International Maritime Protection Symposium 2005

Dealing with a Complex Security Landscape

(A Small Country's Perspective)

12 December 2005

Hilton Hawaiian Village Resort, Hawaii

Our world has changed in the last 8 years

(1997)

SARS (2003)

MT Limburg (2001)

tsunami (2004)

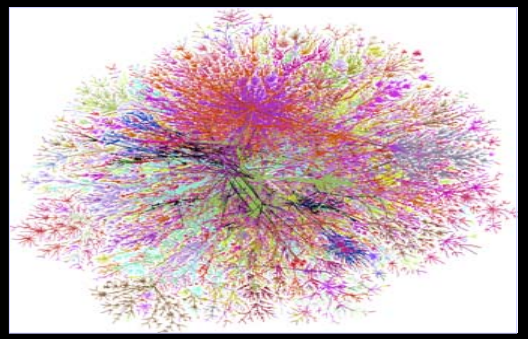
EMERGING THREATS

Maritime terrorism

Religious extremism

Illegal Banking & Finance

Transnational terrorism



Cyber crimes

WMD proliferation

Piracy

Illegal Narcotics

Illegal Migration

Straits of Malacca: An Attractive Terrorist Target

Technology as a Force Multiplier

Overcome resource & size constraints

Strategic technological edge

- Address unique operational needs
- Technological surprise
- Rapid solutions to ops problems & surprises

"… important … to see how we can expand the knowledge, capabilities and expertise we have built up in DSTA and DSO … and use it in a more coordinated way to provide technological support for national security, beyond defence and the SAF…"

Dr Tony Tan

Former Deputy Prime Minister

Minister for Defence

Coordinating Minister for Security & Defence

After visiting DSTA

A Partner in National Security

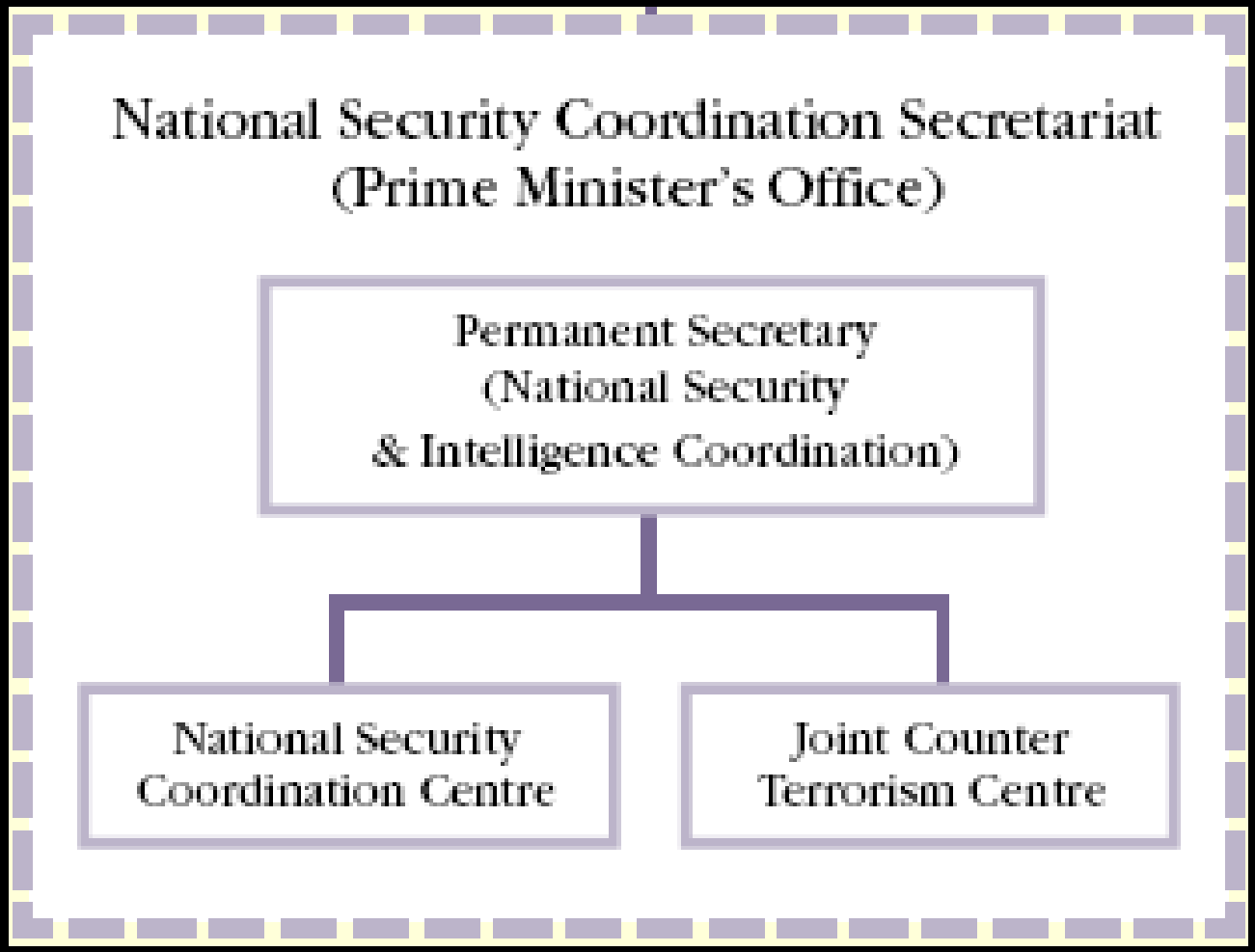
MINISTRY OF TRANSPORT

MINISTRY OF HEALTH
SINGAPORE

MINISTRY OF HOME AFFAIRS

Ministry of Information,
Communications and the Arts

- Maritime Security
- Biological Defence
- Public Health
- Chemical Defence
- Critical Infrastructure Protection
- Aviation Security
- Cyber Security
- Explosive Safety
- C2 Systems
  - Public Safety
  - National Emergency
  - Island Defence
- Emergency Procurement

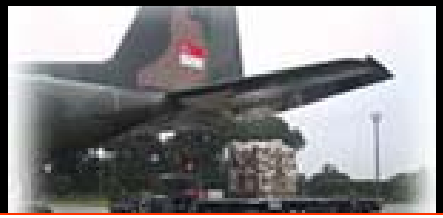

National Security Coordination Secretariat
(Prime Minister's Office)
Permanent Secretary
(National Security
& Intelligence Coordination)
National Security
Coordination Centre
Joint Counter
Terrorism Centre

Second generation SAF

– a balanced SAF

- 80s to 90s
- A modern air force – F16s, E2Cs, KC135s
- Combined arms army
- From coastal force to corvettes, MPAs, submarines, frigates

