

Attachment A: A bibliography of selected publicly accessible internet references to JORN

– attachment to Anthony Kevin’s submission to JSC on the Christmas Island Tragedy, 26 April 2011

Defence Systems Daily: “JORN assures early warning for Australia”, 29 February 2000, by Michael Sinclair-Jones

<http://web.archive.org/web/20071116065249/http://defence-data.com/features/fpage37.htm>

(Full text of article herewith)

Introduction

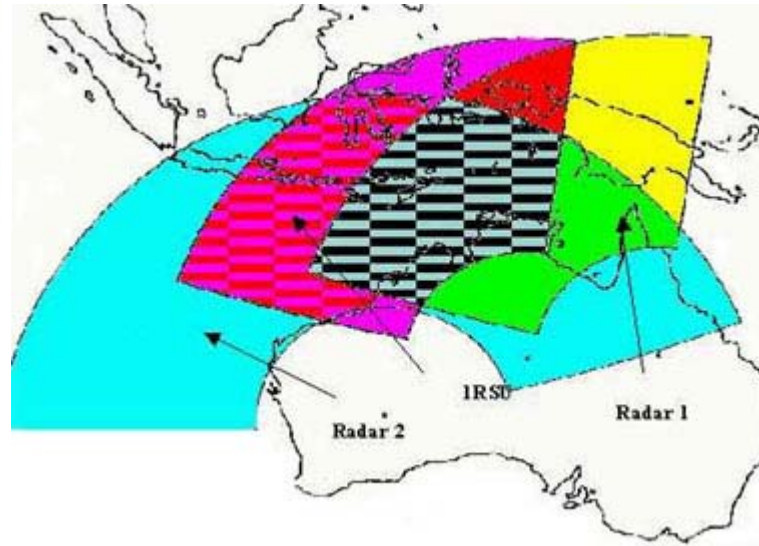
Australia is using a sophisticated new radar network that can detect stealth bombers, curb illegal immigration and spy on neighbouring nations from at least 3000 kilometres away. The \$A1.8 billion Jindalee Operational Radar Network (JORN) has taken more than 30 years to complete but is now undergoing final trials.

JORN is designed to monitor air and sea movements across 37,000km of largely unprotected coastline and 9 million square kilometres of ocean. It is being used to cast a security shield across Australia's remote northern approaches without the high cost of maintaining constant maritime and air patrols.

Operational Use

Jindalee over-the-horizon radar was used to track military aircraft landing and taking off from Dili Airport, in East Timor, on 20 September 1999, when Australia-led Interfet forces began securing the former Indonesian province from militia violence. Australian Hercules C130 transports were detected from 1500 kilometres away by a 6 kilometres-long radar array at Longreach (Queensland), and at a similar site at Alice Springs (Northern Territory).

Aircraft images were displayed on radar consoles in Adelaide and Melbourne, 2600 kilometres from the action. Royal Australian Air Force commanders said the radar was accurate enough to show aircraft turning on their landing approach to Dili Airport.



Radar 2 (blue arc) is located at Laverton

IRSU (pink arc) is the Jindalee Alice Springs Facility

Radar 1 (yellow arc) is located at Longreach

The new radar has also been used to track illegal immigrants approaching Australia by boat through the region's largely unguarded northern waters. Although designed primarily for air detection, JORN was reconfigured last year at Australian Government request to scan for marine intruders. More than 500 illegal immigrants have been arrested and detained in recent weeks, largely as a result of JORN intelligence passed to civilian customs authorities. JORN can also measure wave height and wind direction for meteorological reports.

Jindalee radar at Longreach, Alice Springs and Laverton (Western Australia) enables Australian military commanders to observe all air and sea activity north of Australia to distances of at least 3000 kilometers. This takes in all of Java, Irian Jaya, Papua New Guinea and the Solomon Islands, and halfway across the Indian Ocean.

JORN underpins Australian long-term military defence planning based on repelling an invader that attacks southwards through the Indonesian Islands, as did Japan in World War 2.

RAAF Group Captain Greg Hockings, who heads the new Jindalee Operational Radar Network, describes Jindalee as a "tripwire" in Australia's northern surveillance system.

JORN project manager Gordon McElroy, who previously directed Lockheed Martin's US battlefield defence programs, says of JORN: "There is none like it anywhere on the planet."

The JORN System

Lockheed Martin is the major partner in an Australian joint venture company, RLM Systems, which took over the project from the Australian Government's partly privatised telecommunications company, Telstra, in

1997. RLM performed a rescue operation after Telstra reported a \$609 million loss on the project and could not guarantee a delivery date.

JORN uses two high frequency radio transmitters located 2300 kilometres apart, at Longreach and Laverton. The transmitter arrays are about one kilometre long and can generate a 20 kilowatt signal, which is stronger than most radio station signals.

