

Advise and Strike – The Development of the E7-A Wedgetail

SQNLDR Glenn Salmon and FLTLT Brad Machan

Part 1 of 2

The E-7A Wedgetail represents an entirely new capability for the Australian Defence Force, providing an airborne early warning and control (AEW&C) platform that can fuse data from a variety of sources, analyse it and distribute it to other air and surface assets.

Through its state-of-the-art Multi-role Electronically Scanned Array (MESA) radar complemented by advanced sensors and communications systems, the E-7A Wedgetail significantly multiplies the effectiveness of our existing Navy, Army and Air Force. It is perfectly placed to combine with current and future assets to help Australia maintain a capability edge well into the future.

From the early days of Project AIR5077 to declaring Final Operational Capability in May 2015, the E-7A Wedgetail has grown to prove its worth during participation in exercises such as BERSAMA LIMA, COPE NORTH and RED FLAG. The E-7A has also recently played a vital role in both Operation SOUTHERN INDIAN OCEAN (SIO) and as an essential element of Air Task Group 630 on Operation OKRA in the Middle East.

Presenters

SQNLDR Glenn Salmon joined the RAAF in 1998 and completed a Bachelor of Technology in Aeronautical Engineering at the Australian Defence Force Academy. He graduated from No. 191 Pilots course in 2002 and was posted to fly the AP-3C Orion at RAAF Base Edinburgh. He completed a 4 year tour at No 10 Squadron, completing multiple deployments on operations RESOLUTE, SLIPPER and ASTUTE. SQNLDR Salmon became a qualified flying instructor (QFI) on the PC-9 advanced trainer at No.2 Flying Training School in 2007. In 2009, he was subsequently posted back to Edinburgh to instruct on the AP-3C for several years before being promoted and posted to No 2 Squadron where he is currently the A Flight Commander. SQNLDR Salmon has over 4400 flying hours including over 950 hours as an instructor. He led the deployment in support of Operation SIO and was the Executive Officer for the first rotation to deploy to the Middle East as part of Operation OKRA.

FLTLT Brad Machan joined the RAAF in 1996 as a direct entry navigator, graduating to fly F-111s in 1997. He spent 9 years on F-111s including an instructional tour at the School of Air Navigation. After undergoing pilot training in 2007, he completed a tour as a flying instructor on PC-9A aircraft at RAAF Pearce. This was followed by fighter training until a posting to No 2 Squadron in 2011. Most recently, he flew KC-30 refuelling certification trials and is currently a qualified flying instructor on the E-7A. FLTLT Machan deployed as an aircraft captain on both Operation SIO and Operation OKRA.

On 1 September 2015, SQNLDR Salmon and FLTLT Machan delivered the following address at Russell Offices.


 **2 SQUADRON**
ADVISE AND STRIKE


To Advise and Strike
The E-7A Wedgetail



Airpower Seminar – 01 September 2015
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SQNLDR Salmon: Okay, so Advise and Strike—the motto of the squadron—and today we'll hopefully, as I said, introduce you guys to the Wedgetail and, if you have had some history with us in the past, bring you up to speed with where we are now and where we're going in the future.

 **2 SQUADRON**
ADVISE AND STRIKE



Some History...

- US Presidential Citation – WW2
- Duke of Gloucester's Citation – Malaya
- Vietnamese Unit Citation-Cross of Gallantry with Palm
- USAF Outstanding Unit Citation with Valour Device
- The Original Magpies





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A bit of background, 2 Squadron, we're a very proud squadron, one of the oldest squadrons in the Air Force, and we're the most decorated squadron in the Air Force, hence why Machan and I have the ribbon bars on our right breast pockets at the moment. It's our 100th anniversary next year, so you can imagine there's a bit of a buzz in the air for the squadron. It will be a big year for us next year.

As I said, Squadron Leader Salmon, 'Fish', I've been at 2 Squadron on the Wedgetail for about two and a half years now, but prior to that most of my career has been on P-3s and instructing on P-3s and PC-9s.


FLTLT Machan: I joined as a navigator in '96, as a nav instructor for a couple of years, F-111s predominantly. Re-rolled to pilot in 2007, an abridged jet course, ending at the ACM [air combat manoeuvres] phase at 76 [Squadron] and then 2 Squadron QFI at the moment, air-to-air refuelling instructing—that's me.

SQNLDR Salmon: That whole story about 'Don't tread on the people below you type thing' [is true]. I taught Machan [to fly] and then Machan taught me how to do air-to-air refuelling, so it was interesting.



Scope

- Project 5077
 - Intent
 - Timeline
- Aircraft
 - Overview
 - Mission Roles
 - Crewing
- Capability
 - Now
 - Future
- Challenges
- Key Messages
- Questions



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The scope of today's brief, we are limited somewhat, as you can understand, by the fact that we have to give an unclassified brief on the capabilities of the jet and what we're actually up to. But we should still be able to cover off a fair bit for you. So we'll talk about the project itself, the problems that we had on the project, and where we've come to from there.

Machan will give you a bit of an overview of the jet itself, what it's got on board, how we crew it, how we operate it, and some of the boxes and bells and whistles on the aircraft. We will try and touch a bit on the capability space, what the aircraft is capable of and what we're looking to be capable of in the future, and also looking at some of the challenges that we have faced in the past, what we're facing at the moment and what we envisage will be problems down the track for us as we move forward developing the aircraft. We've got a few key takeaways for you and, as I said, if you could keep the questions to the end, we will hopefully be able to answer those for you.

We had a bit of a discussion about what sort of things we would talk about today within the scope of what we can discuss and we're trying to keep it largely at an operator level. We went through what sort of an audience we would have today. So we thought we'd give you our perspective as a commander of some of the detachments that we've done, and the operators. We did have one of our specialist ACO ABM [Air Battle Management] guys that was going to come down with us but, due to the tasking we've got on at the squadron at the moment, he had to pull out at the last minute.

So these were the CONOPS [concept of operations] for what they wanted originally out of the aircraft.



The 5077 CONOPS

- *As an integral part of a layered ADF Air Defence System, the AEW&C capability will enhance surveillance, air defence, fleet support and force coordination operations in defence of Australian sovereignty and national interests.*

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I think the important thing to note here is that the concept of an airborne early warning capability and an airborne GCI [ground controlled intercept] capability, controller capability, was not an evolution. It wasn't a replacement for something the Air Force had. This was a brand new capability that the RAAF was looking at getting; something that we had never really had the ability to do before. So it was very ambitious and, as with a lot of ambitious things, a lot of problems came along with that. But, through that, it's great to see where the aircraft has got to now and where are the systems operating that.



E-7A Mission and Roles

surveillance, battlespace management, civil support operations



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Out of that CONOPs, they basically came up with what I think are some very broad-brush roles, but these are basically the defined roles for the E-7. So surveillance, battlespace management—and that encompasses a whole bunch of things—and civil support operations, and we'll talk a bit more about all of those as we progress through the brief.



Timeline

- 1990s – Form the need
- 1996 – RFP
- 2000 – Boeing awarded Project Wedgetail
- 2006 – Delivery...*
 - *18 month slide
 - Boeing incurred damages
- 2008 – Further delay due ESM

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This is a timeline for the project itself. There's a few interesting things here. So it was back in the 90's that we first decided we wanted to develop this capability and put a request out for projects. In 2000, Boeing was awarded Project Wedgetail; 2006 was the slated delivery date for the jet. For a whole bunch of reasons, there were delays to that program. Boeing incurred a huge amount of financial penalties for that, particularly when you look at the further delay there due to the ESM issues that the jet had. It was through some outstanding work done by people in uniform and by Boeing engineers that they persevered through that to continue with the project, because it very nearly got scrapped.