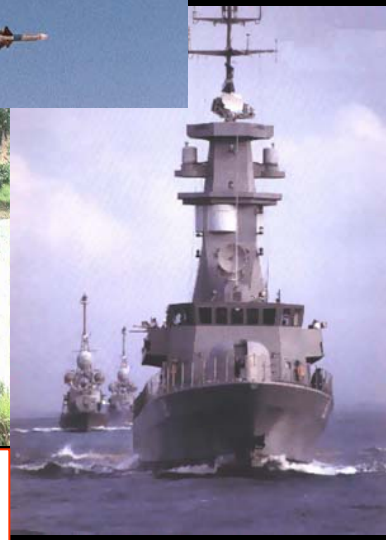
WIDENED SPECTRUM OF OPERATIONS



Non-combatant Evacuation Operations

Humanitarian Assistance & Disaster Relief

Protection of Installations



Peace Support Operations

Island Defence

Conventional Warfare

Continuum of Conflict

Peacetime **Troubled Peace** **Tension Period** **War** **Post-War**

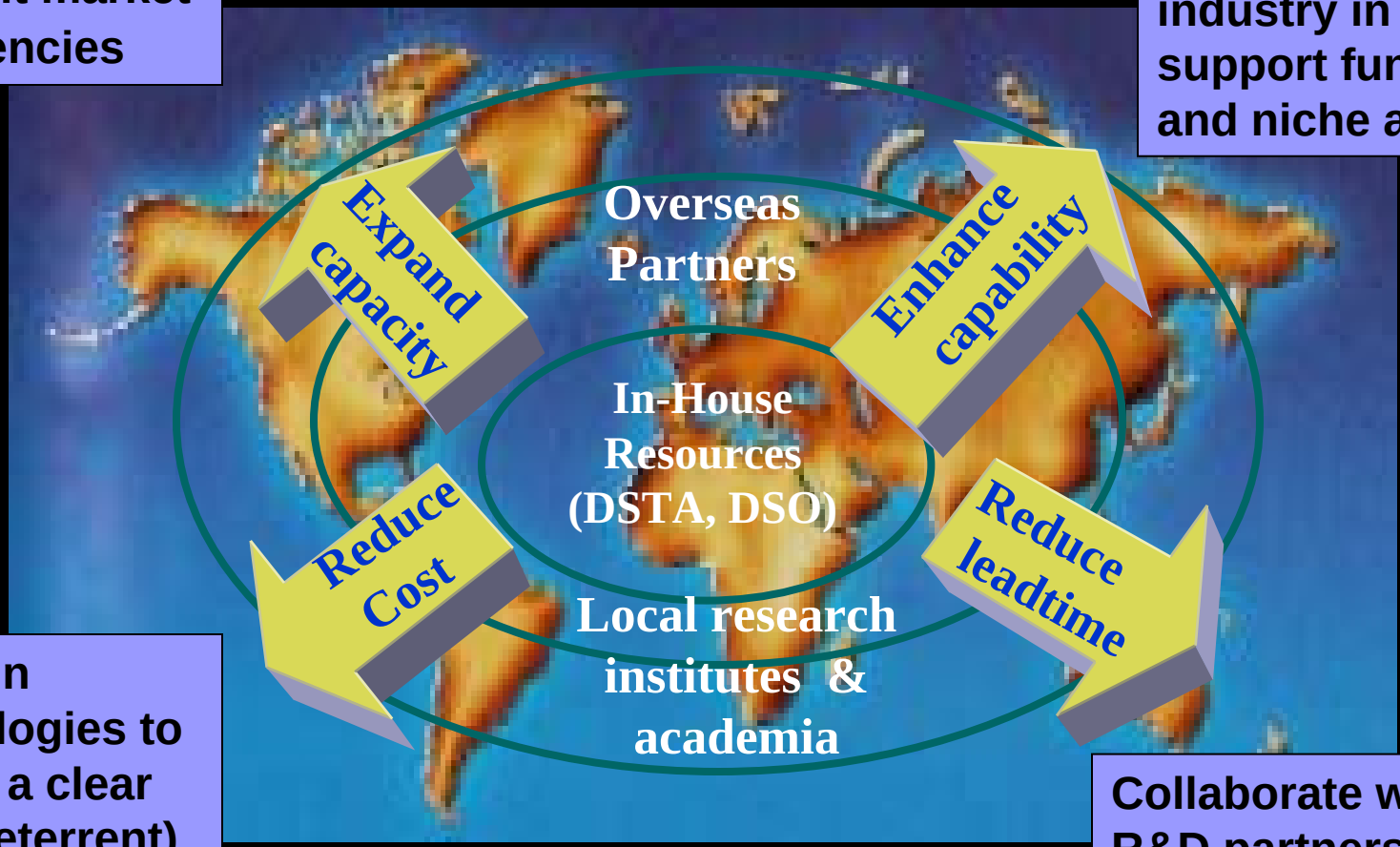
Challenges in Harnessing Science & Technology

- Affordability (cost escalation of defence systems)
- Asymmetry
- Widening spectrum of threats
- Limited resources including scientific and engineering talent
- Rapid technological advances and obsolescence

Global Strategy for a National Capability

Exploit market efficiencies

Build up local industry in critical support functions and niche areas



Invest in technologies to ensure a clear lead (deterrent)

Collaborate with R&D partners globally and locally

Integrated Defence Development

Integrated Process

- Ops-Tech Vision in Planning
- Life Cycle Management in Execution
- Portfolio management & D30/S70 in R&D
- Integration in military and academic research

Investment in Scientific Talent

- 2,500 scientists & engineers in DSTA & DSO
- 400 engineers in MINDEF/SAF
- 80 Scholarships annually
- Education (TDSI, DSTA College)