The signal is said to be strong enough to blow up nearby re-fuelling depots, which are equipped with metal "faraday" shields to stop accidental sparks.

Signals are aimed at the ionosphere, where the beam is reflected over the horizon to targets up to 3000km away. A weak return signal from over the horizon is captured by a highly sensitive receiver that uses advanced software to separate background "clutter" from selected targets.

The receivers consist of two "arms", each 3.4 kilometers long, and each site consists of 960 individual antenna masts that must not be more than 10mm out of line along the whole length.

Transmitter and receiver sites near Longreach and Laverton are located about 100km apart to prevent electronic interference. The system is linked to 17 beacon stations across northern Australia, which are used to measure ionospheric conditions and calibrate transmissions from Longreach and Laverton.

The RAAF admits the system can operate well beyond its "unclassified" range of 3000 kilometres when radar signals become trapped inside the ionosphere and bounce twice before emerging over the horizon.

However, unofficial reports that JORN can see as far as Singapore Harbour, Hong Kong and the Russian border are described by the RAAF as "highly optimistic".

More than a million lines of software code were written to integrate the constantly changing electronic data in what is described by RLM Systems as the biggest software development project in the southern hemisphere. The whole network is linked to a test command centre in Melbourne and, via a duplicate link, to the RAAF's high frequency surveillance command headquarters at Edinburg base, near Adelaide.

Stealth Aircraft not Immune

Edinburg is also linked to a third Jindalee transmitter and receiver at Alice Springs, which has operated as a JORN test site since 1993.

McElroy says the Jindalee radar is very difficult to jam because of the way the signal is propagated over the ionosphere. "It can also detect stealth bombers, which are not designed to defeat the characteristics of Jindalee's high frequency radar," he said.

Stealth aircraft, such as the US Nighthawk F117A, are designed with sharp leading edges and a flat belly to minimise reflections back towards conventional ground-based radars. However, Jindalee radar bounces

down from the ionosphere onto upper surfaces that include radar-reflecting protrusions for a cockpit, engine housings and other equipment. Group Captain Hockings says stealth aircraft are coated with special radar absorbing material to avoid detection by conventional microwave radar. But the Jindalee radar uses high frequency radio waves, which have a much longer frequency than microwave radar. "Unless designed to be stealthy to both microwave and HF radars, (stealth) aircraft would not evade detection by JORN," he said. Defence contractors are due to hand JORN over to the RAAF at the end of next year.

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Defence Daily International, 5 March 2004:

Defence Minister Robert Hill announces a \$48 million upgrade to its Jindalee Operational Radar Network (JORN). Hill says: "After the enhancement program, the radars will have a greater range and will be able to detect even smaller aircraft and ships'.

<http://www.highbeam.comdoc/1G1-113948453.html>

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The website page of "Alice Springs News", 28 April 2004,

<http://www.alicespringsnews.com.au/1113.html>

contains this informative article (full text herewith):

"Nowhere to hide when Alice's radar zeroes in", report by Erwin Chlanda:

For the nation, the Jindalee "over the horizon" radar is an increasingly sophisticated tool to detect intruders by sea or air.

For Alice Springs it means 50 families living here, the people running the installation since the early 70s. Its concept hasn't changed since then, but its performance has immensely, says Wing Commander Stephen "Zane" Gray, the commanding officer of the No 1 Radar Surveillance Unit in Adelaide.

"Originally we could see an object the size of a Concord.

"Now we can spot a Cessna 172."

Wood is not very conductive, so boats made from timber remain less "visible", and WGCdr Gray says the minimum size of a target is classified information.

However, in the next 10 to 15 years, and in part with the recent \$62m boost for radar sites, he says scientists are confident Jindalee's performance will increase up to 100 fold.

The range of conventional radar, the kind you see at airports with its

rotating dish, is limited to direct line of sight.

Conventional radar can "see" a high flying plane 300 km away but at low altitude the range is much less. Objects disappear when they get below the horizon.

But "there is nowhere to hide" from the Jindalee system, says WGCDR Gray.

This is because the radar "sees" the craft from above.

Jindalee's massive ground antennae, nearly three kilometres long, send and receive radio waves.

Approximately 90 km up they hit the ionosphere where they are "bent and bounced down", hit targets on the surface of the earth, and echo back the same way to be received by the installation's second antenna.

The transmitting and receiving arrays are 100 km apart, at Mt Everard and near Harts Range.

The Alice installation is facing north, and can cover an area from 1000 km to 3000 km in a 90 degree arc.

In collaboration with similar installations in Laverton and Longreach, the system can "image all of Northern Australia."

"It's much cheaper surveillance than using a fleet of aircraft."

WGCDR Gray says there has been progress in the last 30 years with hardware and software, refining the capability of detecting targets.

