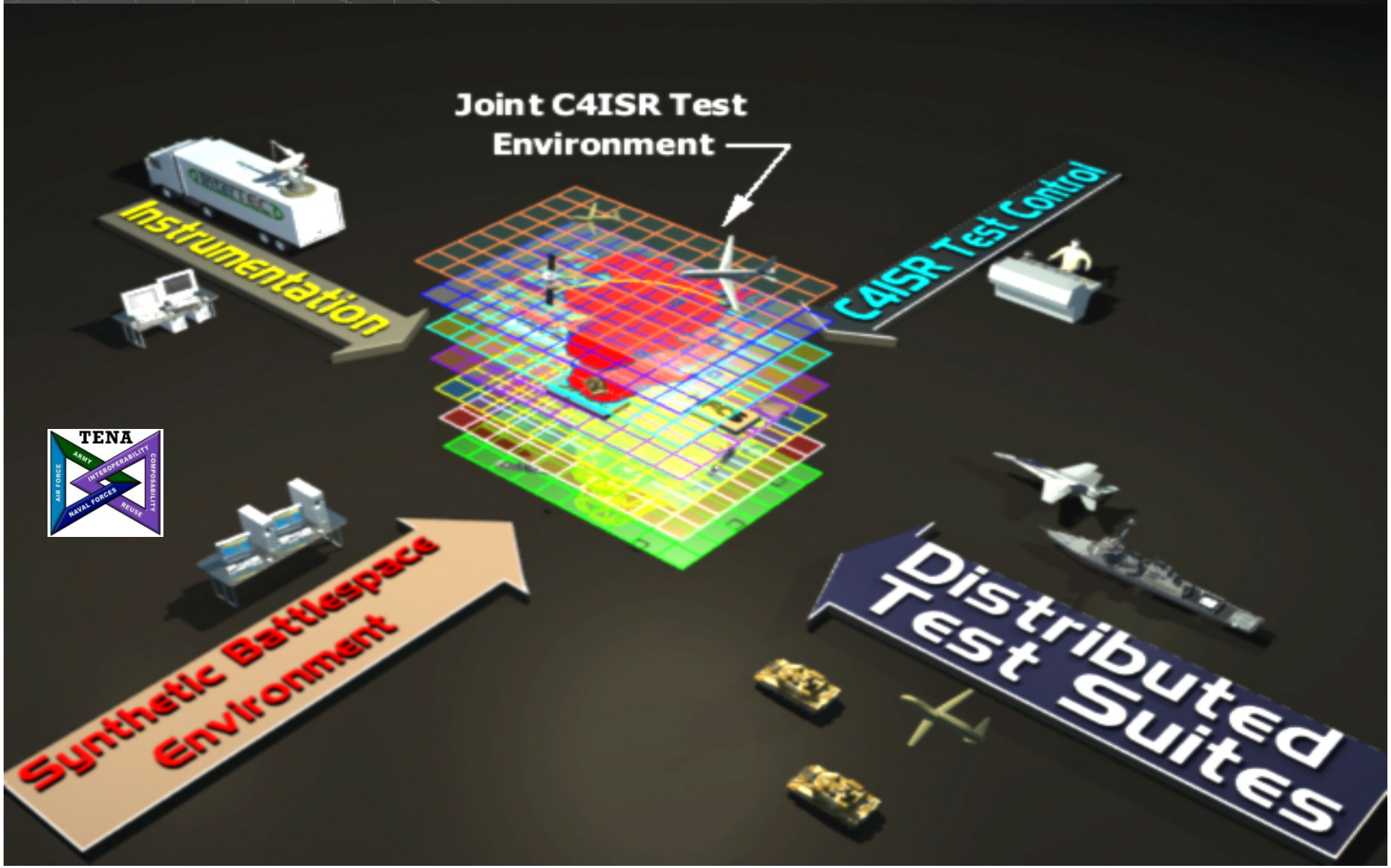
Where do we Testers fit in?



Where do we Testers fit in?

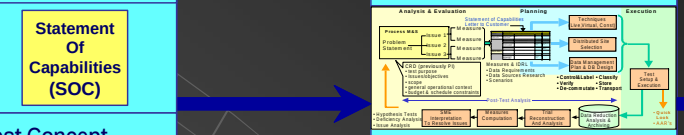
6 Steps
14 JTEM Processes

1. Characterize Test

- Program Introduction Document (PID)
- Statement Of Capabilities (SOC)

- Develop Test Concept
- Develop Evaluation Strategy
- Technical Assessment

2. Plan Test



- Develop Test Design
- Perform LVC Distributed Environment Analysis
- Develop Test Plan

DMAP

3. Implement LVC-DE

JME Foundation Model (JFM)

- Design LVC Distributed Environment Configuration
- Integrate LVC Distributed Environment

4. Manage Test Execution

5. Evaluate Capability

- Analyze Data
- Evaluate SoS Performance & Joint Mission Effectiveness

0. Develop T&E Strategy

- T&E Strategy (TES)
- T&E Master Plan (TEMP)