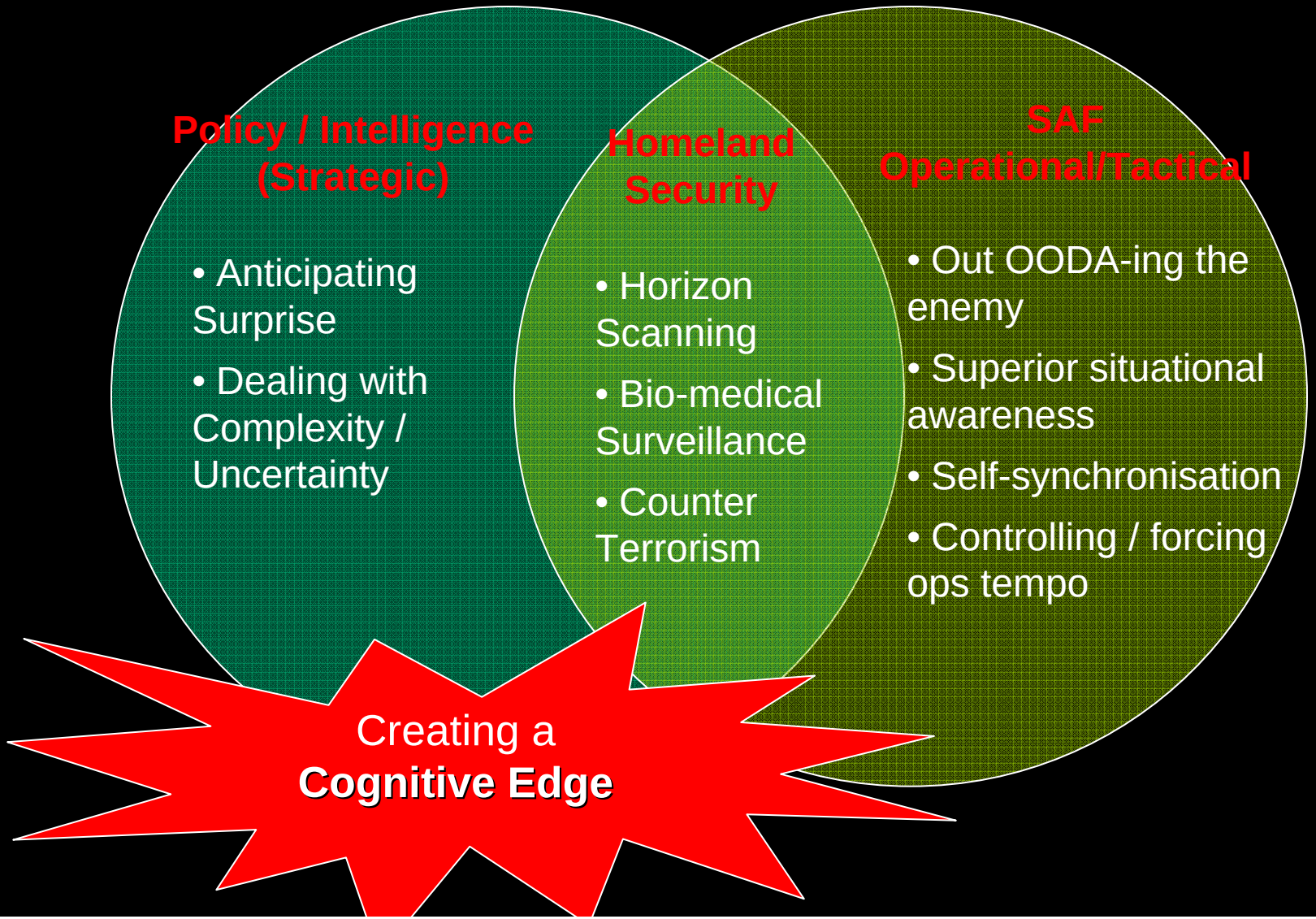
Steady Investment

- 30% of defence budget for capability development
- 4% for R&D
- 1% for experimentation

Focus on Niche Areas

- Unmanned systems
- EW
- C4I
- Intelligence
- Precision Weapons
- Systems Engineering

Sensemaking



Cynefin Framework

Dave Snowden
Executive Director
Cynefin Centre for
Organisational Complexity

Un-ordered Domains

Ordered Domains

Complex

Probe ➔ Sense ➔ Respond

- Pattern Management

Knowable

Sense ➔ Analyse ➔ Respond

- Scenario Planning
- Recognition Primed DM
- Organisational Learning

Chaos

Act ➔ Sense ➔ Respond

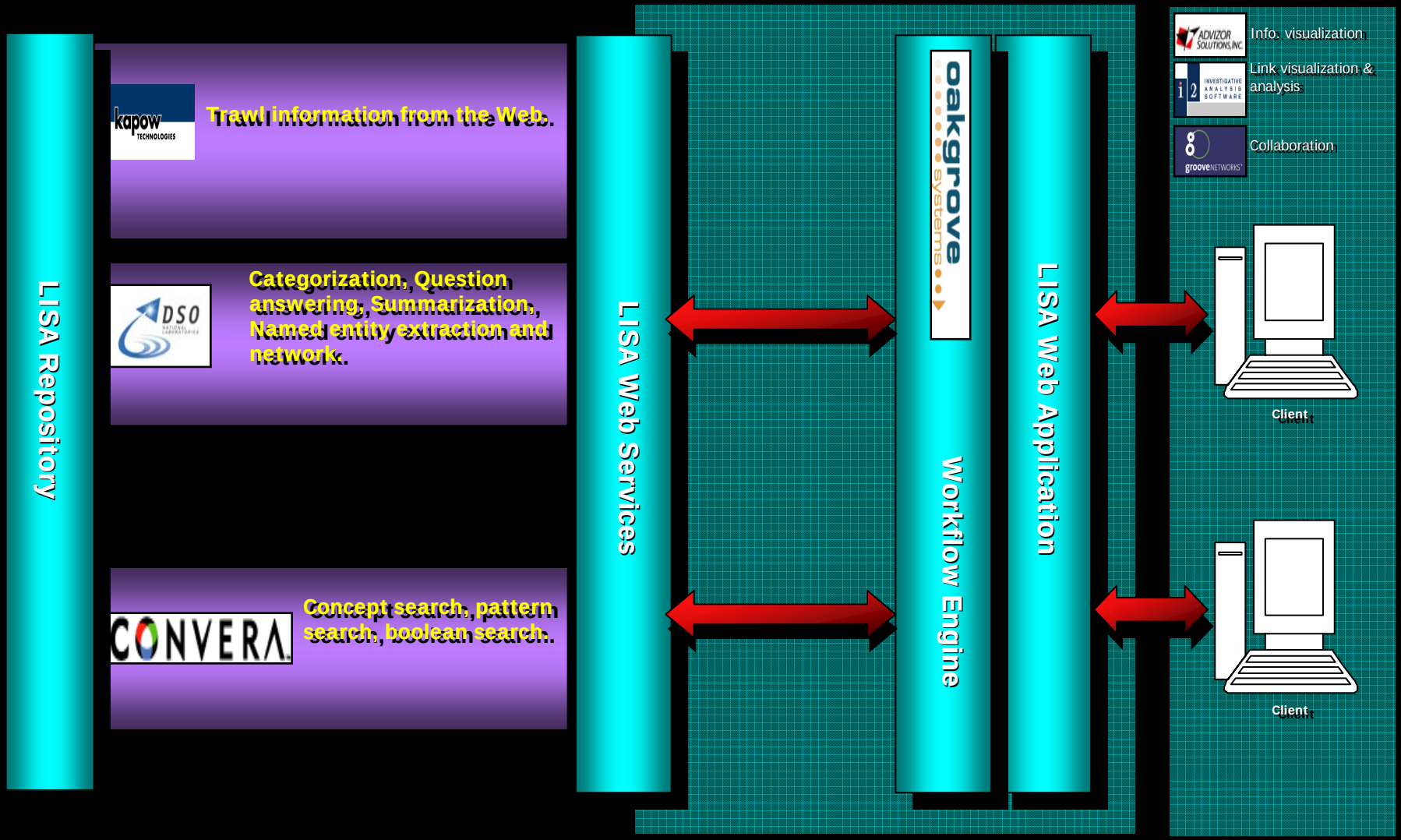
- Stability-focused intervention
- Seeding