But significantly, more powerful computers make better sense of what the myriad of planes and boats to Australia's north are up to.

At the heart of the evaluation of the signals is No. 41 Wing based at Williamstown near Newcastle.

It merges the Jindalee information with data from civilian and military ground based radar, and information about known traffic, such as scheduled airliners and ships.

The results go to the Australian Federal Police, Coast Watch and Australian Defence Force Agencies, says WGCDR Gray. They check anything suspicious and act accordingly. While the computers do a good deal of the work, human intuition hasn't been retired yet from the process. A radar operator saying "that looks odd" has often been the trigger for fruitful action.

How many baddies has it caught so far? "The exact number is classified information, but the Jindalee information is providing our enforcement agencies valuable intelligence against illegal immigrant vessels seeking to enter Australian skies and waters," says WGCDR Gray.

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“Federal government boosts defence radar capability”.

Network is the biggest software development project in the southern hemisphere.

Sandra Rossi (Computerworld) (full text herewith)

28 June, 2007

http://www.computerworld.com.au/article/184860/federal_government_boosts_defence_radar_capability/

The Australian Defence Force (ADF) today signed two contracts worth \$393 million to maintain its 'over the horizon' radar capability for the next five years.

The contracts have been awarded to two Australian companies and are expected to provide ongoing employment for more than 300 people. More than half of these jobs will be located at the Edinburgh Defence Precinct, Adelaide.

The contract with RLM Pty Ltd, worth \$262 million, will provide support for the two Jindalee Operational Radar Networks sites at Laverton in Western Australia and Longreach in Queensland.

The second contract with BAE Systems Australia is to the value of \$131 million and provides for the support of the Jindalee Facility Alice Springs radar site.

Both contracts will also support the Over the Horizon Radar, Centre of Excellence and the Systems Program Office, in Adelaide, South Australia.

The new contracts will standardise engineering, logistics and maintenance support procedures across both contractors and the Commonwealth, and consolidate the maintenance of specialist transmitter and receiver equipment.

Additionally, the new contracts contain an acquisition development component which provides for the future capability development of the Over the Horizon Radar network.

Jindalee Operational Radar Network, or JORN, conducts 24-hour all weather detection of north and northwest air and surface approaches up to 2000 kilometres away from Australia's coastline.

JORN is an early warning trip-wire in the defence and protection of Australia and our national interests, able to detect surface vessels and low-flying aircraft.

JORN also assists Coastwatch, Customs and Immigration in the detection and prevention of illegal entry, smuggling and unlicensed fishing as well as helping with search and rescue efforts and early storm warnings.

The radar network can also detect stealth bombers and has taken more than 30 years to complete at a cost of \$A1.8 billion.

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Signals are aimed at the ionosphere, where the beam is reflected over the horizon to targets up to 3000km away.

A weak return signal from over the horizon is captured by a highly sensitive receiver that uses advanced software to separate background "clutter" from selected targets.

The receivers consist of two "arms", each 3.4 kilometers long, and each site consists of 960 individual antenna masts that must not be more than 10mm out of line along the whole length.

Transmitter and receiver sites near Longreach and Laverton are located about 100km apart to prevent electronic interference.

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“Jindalee support contracts awarded”, Patrick Walters, The Australian, 6 July 2007.

<http://www.theaustralian.news.com.au/story/0,20867,22024143-23349,00.html>

[This article reports an announcement by Defence Minister Brendan Nelson that the Defence Department has concluded two contracts worth almost \$400 million for the maintenance of the Jindalee over-the-horizon radar system (JORN) over the next five years. The article states – presumably drawing on the Minister’s media release, which I have not been able to retrieve from the Internet:]

‘The JORN network provides 24-hour all-weather detection of surface vessels and low-flying aircraft across the northern approaches to Australia up to 2000 km from the mainland. It also provides assistance to Customs and Immigration in the detection of illegal entrants to Australia, illegal fishing and smuggling as well as data to assist weather warnings.’

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The same article is reproduced on a New Zealand Air Force website, 6 July 2007, titled “JORN contracts signed”. There is one website comment here (on same date) by ‘Barnsey’, Group Captain, as follows:

“The radar output is fed primarily to East ROC (Regional Ops Centre) at RAAF Williamtown where there’s a 24-hour surveillance watch manned by the air defence officers.”

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**‘Jindalee Operational radar network’, Wikipedia reference article
(undated)**

http://en.wikipedia.org/wiki/Jindalee_Operational_Radar_Network

‘The **Jindalee Operational Radar Network (JORN)** is an over-the-horizon radar network that can monitor air and sea movements across 37,000 km². It has an official range of 3,000 km. It is used in the defence of Australia and can also monitor maritime operations, wave heights and wind directions. Up to now, the network has cost approximately A\$1.8 billion. ...

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