- Develop Capability/SoS Description
- Develop Joint Operational Context for Test (JOC-T)
- Develop Evaluation Strategy Outline
- Develop/Refine Capability Crosswalk

Test Concept

Joint Operational Context for Test

Test Data

Integrated Vignettes LVC Distributed Environment Design

Joint Mission Environment

Test Control & Monitoring

CTM – Capability Test Methodology DMAP – Data Management and Analysis Plan JME – Joint Mission Environment

LVC – Live, Virtual, Constructive LVC-DE – Live, Virtual, Constructive Distributed Environment SoS – System of Systems

Implications on us Testers

- CAF clearly believes that a usable WTR is vital for testing joint kinetic and non-kinetic warfighting capabilities
  - US and UK ranges cannot do what we need to be doing
- AOSG WTR Role – driving CDG and DMO via proper project support for JP 3024
- AOSG DT Wing & ARDU Roles – JP 3024 needs support for future test methods and driving politics to get a usable open air test and training range
- VCDF / AFHQ – Joint Fires
- AFHQ – EA and non-kinetic effects
- LVC - JOC JCTC Role
- Engagement with JP 3028.
- When are DT Wing getting some useful Simulation to be in the game …

Directed Priorities:

P1	National Operational Support - Task takes precedence over all other tasking.
P2	Strategic Reform Program - Initiatives that improve efficiency and effectiveness within this program
P3	Force 2030 - Programs that contribute to White Paper milestones.
P4	Capability Support - Programs that maintain preparedness in order to deliver future operations.
P5	Capability Development - Programs that develop future capabilities, and ensure units operate within budgetary constraints
BG	Background Task - Can be undertaken without draining manpower

Hawke Review

- Significant known outcomes:
  - Hawke Review has been submitted to MINDEF and MINRET (Resources Energy & Tourism) for comment and recommendations.
  - WPA boundary and CoA rights to control access retained for safety and national security.
  - Agreed that mining shall not be conducted in a proposed but not publically announced ‘no-go’ region.
  - Mining in other areas will be on a time share basis.
  - Defence retains right to the whole WPA for priority testing in support of Defence interests, if approved by MINDEF.
- But:
  - Establishment of a ‘central coordinating’ agency in Canberra: AOSG WTR staff will need your help in feeding this agency with key capability and priorities intell.

MAINTENANCE AND SUPPORT CONCEPTS DISCUSSION

Further Challenges – Your Perspectives & Ideas

- People/Organisational
  - DSTO/AOSG/ARDU Heritage
  - Current workforce profile – techos are operaters
  - No WTR T&E specialists – testers come to test
  - Industry base limited – commercialisation tried
  - Concurrent trials limited by 1960'2 technology and 1980's trials manning
  - Support Model
- Policy/Political/Financial
  - National Security
  - Self-reliance – good Coalition Partner
  - WPA now has No Mining and Time Share
  - WTR business model – sweet spot and surge with
  - MOUTEP – PAs in work / proposed / timelines
- Technological
  - 1960s instrumentation dragged into 1990s
  - Range instrumentation
  - NCW instrumentation
  - Efficient use of Spectrum
  - Concurrent trials?
- 'Socio-economic'
  - Native Title
  - Resource Sector – Permit System
  - COTS / MOTS acquisitions without trials planning and depth

- People/Organisational
  - over tasking
  - Hawke Review with Board and Coordination Office
  - Support to project
  - Aligning well with TRMC US Use Cases
  - Strategies – advice / Joining RCC re-attacked
  - Lessons learned from US
- Policy/Political/Financial
  - ADTEO asking for TRMC / DOT&E input
  - Security with links
  - commercialisation vs cost for activities
  - Hawke Review with Phase 2
- Technological
  - iNET, CRIIS, InterTEC, JMETC Node
  - F-35 P-5 vs test CRIIS Freqs?
  - operational control with multiple sites versus monitoring over multiple activities?
  - Security – encryption implications / Info Assurance Certification/Accreditation
  - US 'Plat Form IT' – allowable system
  - US Army Replacement Radar Program - open
  - IRIG standard for advance modulation, freq agility, freq deconfliction – IFDIS in West USJT3. Mobile TM systems key.
  - Fibre Optic backbone important
  - Multiple emitters.
- 'Socio-economic'
  - commercial model / strategy
- Others
  - -

Other Issues

- Focus Areas?
- Interest in SETE 2012 Forum / Session?
  - ITEA for now, but …
  - Spectrum – DSO
  - Have Underwater ranges in Test Ranges
- MOUTEP PA Working Group Involvement to help solidify technology such as TENA?

QUESTIONS AND DISCUSSION


WOOMERA
TEST RANGE
Test everything. Keep that which is good.
1 Thessalonians 5:21
'SHARPEN THE SPEAR'

Acknowledgements

- Dr Doug Gerrie / Lindsay Campbell, AOSG WTR General Brief, Feb 2011
- WGCDR Mal Tutty, FTSA 2011, March 2011
- US JTEM Process, 2010
- Susi Mckee, SETE 2010, May 2010