Known

Sense ➔ Categorise ➔ Respond

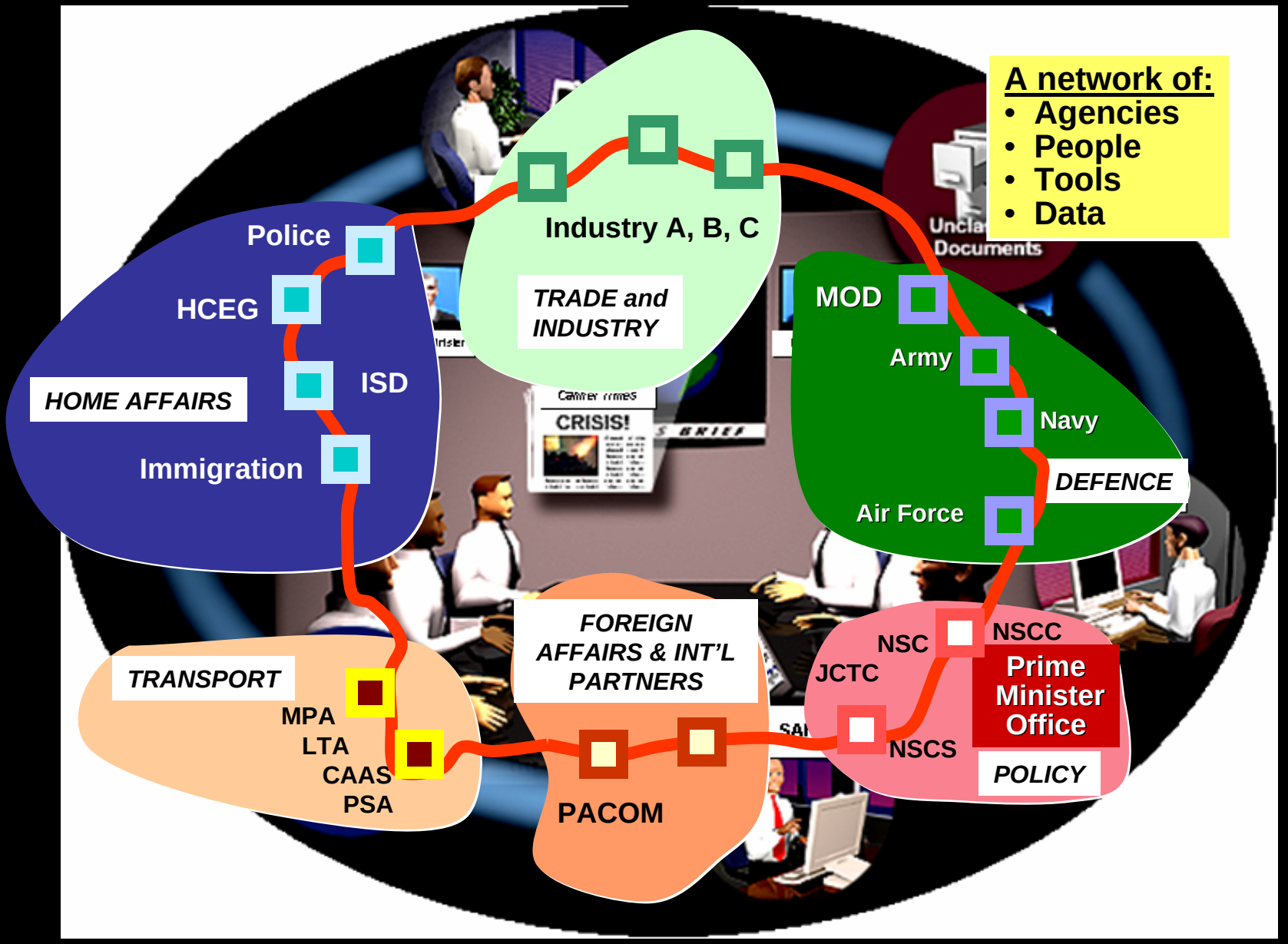
- Best Practices
- Rules
- SOPs

LISA = Architecture + Algorithm + Process

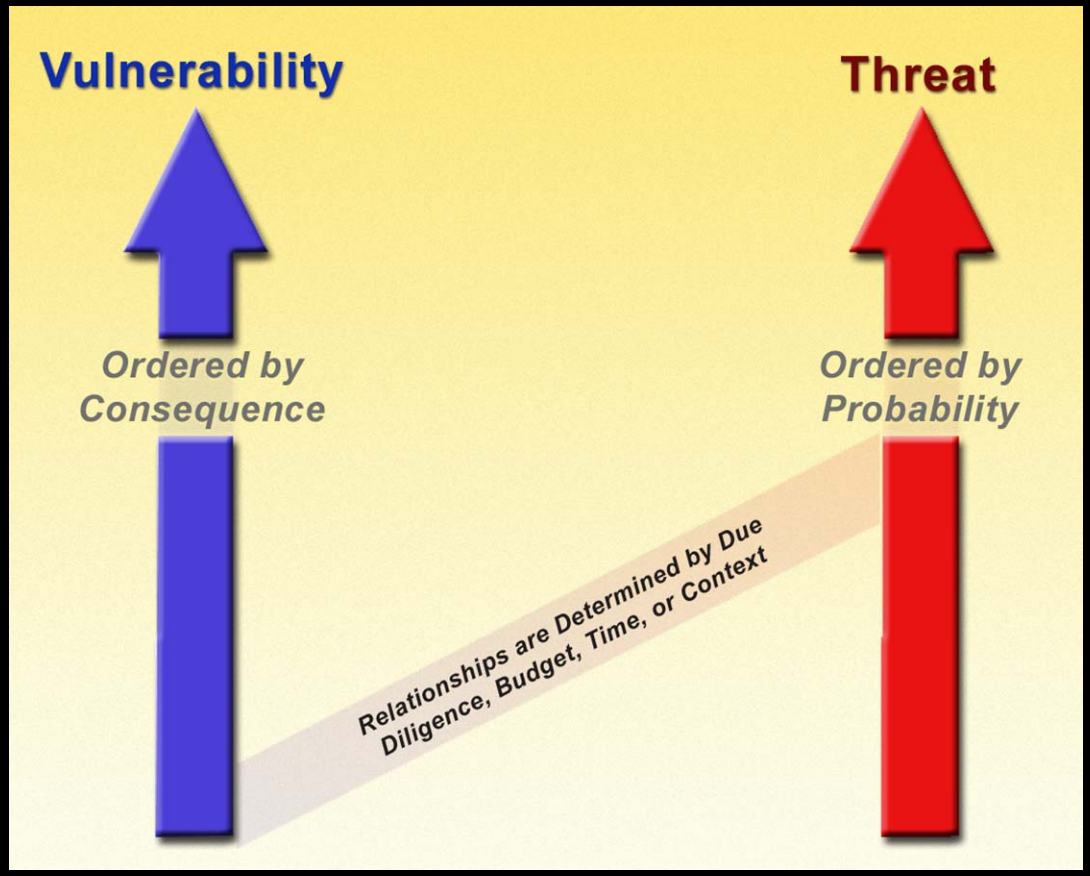


Collaboration with The Arlington Institute

A Networked Government



The Need for Systems Architecture



Design for ilities:

flexibility, interoperability, scalability, adaptability, modularity, etc

DSTA Battles SARS

It was 3 April 2003, 9.33am. An email from Health Minister, Lim Hng Kiang, popped up on Chief Executive's computer screen. Mark urgent, it was entitled “SARS screening idea".
Minister was requesting for DSTA's assistance in sensor technology

Tan Yang How (left), Division Manager, Sensor Systems Division, making sure that the system works at Changi Airport.

Experimentation

Battle lab to help reshape SAF war muscles

Centre being set up to explore new battle concepts and assess how IT can help armed forces win in modern combat

By DAVID BOEY

THE Singapore Armed Forces (SAF) is setting up a Centre for Military Experimentation later this year to spearhead efforts at assessing how information technology can help ... world, especially Net-based technology.

Details of the Centre for Military Experimentation were revealed yesterday by Brigadier-General Jimmy Khoo, Mindef's Future Systems Architect.

SAF CENTRE FOR MILITARY EXPERIMENTATION

" (the SCME) IS the key to the SAF of the future."

Minister for Defence during opening of SCME on 5 Nov 03

Modelling & Simulation

- "what-if" scenarios analysis
- Surprise Anticipation
- Better prepared for complex operation

The Straits Times, 22/05/03

Army taps PC games to hone soldiers

Virtual engagements and tactical exercises with simulation software and games will be training tools

By **DAVID BOEY**
DEFENCE CORRESPONDENT

SOLDIERS at the Army Officers' Advanced School at the Safti Military Institute fought more firefights yesterday than most soldiers would in their entire lives.

But while they dodged bullets and bombs, they risked only tired fingers — from clicking their computer mouses rapidly.

These virtual engagements took place on computers manned by soldiers from the Singapore Army. They showed how PC war games will soon be added to the army's training syllabus.

Speaking at the launch of the Army's PC gaming and simulation software, Mr Cedric Foo, Minister of State for Defence, said: "Fighting concepts have undergone a drastic transformation. You only have to look at how war has been waged in Afghanistan and Iraq to see that really, wars now involve a lot more than just boots on the ground.

"You're seeing integrated, knowledge-based command and control, precision weapons, network-centric warfare and so forth.