Timeline

- 2009 – Scan eagle UAS control
- Nov 2009 – 2 a/c delivered to RAAF
- May 2010 – Formal acceptance by RAAF
- Nov 2012 – IOC ⁽⁺⁶⁾
- Apr 2014 – OP SIO
- Oct 2014 – OP Okra
- May 2015 – FOC ⁽⁺⁶⁾

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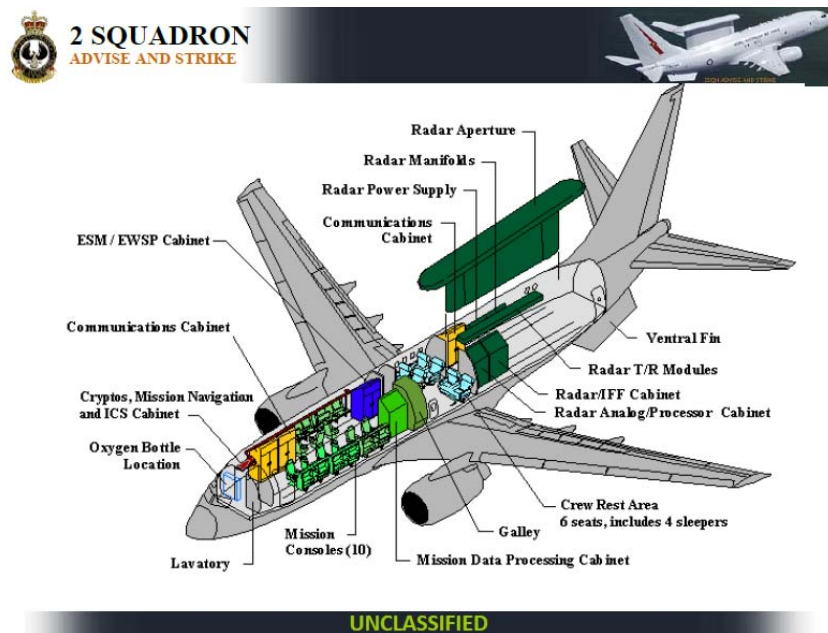
Two thousand and nine was the first time the jet took control of anything, and at the end of 2009 we had our first two aircraft delivered. November 2012 was when we declared initial operating capability. That was five years after the original planned date that we were supposed to have the aircraft.

Shortly after declaring IOC, we found ourselves on the search for MH370, an operation in the Southern Indian Ocean. I'll talk more about that, a bit more about that later. But, as you can see at this stage, April 2014 Op SIO, October 2014 Op OKRA, and we're still not even at FOC. So it was very impressive what the team was able to achieve with the jet in that year, basically. May of this year, unbeknown to me at the time, they declared final operational capability, which is six years after the planned date that we would declare FOC.

As I mentioned, we did a couple of operations prior to actually declaring FOC, which raises the question 'What is FOC?' How do you define it for your particular capability? Is it number of jets? Is it number of crews? Is it having a sustainable raise, train, sustain element? Is it a logistics and supply chain? The engines are so reliable, the Air Force has only bought 12 for the six aircraft that we have. We have no spare engines, because they're not planned to fail. I hope we don't test that. Is it all the support systems that you need? We have a team of mission planning people that burn our mission discs and set the mission systems up for us, and they're a finite quantity. Is it having your fully defined and articulated CONOPS to the level that you're happy with? Because that is also an ongoing beast for us. So we'll talk a bit more about that sort of stuff later.

Hand over to Machan for a chat about the aircraft itself.

FLTLT Machan: So it's basically a 737-700 Improved Gross Weight. So [it has] extra structural components to the main landing gear and other parts, due in part to the extra weight of the MESA radar. The occupied element of the cabin is only about half of the fuselage, so there's a few cutaways to show you the section. The takeaway there is it's a pretty squeezey little platform—21 POB [persons on board] maximum. So you can imagine taking a jet around the world—there's not a whole lot of spare space. Guys who would go in a P-8—a lot more room there and a whole lot less non-occupied cabin.



So, front to back, obviously the pilots up the front with the standard 737 fit. There are a few modifications in the cockpit, which I'll talk to—the mission crew area there with the ten mission consoles. The beauty of those is they're fully interchangeable. So there are some consoles that have some, well, one in particular, which has an extra A-scope for ESM. However, there are elements of that ESM data that are available to all of the mission consoles. So you've got a lot of flexibility. The minute you lose one screen, you don't really lose capability straight away. So, pretty good.

Work down the back towards the centre galley, the crew rest area, just near the aft wing route there, and then after that you've got the associated non-occupied space with the MESA radar on top. Just the ventral fins and other obvious modifications, those ventral fins which are for improved longitudinal stability and they also act as a HF antenna.

The cockpit [is] pretty similar to your normal 737. A couple of notable additions, down here we've got a TCDU [tactical control and display unit]. We love our acronyms in the Air Force, obviously, but that's basically a box that controls the tactical display, and this is the main difference between an E-7A Wedgetail and any other legacy AWAC platform. There is no brick wall between the front and the back. We get a feed of what the mission crew are seeing and we take a lot of interest, for obvious reasons, in how the fight's going, what's actually occurring in the battlespace and threat awareness. We share that role.

So, through this screen here, we can modify what we want to and don't want to see in the tactical battlespace. Some of the downsides of that, in the orbit, I'd probably rather be looking out there than all the way down there. So the good news for P-8, guys, is this screen will interchange with this screen. So that would be the take-off configuration and then once you're in a tactical environment you would flip those. So, good for P-8, maybe good for us in the longer term.

Other additions are the countermeasure dispensing system. Dispense button is another one down here. And just off the screen is the air-to-air refuelling panel. The other main unique component about the Wedgetail is the electrical panel up here, and we'll probably chat a little bit about that later. But, you can imagine, a radar that can see as far as the Wedgetail radar can see needs a lot of power to keep it running. So it's a very unique electrical system that runs the E-7 Wedgetail.



Simulator X 2



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To support that, we've got simulators. This is the front end simulator. We've also got a mission crew simulator. I couldn't find any photos of that one, but essentially it's a replication of what is in the back of the Wedgetail. The guys have just finished an [Exercise] COALITION VIRTUAL FLAG using that and other simulators for other [weapons] systems that we've got. [They are] level 5 simulators—good for all training. We do air-to-air refuelling training in that as well, which is pretty unique.



Mission System



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This is a picture of the mission system layout. Again, differences—I know it's throwing to P-8 here, but I know there are a few people involved with P-8 around the audience here. The key difference is a bit of extra space and the P-8 has dual screens. This is a pre-OKRA mod as well. So, for OKRA, we had a bunch of extra capability and extra screens that probably just go a little bit above the classification of this brief, but that's the mission crew area there.

SQNLDR Salmon: We would kill for the screens that the P-8 has got, the dual screens. That would help us a lot.