"In order for the Singapore Armed Forces to test and validate some of these concepts, I think computer

Benefits

PC war games are no substitute for realistic field training but can help achieve the following:

◆ **Mission rehearsals: They are useful for complex manoeuvres used in urban fighting or night combat.**

◆ **Decision-making: They train commanders to think**

A commercially-available PC game called Operation Flashpoint is also being customised by the Army and DSTA. The souped-up software will link 16 soldiers in an interactive environment where one false move could see them zapped by a simulated enemy.

But the PC games will only supplement Army training. Realistic war games will remain an essential training method. Colonel Goh Kee Nguan, assistant chief of general staff (training), said: "We do not see our soldiers being ready to operate outside after being trained on PCs. We will still see field training outside, under the sun, as a key training tool."

Games

- Adaptive Thinking & Decision Making
- Mission Planning, Rehearsal and Evaluation

Cap Vista Pte Ltd (CVPL)

- formed in Apr 03 as a company of DSTA
- prospect for innovative technologies applicable for military use
- explore the “non-traditional” sources of technology

Defence agency to fund start-ups

Small companies can get backing even if not into military research; technologies can be adapted for defence purposes

By CHAN KAY MIN

SINGAPORE'S premie
fence-science research
development agency is
into the venture-capital
ness.

The Defence Scienc
Technology Agency (D
plans to fund small sta
companies conductin
search relevant to the
tary.

This could include ec
nies creating com
games software, becaus
could hold the key to
battle simulators.

Mindef seeks ideas for military use

Funding available to SMEs to develop ideas in infocomms, satellite technology

By David Boey

THE Ministry of Defence is on the prowl for new ideas and on its hit list are small and medium enterprises (SMEs) buzzing with ideas that can be adapted for military use.

Five SMEs have already earned "seed funding" from the $20 million Technology Innovation Fund managed by the Defence Science & Technology Agency (DSTA). And the good news is that DSTA is prepared to "top it up if there are more good ideas", said William Lau, director (directorate of research and development) at DSTA, the national authority on weapons procurement.

nologies generated from them. To continue in our mission to provide leading-edge solutions for the SAF, we will explore more collaboration opportunities with the SMEs as well as industry, tertiary institutions and foreign partners."

Mindef's defence science community has long recognised the military potential of commercial products. When armed forces use commercial technology, such inputs are tagged with the acronym COTS, which means "commercial off-the-shelf", to distinguish such products from those designed from the start with military applications in mind.

At the top end of the scale, Mindef engineers have modified the Fokker 50 twin turboprop commuter plane for use as a missile-armed and radar-equipped maritime patrol aircraft.

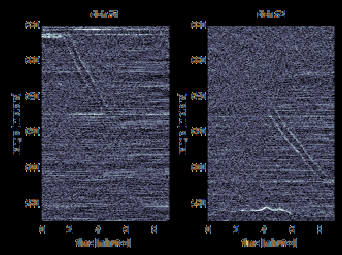
Innovation using COTS technology

Extension of proven technologies for a rapid and low cost solution

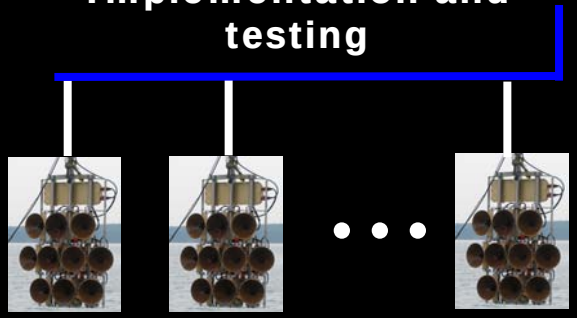
Rapid Feasibility Tests

Transit to multi-node development

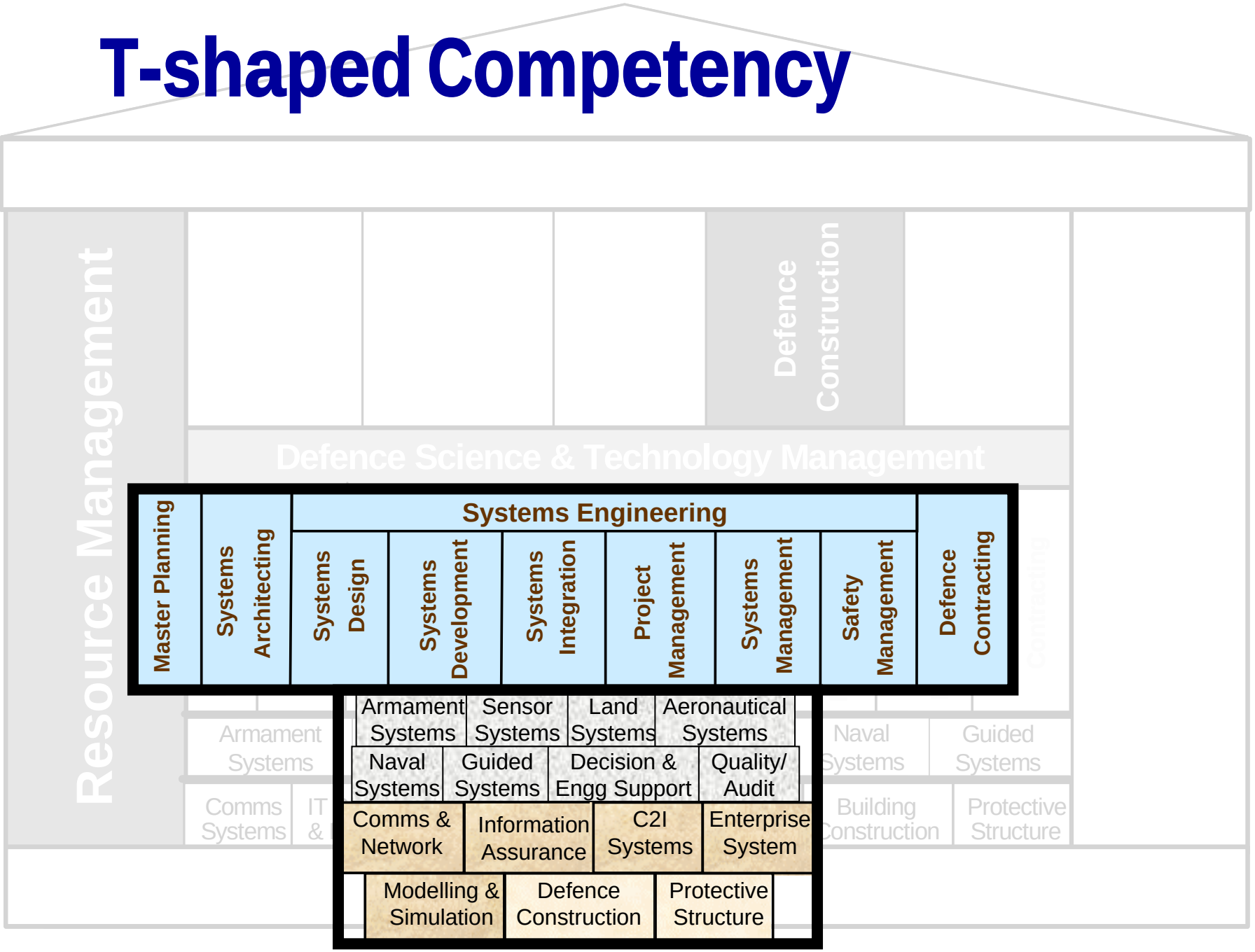
Proven air-backed parabolic transducer technology

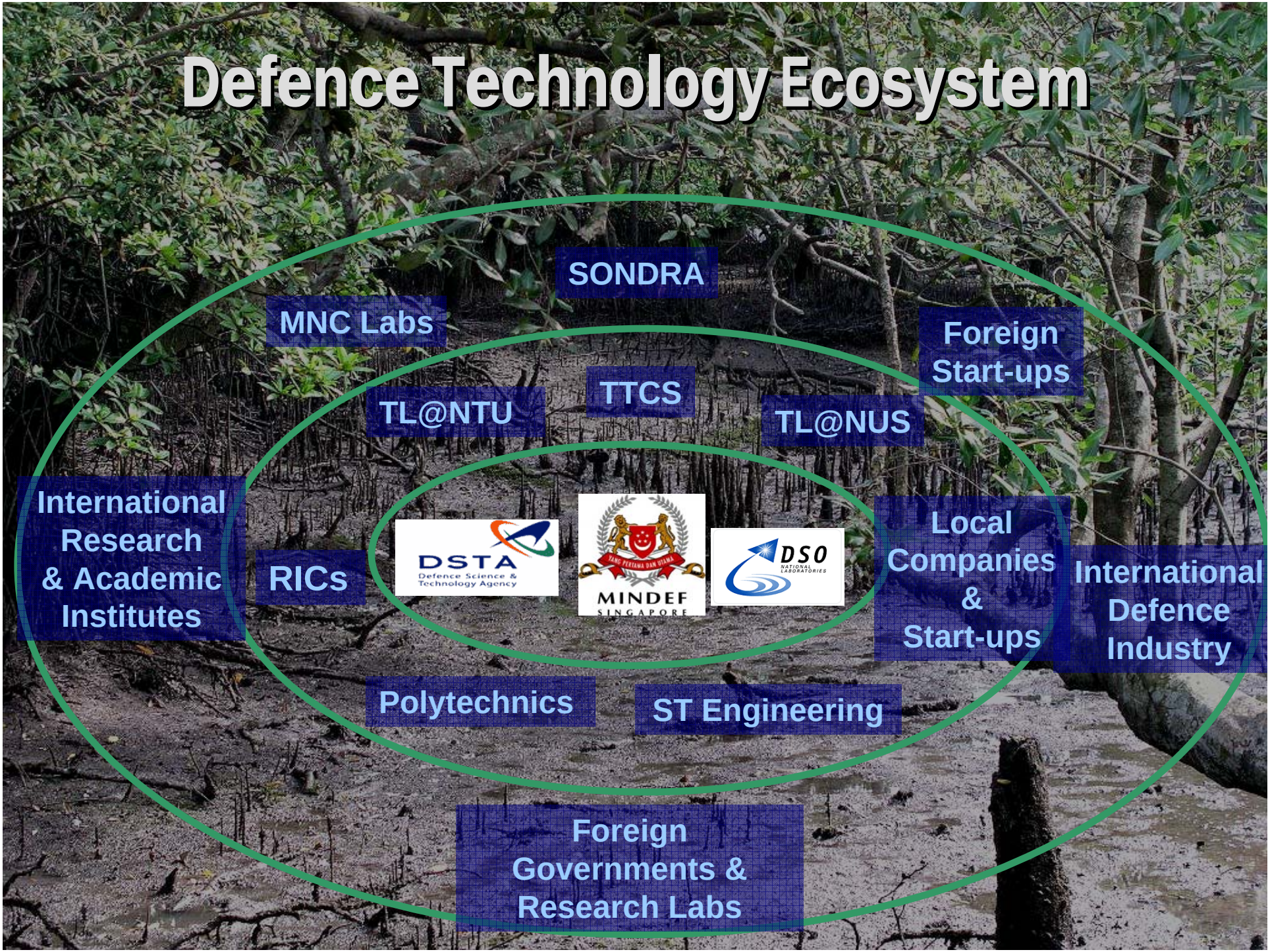


Full scale Prototype Implementation and testing



T-shaped Competency



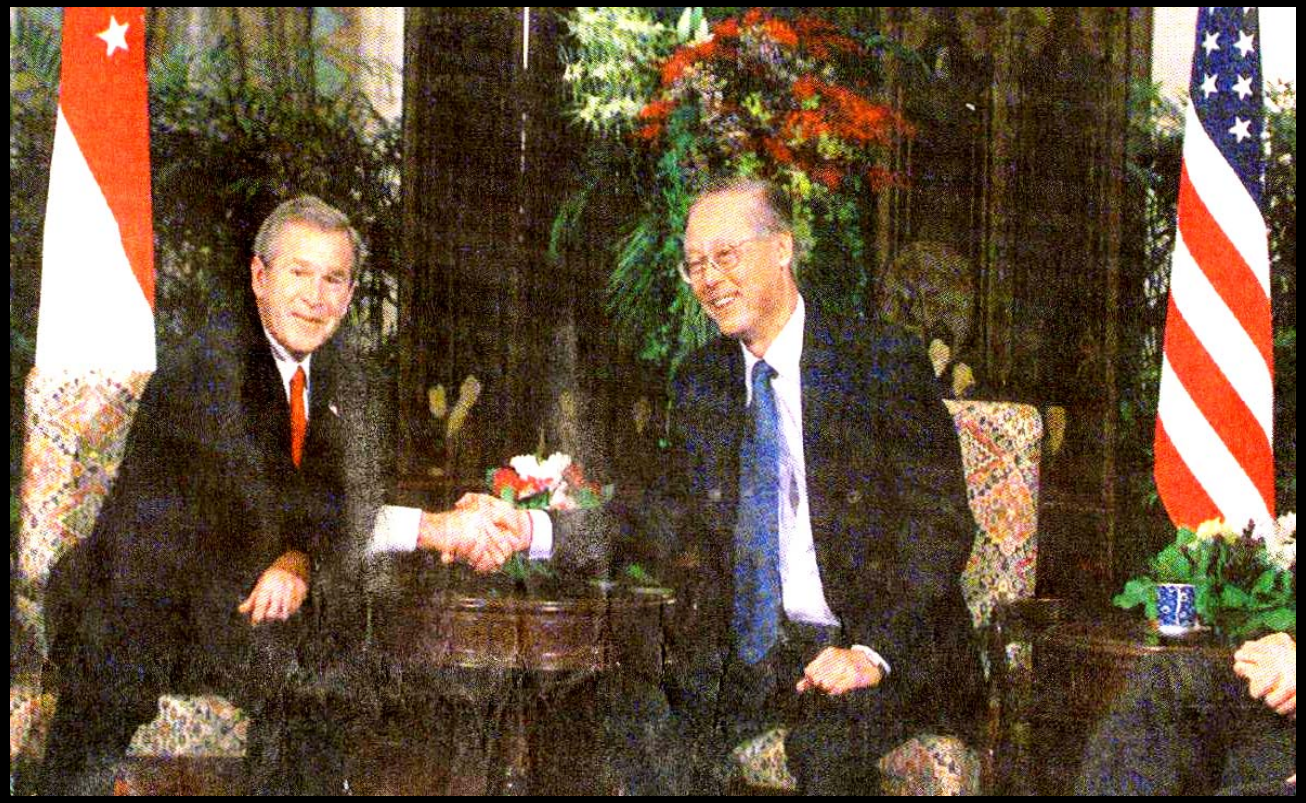

Defence Technology Ecosystem
SONDRA
MNC Labs
Foreign Start-ups
TTCS
TL@NTU
TL@NUS
International Research & Academic Institutes
RICs
DSTA
Defence Science & Technology Agency
MINDEF
SINGAPORE
DSO
NATIONAL LABORATORIES
Local Companies & Start-ups
International Defence Industry
Polytechnics
ST Engineering
Foreign Governments & Research Labs

International Technology Collaboration

Why the United States?