Multi-role Electronically Scanned Array

- Back-to-back side arrays & end-fire 'top hat' array
- High update rates for selected targets
- Enhanced detection in sectors
- Selectable radar revisit rate
- L-band
- Integral IFF system



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FLTLT Machan: Okay, so the business end of the capability is the MESA Multi-Role Electronically Scanned Array. So it's actually four radars. So, if you think of it, the two side arrays are the more obvious ones, so that's the side array and there's one on the other side as well, and then in the surfboard you've got two radars, so you've got the top hat forward and the top hat aft. The idea behind the top hat radar is to account for the interface between the two side arrays. So you've got one side array looking out that way, one out that way, and there's always going to be a bit of a gap, so that's what those top hats do. They take account for that overlap of the two main side array radars. So the good news about that, it's an electronically scanned array, so no mechanical slewing, no 1970's. The future great capability is pretty much unparalleled and we'll talk about that at the end.

Being able to steer the beam electronically obviously has its benefits. We've got a few animations to show you in a sec. We can then choose higher update rates to hone in on specific targets of interest and use sectorised enhancement for extra range on areas of interest. So, again, capabilities that aren't immediately available with legacy AWAC systems.

Radar revisit rates are selectable. It works in the L-Band, so around the one Gig [GHz] range there, and it's got an integral IFF [Identification Friend or Foe] system embedded within the radar. So you've got PDA, SPS and IFF, which we'll talk about. They're the three key ingredients of the radar picture.



MESA RADAR MODES

- PDA Mode - Pulse-Doppler Airborne surveillance
- SPS Mode - Single Pulse Surface surveillance
- Modes are interleaved or sectored to function simultaneously
 - Radar/IFF alternate usage of Top Hat and Side Arrays
 - Radar scan
 - Priority surv for track revisit

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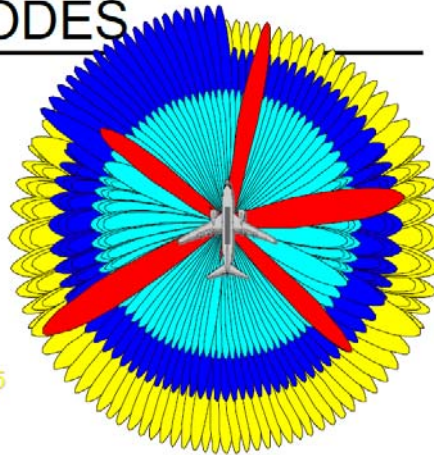
FLTLT Machan: The MESA radar modes: PDA mode, SPS and then the IFF is integral to that. So Pulse-Doppler Airborne [PDA] surveillance is for airborne threats. SPS—Single Pulse Surface surveillance [is for] surface threats being land-based or maritime-based. For a pilot, PDA—planes, SPS—surface. The modes are interleaved, or sectored, to function simultaneously. Again, another good reason, or good benefit of this type of radar.

So we can integrate radar in IFF, alternately in the side array and the top hat, at separate times or almost independently. We can mess with the radar scan and prioritise surveillance for track revisits. We've got some animations coming up which will probably make a little bit more sense. Okay, so the PDA mode, good for not only fast-moving airborne threats, but also slow moving airborne threats, so helos and other slow movers.



MODES

- Airborne Mode (PDA)
 - Fighter
 - Slow Airborne targets
- Sector Emphasis
 - Extended Range Detection
- Maritime Mode (SPS)
 - Fast Patrol Boat
 - Frigate
- Radar Revisit Beams
- IFF Modes 1,2,3/A, C, 4 and 5



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Sector emphasis for extended range detection – slide to come shortly. Maritime mode, or SPS – ships. Things there, we're looking particularly at fast patrol boats, frigates, radar revisit beams – animation is going to come shortly – and then we've got the IFF interlaid. So, having a look at PDA mode there, so in this case looking for a 360 coverage at a specific range, using those four radars with the overlap. We might want it sector-emphasised to the forward left quadrant, because that's where the threat might be coming from, so we can channel more energy for extended range in that particular sector.

Coincident with that, we don't just have to look at PDA, we can also time share to do SPS, because there's no use just being aware of air threats if there are ground threats. So the radar has obviously got the brain space to do that. So Maritime mode, SPS overlay, and then, within that, a radar revisit beam could be directed at other parts of that 360 degree sphere, and then finally the IFF Modes 1, 2, 3, Alpha Charlie Mode 4 and 5. So, all of those ingredients allow the mission crew to build the recognised air and surface picture, and that's pretty much what our core role is, to sanitise that air space.



MULTI-SENSOR INTEGRATION (MSI)

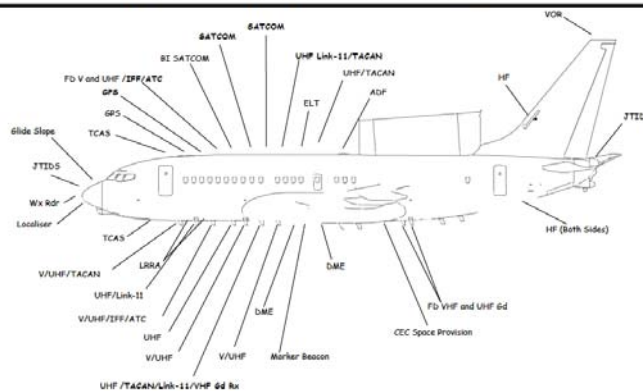
- Single track on a target with the correct ID
 - Tracking
 - Automatic ID
 - Situation & Threat Assessment
 - Sensor Management

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How the jet actually does it is using MSI, or the Multi-Sense Integration. So, here, I'm not just talking about radar. We'll talk about ESM integration—Electronic Support Measures integration, shortly. But this is where a lot of the timeline creep occurred in Wedgetail. You can imagine trying to get all of this information to talk to each other correctly is what kept a lot of guys up at night and what they spent a lot of money trying to fix. So a single track on a target with the correct ID, they're the four key components that will go into achieving that through the MSI function.



ANTENNA LAYOUT

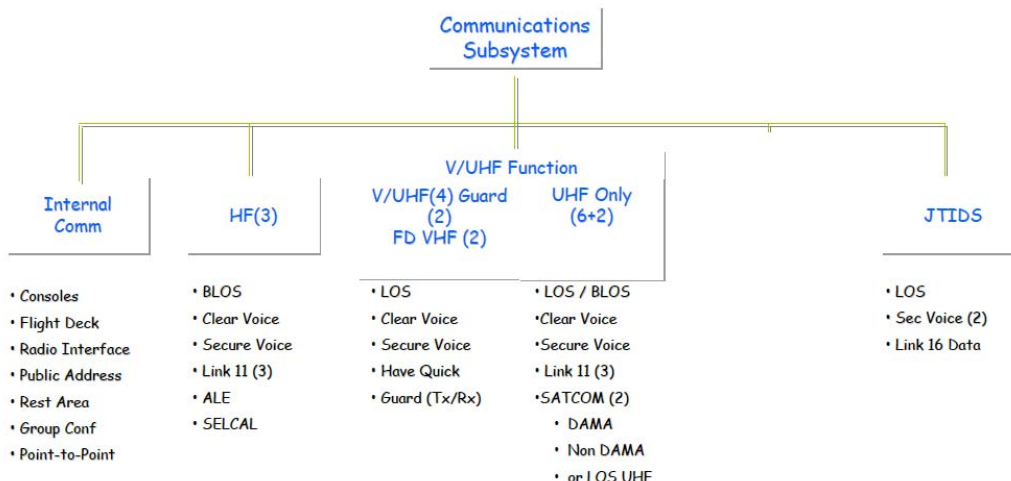


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We've got a lot of antennas. I probably wouldn't know if I'm missing one on a walk-around—there are so many. But you can see HF antennas on the bottom, a bunch of different VU and JTIDS [Joint Tactical Information Distribution System] antennas. You've got Link 11, 16 and we've also got MiRC as well now, post [Operation] OKRA.