- Common perspectives
- Strategic convergence in the face of new threats

STRATEGIC FRAMEWORK AGREEMENT



President Bush and former Prime Minister Goh Chok Tong

Washington DC, May 2003

SUPPORT FOR OPS ENDURING FREEDOM & OPS IRAQI FREEDOM

- Deployed LST, C-130, KC-135
- Police trainers
- Support for transiting US ships and aircraft
- 24-hr operation @Paya Lebar Airport
- Blanket diplomatic overflight clearance
- Close escort for high value US ships

COUNTER-PROLIFERATION

Container Security Initiative

Deployment of Radiographic Inspection System (Gamma-ray scanner)

PROLIFERATION SECURITY INITIATIVE

- **PSI Core Group member**
- **Participated in PSI maritime exercise in Arabian Sea, Newport PSI wargames with US**
- **Hosted PSI Ex Deep Saber in Singapore in August 2005**

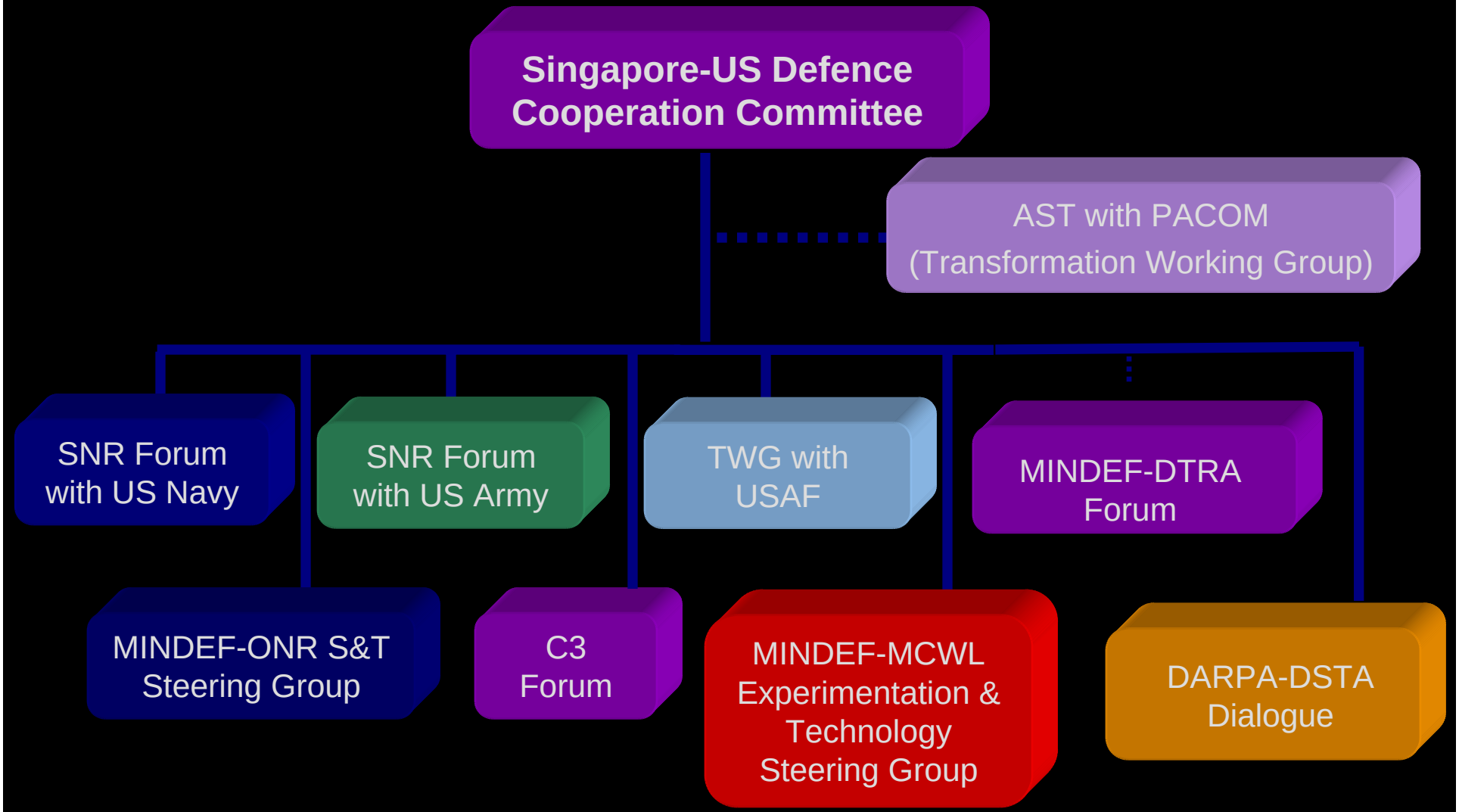
Regional Emerging Disease (REDI) Center

- MOU signed in Oct 2003
- MOH & CDC/NIH
- US-Singapore Joint facility:
  - Enhance shared detection, monitoring and response capabilities to emerging infectious diseases and bioterrorism threats
  - Training base for health professionals
  - Catalyst for regional collaboration
  - Facilitate vaccine development

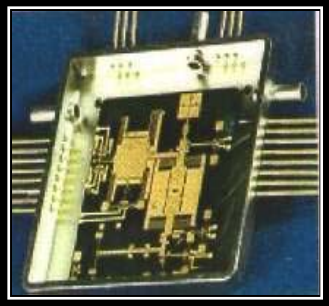
Mutually Beneficial Relationship

- Share expertise and cost in areas of convergent interests
- Singapore can serve as a test-bed to fast track experimentation and application of innovative technologies

Framework for Technology Cooperation

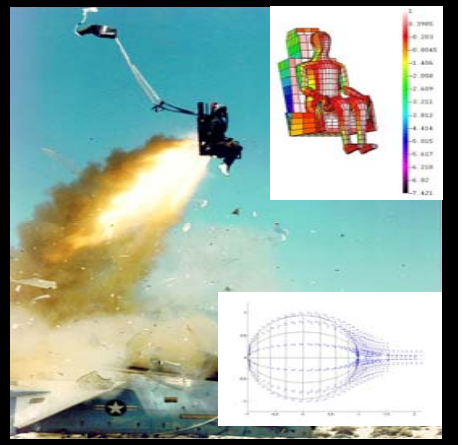


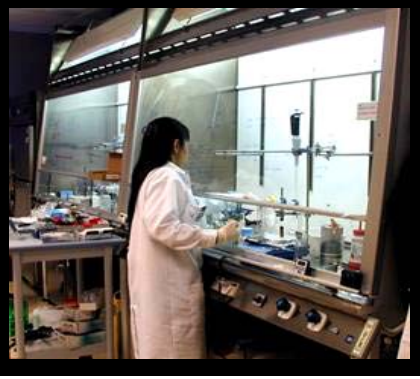
US-Singapore Defence Technology Collaboration