COMMUNICATIONS



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Broadly, the Com Subsystem, is broken up into those main branches there. Data links, Link 11 and 16, and looking for Link 22 as that comes online as well, so we've got a future path already laid out for that one. I guess, close to it but not quite the same is MiRC. So MiRC is life in any coalition operation, and pre [Operation] OKRA we didn't have it. And OKRA was a real precipitator of MiRC for us, and it's been a game changer for the way the aircraft is used and also how the mission crew operate, and even us up the front with how we operate the orbit to make sure we don't get MiRC dropout.

SQNLDR Salmon: MiRC being an internet chat capability, if you're not familiar with that, so basically having a laptop screen. The lads have to have a bunch of chat windows open to various organisations, whether it's the CAOC or home base or other various windows, depending on what you want to talk on.



WEDGETAIL ESM

- Significantly upgraded AN/ALR 2001
 - Improved digitization, additional receiver channel
 - Provides passive detection, classification & location of Tgts
 - Collects emitter data for post-mission analysis
 - All operators can access information - EWO has A-Scope
 - Fully integrated into Mission System

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FLTLT Machan: Wedgetail ESM, basically we run a very much upgraded version of the AN/ALR-2001. Again, that's the second component of the Wedgetail delay in circa 2008. The upgrade to the 2001 did a lot of things. Mainly, it just improved the digitisation and the usability of the system so it can passively detect, classify and locate targets, collect data that we can analyse at a later stage. As I mentioned at the very start, any operator in the mission crew area can analyse any of the ESM data that they'd like to. Generally, they're pretty busy and they're doing other things, but the ESM operators also have an A-scope or an oscilloscope where they can physically look at return emissions and then classify [the contact] based on the wave form. So that's pretty useful, and it's integrated into the mission system.



So the antennas for the ESM, pretty much any of the black antennas, with the exception of the forward top hat here, and the tyres, are pretty much ESM. So the intent there, [is] just giving us 360 degree coverage for passive detection.

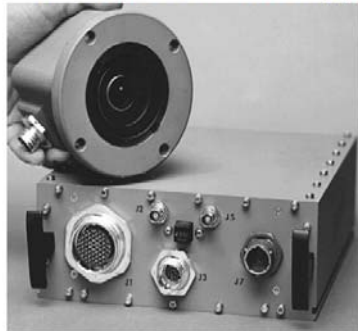


2 SQUADRON
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WEDGETAIL EWSP

- Passive Missile Approach Warning



AN/AAR-54



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Along with that, in the ESM system, is a component of our Electronic Warfare Self-Protection System—the AN/AAR-54 MAWS—Missile Approach Warning Sensor. We've got a bunch of these situated around the aircraft. You can see two of them here. They work similar to the ESM system in regards to them being passive, but they're detecting infrared missile launches and then alerting us, giving us a line of bearing, and then talking to the laser, which we'll talk about in a sec, which is the LAIRCM at the tail end of the aircraft there.



WEDGETAIL EWSP

- Large Aircraft Infra Red Counter Measures (LAIRCM)
 - Fully automated
 - IR threats
 - Separate sensor if AAR54 degraded



AN/AAQ-24 NEMESIS



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Here's what I was just briefly touching on—the large aircraft infrared countermeasures. It's an AAQ-24, for those that like numbers. It's a fully automated system. It's got its own integral sensor, if we have a MAWS degradation, so we've got a level of redundancy there. It will ID cue, make a gross assessment as to the validity of that threat and then, based on its judgment and what other flares we've got in the CMDS system, it will then make a decision as to whether it will fire its laser or not.



COUNTER MEASURES DISPENSING SYSTEM

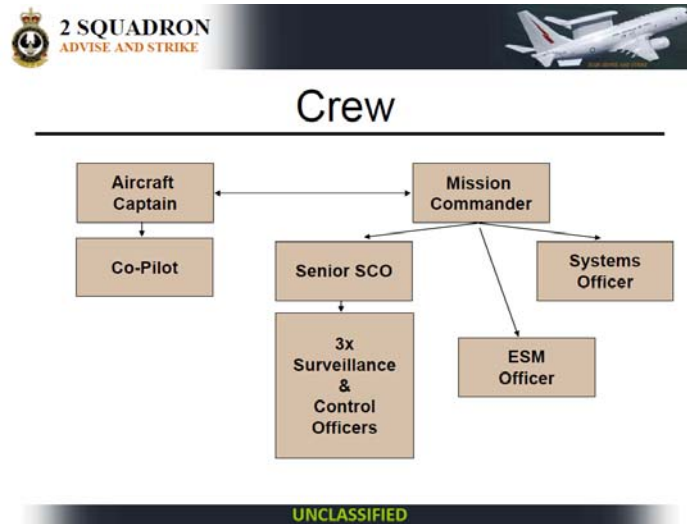


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We've got a number of countermeasure dispensing system buckets placed around the aircraft. Three modes [are] either auto, semi-auto or manual. Depending on the operation, we will choose one of those modes, and the idea is, as I've just alluded to, threat A is out there, we get information on that, it talks to the LAIRCM, and the LAIRCM will then make a decision as to whether it will employ flares from the buckets or whether it will fire a laser at the threat itself. So the system is highly integrated. And here is a look at where some of those countermeasure dispensing system buckets are.



I guess the takeaway there is it's the most protected AEW&C platform every built. When we're operating in the exercise and operational context—obviously it's a high value asset—but a lot of the tankers, but particularly the E-3s, are super jealous that we've got any self-protection capability because they don't really have many. So we're very thankful for that. Is it end-state? Well, absolutely not, and we'll talk a little bit about future stuff shortly.



Crew construct, so it is a bit of a diarchy. You've got the mission commander commanding the mission and the mission crew, including ESM operators that fall under the mission commander, and this is essentially all of the guys in the back doing the hard yards. Up the front, you've obviously got the aircraft captain and the copilot. For the mission, obviously the mission commander has the say, but for anything that's overall mission and obviously safety of flight, the aircraft captain maintains the veto on that.

The mission commander and the aircraft captain work very closely, but any minute there's any safety of flight or aircraft safety issues, the diarchy ceases and the aircraft captain will maintain the right to make that ultimate decision.

Notice the ESM operator, because they have such a unique role, report straight to the mission commander. The systems officer is the person that runs the radar and the links and MiRC, to a large degree, and then the surveillance and control officers are the people that are physically doing the control, whether it's force or digital control. Taking care of those, normally up to three surveillance and control officers, is the senior surveillance and control officer. He or she reports to the mission commander.

So the takeaway out of this slide, this is pre-OKRA. Things changed a little and we'll show you a slide in a bit, but you can imagine the diversity of the roles within the Wedgetail have a massive training overhead, and that's one of the things that we find ourselves up against in the unit that's as small as 2 Squadron.

SQNLDR Salmon: Yes, it's important to note with that slide that that was basically the CONOPS-envisaged crewing of the jet and the roles that we would have on board and how many people we'd need to run the jet. That assumption was based on, or that crew model was based on an assumption that a lot of the stuff on the aircraft would be automated by the mission systems. In practice, we found that's not really the case, and through a couple of other roles that have developed on the aircraft, that crew of nine has grown somewhat since the original days of operating the aircraft, and we'll touch on that a bit later.

End of Part 1

Note: Words in square brackets [] were adding during the editing process for clarity.

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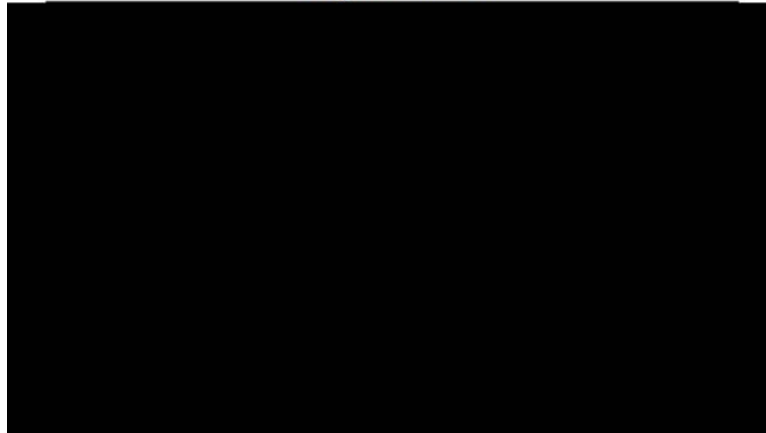
Part 2 of 2



FLTLT Machan: Enabling the capability persistence, being one of those key requirements of an AEW&C platform, is obviously air-to-air refuelling. Day and night KC-30 trials have just in the last month or so been completed, so we're just finishing a raise-train element of KC-30, day and night, air-to-air refuelling capability for the E-7 pilot crew. So that's been a big job and, overall, it's improving the quality of pilots we have and are retaining at the squadron. Up until OKRA, we kind of did this once or twice a year. Because we didn't have KC-30s, we'd have to go and tee it up with the Americans or the Singaporeans, but it's really just what we do day-to-day. There's nothing special about air-to-air refuelling—it's just a task that any E-7 operator needs to be able to do.



Night AAR



So there's a picture of night air-to-air refuelling. That's what it really looks like. It's pretty dark.



Night KC-135



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That is a KC-135 at night—that is a really well lit one. A lot of them aren't quite that well lit. As an E-7 pilot, there are hours and hours where you can just let the autopilot do its job, but the really great thing about the Wedgetail is that we get to do this stuff as well. So it keeps us interested. And, concurrent with this, in theatre, the mission doesn't stop. The guys are still doing stuff down the back. They're doing procedural control of assets in Iraq and Syria and other things, which we'll talk about in a sec.



Night KC-10



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[To more] recent stuff, in [Exercise] TALISMEN SABRE at Tindal, so [this is a] night KC-10, that's at 50 feet. We come into about 20 to 12 feet for the actual tank. So it's pretty big.

So where we're at now for capability, from the early days and from definitely those around the mid-2000s, I think a lot of people are very, very happy that people persisted at Boeing and at Russell, both on the project side and over in Seattle.



Capability NOW

- Robust radar and mission system
- Maturing support and infrastructure
- Exercises
- Operations

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So we've now graduated to quite a robust radar and a robust mission system. Maturing support and infrastructure – we're still doing a lot of exercises and operations – and we're going to talk a little bit about those in a sec, and some of the pitfalls of that.



Exercise Red Flag Nellis

Tier 1 exercise
Most advanced threat simulation
anywhere in the world
Develop/validate TTPs
Conduct check rides and
upgrades (force
generation/sustainment)



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SQNLDR Salmon: So the main exercise that Wedgetail participates in, in terms of the level of involvement we have, the effort we put into it and the benefits we get out of it, is Red Flag. We do two a year. We do one in Nellis [Air Force Base] and we do one in Alaska. The Alaska one just finished and the guys are back at work this week. Why do we do Red Flag? It's a Tier 1 exercise. What does that mean? It means that the crews that we send have all got Top Secret Positive Vetting [security clearances]. We work with the United States [Air Force] pretty much exclusively and, to a lesser extent, the Brits, and operate in the SAPSTO space with capability briefs and discussing what our various air forces are actually capable of, and operating to those levels of capability.

The range at Red Flag, the NTTR [Nevada Test and Training Range] as they call it, which surrounds Area 51, affectionately referred to as 'the container', flying into the container will earn you an immediate 'Land, go home' and an epic slap on the wrist. What they have in that range, though, is some of the most advanced threat simulation in the world, for air platforms of various ranges of actual surface-to-air missile threats, emitters of all kinds. It's the most realistic training we can get.

We use it to train our people, upgrade our people, develop and validate our CONOPS and our TTPs, our tactics, techniques and procedures, and it's essentially three weeks of the best training we can get for the aircraft. So we will always endeavour to participate in that, because it's the main thing that we need. Our success over in the Middle East on OKRA was almost solely due to our participation in Red Flag, because it's the only high-level, war fighting simulation that we get that operates at that level. Have you got anything to add on our times at Red Flag, mate, in terms of how we operate the aircraft over there?

FLTLT Machan: No.



2 SQUADRON
ADVISE AND STRIKE



OPERATION SOUTHERN INDIAN OCEAN



- Civil support introduction
- Still only IOC then
- Mission timeline

UNCLASSIFIED

SQNLDR Salmon: So, moving on from that, Operation SOUTHERN INDIAN OCEAN in about May of last year. So we've all heard about MH370. I was a little surprised, actually, when we got the call over at Williamtown to rock on over to Perth and start participating in the search for MH370. I thought that was just going to be the domain of my P-3 brethren and their allies to take care of that, because that's their bread and butter and they do it fantastically. Nevertheless, we were called over there. Why were we called over there? For a couple of reasons. One was, depending on the search areas they were looking at, it was a long way out, so we were a coms relay platform for a lot of the search assets. And, two, there were a lot of nations involved – Malaysians, Chinese, us, the Yanks – and communication was difficult.

At times, the varying nations had Australian air riders on board to essentially translate what the Wedgetail was saying into normal speech that would then be spoken by a translator who would translate it, say, for argument sake, from Australian into Chinese. But it was a very real barrier that we had to overcome.

As I said before, we were still only at IOC level of capability that we had declared at the time, so we were still fairly infantile in what we were doing. The big thing for us when we got over there was we were initially operating out of Perth Airport, just for logistics reasons, and that worked well with where the search area was. Later on, we moved up to Learmonth, for some reasons that I'll talk about in a second, but primarily based out of Perth and then Learmonth.

It was completely different to what we had been training for. We had been training for Red Flags with B-2s and Raptors and a whole bunch of really cool things, and that was our controllers bread and butter and they were very, very good at that. I don't think any of them had ever really had anything to do with search and rescue or search and rescue assets, or considered what those assets might actually need as a level of service from the Wedgetail, because ultimately we're just a cog in a machine and we're there to provider a service. We're very used to providing service to fighters and to a wider air battle management area, but we're not used to focusing our efforts close to the ocean on a search and rescue scenario. So, having a bunch of aircraft at low level operating extremely close to each other in a very confined bit of airspace is often bread and butter for P-3s and Hercs and other search assets. [But it was] radical for my controllers down the back of the Wedgetail and it was a very big culture shock for those guys and girls when we first started doing that.

In addition to that, I went over there as the DETCO [Detachment Commander] and one thing I found was it was the first time that 92 Wing, which is the P-3s, and 42 Wing, which is us, had really worked together on something. It was our first operational tasking, obviously. They're two completely different languages, operationally and tactically, that the crews speak. I came to Wedgetail and I knew all about submarine hunting, ship killing, search and rescue, surveillance—all that kind of stuff. That was my bread and butter. I came to Wedgetail and they're talking about 2vXs and ranges and timelines for shots and just a whole other world.

So neither of those groups of people really knew what the other one was talking about, and there was a bit of friction there initially and a few things that needed to be overcome to basically talk a communal language and get out of each asset what we were after. The search assets had never really worked with an AWAC platform before, so they weren't really aware of what the jet could provide them and what services we could help them out with. Similarly, we hadn't really worked with the P-3s and other search assets before, so we didn't know what they were going to need when they were operating down at low level two miles from a Chinese Herc looking at the bit of ocean they were assigned that day. So it was a really big learning curve, but the one thing I took away from SIO was that fact that I think both organisations had a better understanding of each other, and that's only a great thing for the future for us.

I mentioned earlier, we moved up to Learmonth later on in the search phase for MH370, and there's a couple of reasons for that. One was the search area had moved that way and, to give us as much on-station time as possible, it made sense for us to move up there. The other one, from a legal and rules point of view, is we're currently constrained by a civilian concept of EROPS or ETOPS, which is Extended Range Operations, which governs aircraft of civil aviation around the world that operate on two or four engines and dictates from a safety reliability point of view how far those aircraft can be from a suitable airfield at any given time.

For us on Wedgetail, at the time, we moved out to three hours away from an airfield. So three hours at a prescribed distance basically gave us give or take 1000 miles we could be away from Learmonth or another suitable airfield. The actual area that the aircraft was searching at that stage was probably another couple of hundred miles past that, wasn't it Machan?

FLTLT Machan: Yep.

SQNLDR Salmon: And we physically were hamstrung by that bungee cord that we were on. Why is that important to note? The US Navy and the P-8, they did not apply civilian EROPS or ETOPS rules and they were out 1200 or 1300 miles from the coast operating on their twin engine 737, unconstrained by those rules. So that really did hamstring us to a certain extent and prohibited us from perhaps getting out where we would have liked to have got, and it also constrained our bingo fuels to a certain extent as well. At that particular time in May last year, a serviceable KC-30 would have been a very useful asset for us.

But that was MH370. Ultimately, as we all know, we didn't find what we were looking for, but there were a lot of excellent lessons to come out of that particular operation and our first taste of what life was like on something where a lot of people were looking at you on a daily basis and judging your performance.

FLTLT Machan: The good news on that EROPS thing is that there were occasions where we got specific Air Commander Australia authority to go further, so we had a little bit of military flexibility and we were also adopting the Defence Long Range Procedures and Protocols, which are inbound soon. So, hopefully, a lot of those civilian constraints will come off. But, overall, we had a civilian operating culture, because all of our initial cadre pilots had done significant time at civilian airlines. So, by definition, our procedures are very much civilian aviation and airline prescribed. SIO was our first ever way to becoming an actual valid military platform, so that was great to see, and it only went further when we got to OKRA.

SQNLDR Salmon: Now, one of the things I did find out about the capability when I first got to it was we were operating largely as an airliner with a surfboard on the top, and it wasn't, it's not an appropriate use of the asset. It's a military aircraft and it should be operated as a military aircraft. We operate it; we don't fly it. And I'm pleased to say that over the past few years there's been a lot of work done and we are operating Wedgetail now, which I think is a great think.



The lead up to Operation Okra



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We'll get into a bit of the guts of OKRA now. I think it's interesting to just cover off on the timeline. Most, if not all, of you may not have been aware of the actual timeline that we were running to in the lead-up to OKRA. For myself, who'd been privileged enough to deploy a few times on operations before, I'd seen this sort of thing. And we've slowly infiltrated 2 Squadron with some maritime guys over the years, so there were a couple of us that had sort of seen this stuff before and we're sort of used to seeing spool-ups and all that sort of thing, but for the vast majority of people at my squadron this concept of deploying away with a squadron was brand new and it reached fever pitch at times.

It was interesting sitting back and watching these guys get really, really ramped up about the potential of deploying, and I don't think at the time they realised the ramifications of being on an operational squadron and multiple deployments would have on their lives, both professional and personal, and we are starting to realise that now. Our first bunch of guys that was over there with us have just returned for their second tour, so more on that later. Anyway, so the lead-up to Operation OKRA, as I said, it was interesting. There was an epic spool-up at the squadron at the time, people getting very excited about this potential chance to go over to the MEAO.



Pre OKRA Notice to Move (NTM)

- Jun 2014: 2 crews put on 24 + 72 hr NTM (50% of our line crews at the time)
- Jul 2014: NTM relaxed to 7 days. Enabled participation in Ex Pitch Black and Kakadu (RTS)
- Aug 2014 : Spool up, then down. Fish's take on it all
- Sep 2014: ISIL were engaging ISF heavily and openly beheading captives

UNCLASSIFIED

So, Notice to Moves. A lot of you in the room would be familiar with that—basically telling a unit, a capability, to be ready to do something in a prescribed amount of time. Back in June 2014, we had two crews put on notice to move. One crew was put on 24 hours' notice to move. A second crew put on 72 hours' notice to move. At the time, we had four line crews, so that was 50 percent of our capability instantly taken up by that.

We had a lot of things on the boil. We were getting ready for [Exercises] RED FLAG ALASKA, PITCH BLACK and Exercise KAKADU. All of these raise, train, sustain events that we had been doing in our lives to try and develop our capability, develop the CONOPS, develop our people, instantly got put on hold. There were a lot of discussions about this. It put a great strain on us to have 50 percent of our capability taken up by being on notice to move and not really being able to go anywhere and do anything. So, in July, we got that notice to move relaxed to seven days. That allowed us to go up to Pitch Black, it allowed us to do Kakadu, and continue that raise, train, sustain stuff.

Interestingly, Machan's crew was up at Kakadu at the time. In August, it looked like we were going to spool up again and it looked like things were on and we were going to head off. Then it quickly died away again. My assessment to my guys and girls at the time was I didn't really see how we were going to head over there unless something significantly changed with what was happening on the ground in Iraq and Syria. I didn't see that the Government would pull the trigger unless something [happened]—a switch was flicked.



Pre OKRA NTM

- Sep 2014: Senior personnel called to CBR
- Sep 14th: Deploy order
- Sep 21st: Land in the MER.
- Sep 28th: First (AG) mission flown
- Oct 1st: First mission into IZ.



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And in September 2014, ISIL were really heavily engaging the Iraqi security forces. By this stage, there had been numerous public beheadings. Public sentiment around the world was 'Let's go and get these guys' and that's effectively what started to pull the Government towards it. That's actually a shot down the bottom of the base that we ended up operating at and they're the tents that we were living out of and working in for the time that we were there.

In early September 2014, a bunch of us were called down to Canberra for some more detailed planning and consultation. About September 14th plus or minus a day, we were given the order to go. It was actually September 22nd I landed a jet in the Middle East. So a week after we were told to go, we got there. A week after that, including all of the force prep and induction and all the necessary faff that goes along with arriving in a theatre, we flew the first missions. That's not a bad timeline.

That first mission was just in the Arabian Gulf. We didn't actually have diplomatic clearance at the time to fly into Iraq. October 1st, we got our diplomatic clearance that morning and we launched on our first mission into Iraq. About halfway through the mission I had the Commander come into my office, just shy of screaming at me, essentially saying 'What have you done?' and I didn't know what he was getting at. He said 'Where's the jet?' and I said 'Ah, it's in Iraq sir,' and 'Oh, good news, the USAF E-3 fell through and they've taken control of Iraq'. So, on their first mission, the guys were just planning to shadow the E-3, get a feel for it, see how it was doing business. The next thing they knew, it dipped and they were taking control of the airspace in Iraq.


I was pretty chuffed, 'Good work, my team, well done' and he said 'Fish, you don't have diplomatic clearance to be in Iraq, what have you done?' and I was 'Well, that was a good career while it lasted'. I was pretty confident I did have diplomatic clearance; he reckoned that Canberra told him we didn't. So, for the next four hours, I played the waiting game as to where I was going to end up for the rest of my life. It turns out I was right, we did have the diplomatic clearance and it was all good, but it was a bit of a tense afternoon while we were waiting to find out whether Iraq had actually given us the diplomatic clearance. Diplomatic clearance to operate in and around a bunch of those countries is an ongoing, very sensitive issue.

Just to reiterate, from the timeline that we were given, for a jet that had never really deployed operationally, we were there flying missions in Iraq about two weeks later after we got the order. So I think that was quite impressive.



OPERATION OKRA

- C2 of all airborne coalition assets in IZ and SY
- ISR of IZ and SY
- 14hr missions, 1 refuel.
Record....16.3*hrs
- Mission/planning timeline



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What did we do there? When we were airborne, we were basically responsible for command and control of all airborne Coalition assets in Iraq and also in Syria. It's important to note that we were controlling assets in Syria. Our Super Hornet fighters were not cleared to operate in Syria, nor was the tanker, but we were cleared to provide effects into Syria from a rules of engagement point of view. So that permitted us to control strikes into Kobani and Aleppo—those sorts of places which were hotspots at the time.

We provided intelligence surveillance and reconnaissance in both Iraq and in Syria. Our average missions that Machan and I were flying were approximately 14 hours long, anywhere between sort of 12 and 14. We would regularly be on station for longer than that because the E-3 either side of us would break, just because of the age of the platform. So that would require us to extend basically as long as we could.

So our 14'ish hour missions, we were getting away with one refuel from a tanker for those. The record that Machan set while we were there—hence the asterisk because I know the guys have beaten it since—we got a 16.3 out of the jet, which was two plugs from the tanker, and obviously you can understand, if that's 16.3 hours airborne, our day before and after that was quite long. Machan will touch a bit more on that later. I think we're up to about 16.5, 16.6 hours airborne at the moment as the longest flight that Wedgetail has done over there, which coincidentally has broken all records for a 737 by a long, long, long way.

Machan, do you want to touch on our timeline for a day that we would fly a mission?

FLTLT Machan: Yep. So, depending on the complexity of the mission, it was the amount of pre-briefing that had to occur, and I'm talking about particularly Syria strikes. The timeline was—obviously the ATO [air tasking order] base timeline isn't going to shift—it's just the normal 72 hour ATO cycle. So we adhered to that, from an operator perspective. ATO would drop [be released] and we'd then begin starting the planning process. The great news about our basing was that we were right next door, or just across the road, from the E-3 guys and the Raptor guys, so there were a lot of real benefits of being able to do face-to-face coord with those guys. [We were] still able to do that through other means, being based elsewhere.

Essentially, the day prior [to the mission], a series of co-ordination briefs, getting the relevant data we need, not only from our own fuel onload/offload tasking, orbit times and altitudes, but also the strike, particularly for Syria strikes, getting all that deconfliction data, fallout plans from the strike commander through to the mission commander and then executing it. For the actual execution day, depending on what VUL [period on station] we were tasked for, that would determine our show up to work time. But, essentially, we were operating to around about a 19 hour crew duty day, which is why those numbers [flight times] were hovering around 17 hours at a max. Post-that, [we would] land normally three in the morning, debrief, go to sleep until about four in the morning when the F-15s would take off.

SQNLDR Salmon: Or the U2s.

FLTLT Machan: Or the U2s, and then sleep till about midday, and then we'd have a day off, essentially, and then start it all again.

SQNLDR Salmon: OKRA itself [was] fantastic. The jet—and we've got a picture of it coming up—what the jet looks like down the back, how the guys and girls are operating it, what we're doing with that aircraft, what the radar and what the sensors are capable of now is so far removed from what it was doing even two or three years ago. I took a step back and looked at it after I left the rotation and I was shocked. The capability is unbelievable. It's amazing.

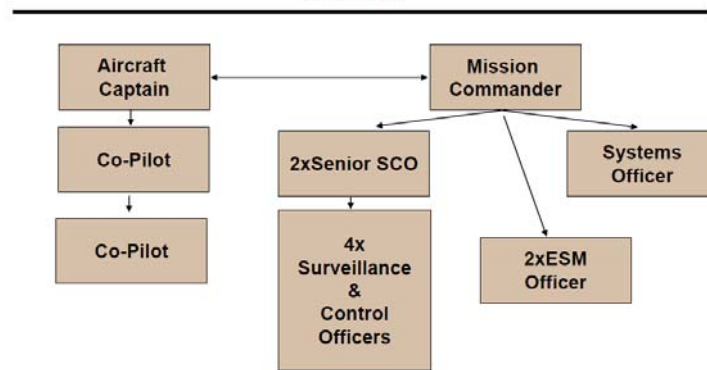
The Director in the CAOC at the time, the USAF general, called us up one day and he said 'I need you to get me more crews and I need you to get me more jets' and I said, 'Oh, why is that sir?' and he said 'The Wedgetail is just so much more capable, technology-wise and control-wise, the level of control that my fighters are getting. We want you guys airborne all the time'. It got to the point where we were getting specifically tasked whenever certain strikes were happening; that's when we would fly to cover the strikes. I said 'Thank you very much sir, that's great, but we've got two crews here—that's 50 percent of the Royal Australian Air Force's capability right here. And we're wheezing back at home to just keep raise, train, sustaining the ones that will come after us and replace us'. And he was shocked. He had absolutely no idea that our Air Force was that small in terms of our AEW&C community. They [USAF] had five [E-3] jets and nine crews on our base alone.

So we punch above our weight. Unfortunately, it's led to a high demand for our services, which has a lot of impacts on us and stuff. I wish we could have given him more crews and more jets—I really do—but that's just the state of play that we had. And, from a sustainment point of view now, because again my personal view on this is that I think Wedgetail will be involved in this for quite some time, we've dropped back to one crew over there, just to be able to sustain operations for the long term.

[It was] very interesting working with the CAOC, very interesting working with our Super Hornet and KC-30 brethren. It was really, really exciting to take all three of those platforms over there and watch them do what they were doing. I can't speak highly enough of the professionalism of the Hornet crews or the KC-30 crews. They were fantastic.



Crew



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So we looked at what we were doing and how we were doing it and the number of people we needed to do it. During OKRA – basically this morphed while we were over there – we realised that from a fatigue point of view, if you're going to fly for 16 and a half hours and safely land an aircraft at the end of it, you probably need a couple more, or at least another pilot, just to be able to provide relief so that the captain and the senior copilot can just get a break every now and then and stretch their legs, make sure they're alert for the arrival back in at the back-of-the-clock times. We still have the mission commander, still have the systems officer. The sheer volume of data that the ESM system was absorbing in that part of the world meant that we needed two ESM operators to be able to process it all.

We had two senior surveillance control officers in the end. Again, just the duties that those guys had to do meant that it was too much of a workload for one person, with the sort of roles that we were using the aircraft for over there. And, again, surveillance control officers, we had to beef that up, because we picked up some responsibilities and tasks that we didn't previously think we would have to do.

So you now look at original CONOPS crew of nine and we're now more realistically looking at 13. So that obviously has flow-on effects, if your entire organisation has been based to a CE [constrained establishment] of five or six crews of nine and we now have worked out that we need 13 per crew. Again, [these are] challenges for us now and in the future. But that realistically is the model for any high level operation, whether it's a RED FLAG, whether it's OKRA, whether it's whatever operation we end up participating in next. The original envisaged crew of nine just doesn't cut it.



OPERATION OKRA



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So that's what it looks like down the back on station. Machan, if you just want to point out the MiRC terminal screens. It's probably the only additional thing there that we didn't see on the previous slide. And they all have keyboards placed between operators so that they can look at the various chat windows—whether it's the CAOC, whether it's personnel recovery, whether it's tanking, strike windows—you name it. That's been, as Machan said, critical. The war revolves around chat.

FLTLT Machan: That's the A-scope for the ESM that we were talking about a couple of slides ago, just there.

SQNLDR Salmon: So that was basically Operation OKRA in a nutshell. It was fantastic. We got a huge amount out of it, the Coalition over there got a huge amount out of the services that we provided, and it's just been fantastic for pushing the capability forward.

FLTLT Machan: The only additions on the OKRA stuff, just in relation to that second senior surveillance and control officer, the air-to-air refuelling plan was obviously pretty, pardon the pun, pretty fluid over there, and a lot of the work that the second senior surveillance and control officer did was revolving around managing that component of the war.

Of note, for our on-state period with 1990s quite fuel-efficient engines, our fuel offloads were normally well less than 40,000 pounds. For an E-3, their fuel footprint to on-station period for the same amount of time was about 130,000 pounds. So, every time we were replacing one of those guys, we were saving the Coalition 100,000 pounds of fuel. Now, fuel is life for fighters over there, so that was another good force multiplier of having a much more fuel-efficient platform. And that was ringing true every day.

SQNLDR Salmon: Conscious of the time, mate. We might just quickly go through the last few.



Capability FUTURE

- Robust radar and mission system
 - AESA growth capability
- Support and infrastructure
 - FOC = sigh of relief??
- Exercises
- Operations

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FLTLT Machan: Absolutely. So, for the future, as I mentioned, the MESA radar has a lot of electronic – well, it is, at its heart, an electronically scanned array – so there is great growth capability inherent within that design, which is only going to be limited by the amount of time and money you want to throw at it.

So, supported infrastructure, when we got FOC [Final Operational Capability], a lot of the engineers at the SPO [System Project Office] took a collective sigh and went ‘Oh, thank God that’s over’. Now is when the job is really starting because getting FOC is just meeting the minimum required standard, in my opinion. So, to keep the jet evolving at the rate we need it to evolve, that workload is only ever going to increase.

When we’re down to the last \$450,000 in the bank, we will always go to Red Flag in Nellis, Tier One, because that is the closest replication to an OKRA high-end, war-fighting scenario at that TSPV level. So we get a lot out of that.

[Plan] Jericho is going to be in with that, operations, as the boss mentioned. I see us being in the MEAO for a while, just like the P-3 guys were in the Middle East for a long time, and we’ve got specific issues with that, with the small footprint.

SQNLDR Salmon: I’m acutely aware, just on that as well, one of the things that the P-3 operators in the room will remember was the degradation of our anti-submarine warfare skills through our time in the Middle East, just because we spent so much time over there and so much time with Operation RESOLUTE and not enough time doing the high end war fighting stuff that the P-3 was built to do.

I am acutely aware that my controllers’ ability to control a 4vX large force employment exercise is also a perishable skill. And I will fight very, very hard to ensure that we continue to do things like Red Flag to maintain those skills, because I’ve seen what happens when you don’t.

I’m just very cautious of the fact that, through budgetary constraints or tasking, we may lose those opportunities. And that’s one of the things that I’m very aware of at 2 Squadron is I don’t want to lose those perishable skills that my controllers have. And things like Red Flags are the only way that we get that high level training into those people.



Jericho

- Technological and cultural integration of 5th generation capabilities with each other and legacy capabilities
- Realisation of battlespace SA available from new systems
- C4ISR is key to this information fusing

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FLTLT Machan: We'll be central in [Plan] JERICO. Obviously, Jericho is a reasonably hot topic at the moment, but the idea of being able to integrate 5th generation capabilities by spreading the SA [situational awareness] that those guys have over multiple platforms, we're obviously in a good position to be that central data fusion node. So Wedgetail will be well involved with Jericho and there's a lot of work that we're doing at the moment to help with that.



Challenges

- Aircraft
- Manning
- FOC Definition

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Challenges, I guess we'll both talk to this. We've mentioned that the aircraft's pretty good, the aircraft's pretty reliable, the mission system is quite reliable and the radar is a lot better than it used to be, but it doesn't mean that's where we're just going to rest on our laurels. There's still a lot of work that we want to do to maintain the operational edge.

Manning is one of the real key drivers. We don't have many people, and my guys have just got back to Iraq after essentially the minimum time that they had to be at home to be along with the lines of the job intention there. So we're at risk of burning out our people, so we just want to keep a very close eye on that.

FOC definition—so Full Operational or Final Operational Capability; it depends on—obviously I know what the definition is—but for Wedgetail, the point there is that we've got a lot of work that we still want to do there to maintain that edge. Sir, have you got additions there?

SQNLDR Salmon: No, that's great mate.

FLTLT Machan: Over to you for the keys messages, sir.



Key Messages

- An AEW&C capability is vital for any first world Air Force
- The E-7As reputation is well deserved
- E-7A will enable Project Jericho

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SQNLDR Salmon: Yeah, we have learned that a modern AEW&C capability, it is vital in any operational theatre these days. As I alluded to before, the jet has just come along leaps and bounds in terms of its reliability, its performance, and along with that, the training levels that we put into these people. One thing I've noticed in my career is the Australian Defence Force continually outperforms our allied nations, and one of the reasons that we do that, my fundamental belief, is the level of training we put into our people, because we have to train. We don't have 50,000 people we can throw at a problem. And the E-7 is well and truly holding that mantra up for me.

As Machan alluded to, Plan JERICHO is the way of the future. Wedgetail was born to thrive in a 5th generation environment. Our capability and our compatibility with those aircraft, with Raptors, with the Supers, with F-35s, it's unbelievable.



Key Messages

- The E-7A has become 'the C2 platform of choice' in theatre
 - CAF - Australian Aviation April 2015
- We are not special...just different
 - XO42 WG

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A couple of choice quotes there. The one there from the XO of the wing, we don't want to lose sight of the fact that, even though I'm singing our praises and the jet is doing a really great job, we are ultimately just a very small cog in a very, very big wheel, and we can never lose sight of that. We just provide a service to people. I think it's important for us to maintain that and not start thinking that we're special in any way, shape or form.

FLTLT Machan: This was just a month or so ago—air-to-air with a KC-30.



2 SQUADRON
ADVISE AND STRIKE



AAR with KC-30



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End of Recording.

Note: Words in square brackets [] have been added to the transcript during the editing process for clarity.