Collaboration Mechanisms

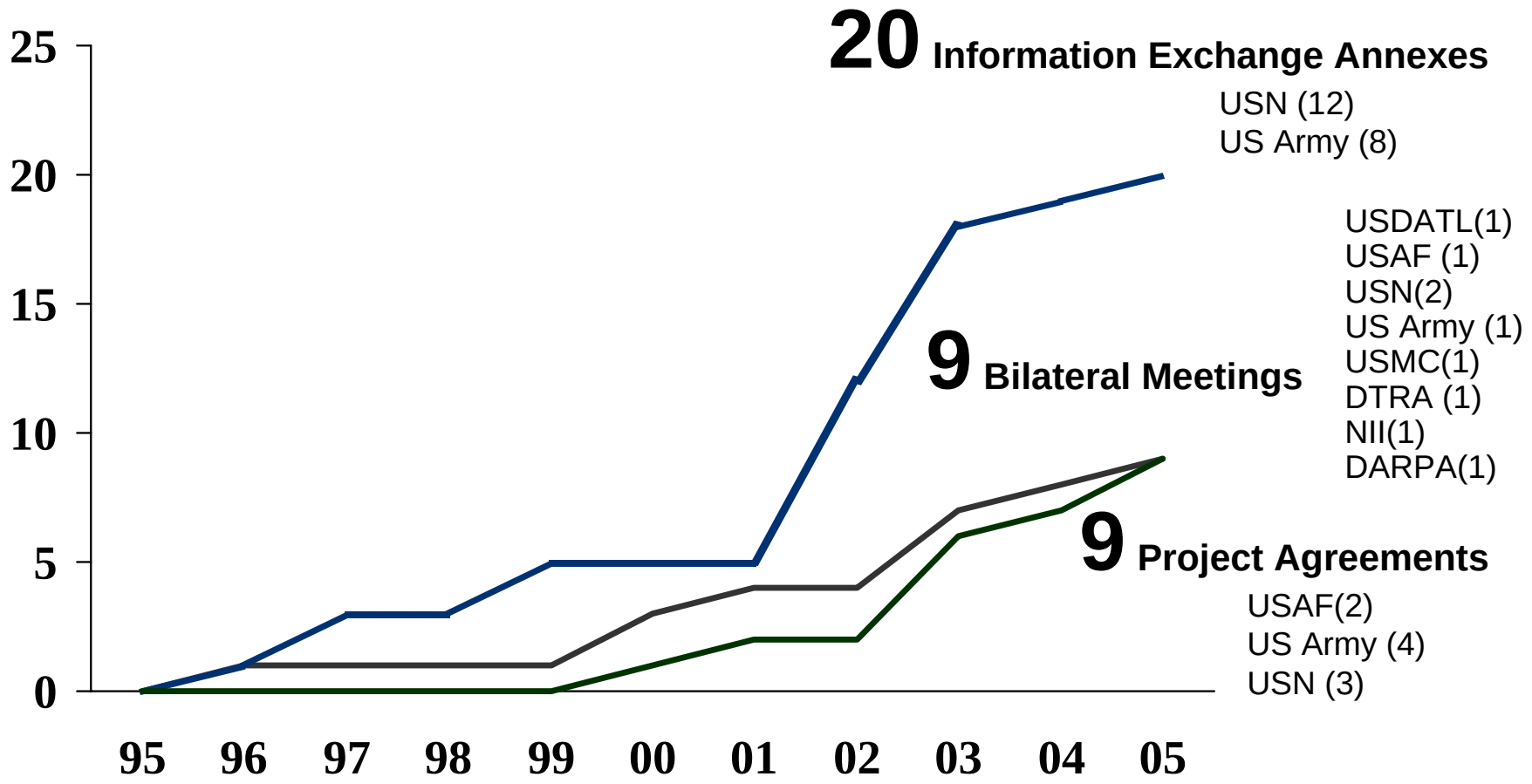
- MIEA - Information Exchanges
- RDTEA - Joint Projects
- ESEP - Personnel Exchanges



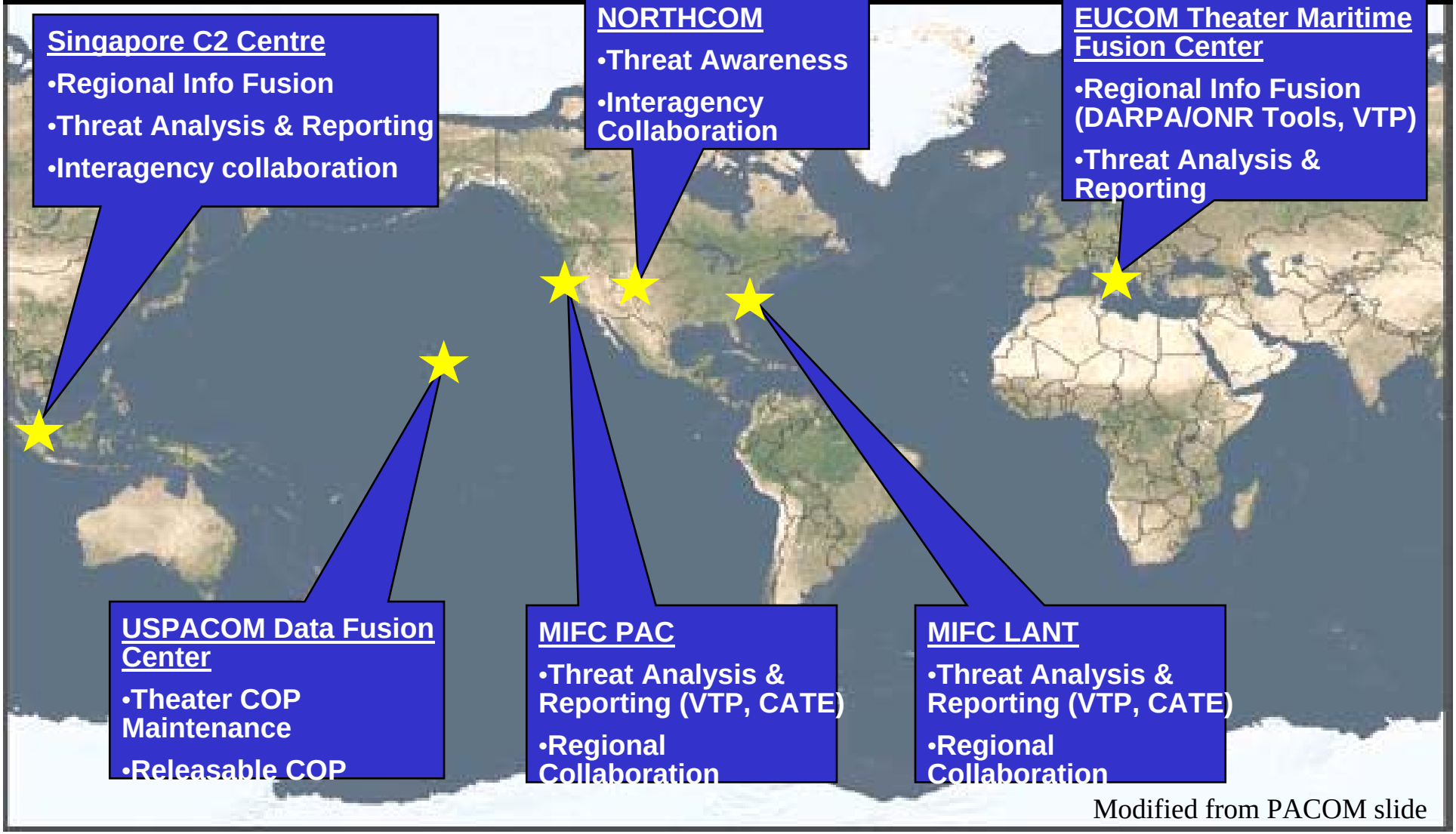




Agreements and Bilateral Meetings

Number of Agreements/ Bilateral Meetings Established



CMA Partnership Approach



Modified from PACOM slide

DSTA-DARPA Dialogue

(24-27 May 2005)

- A 14-strong DARPA visited Singapore
- Include Dir, Dy Dir, 2 Office Dir, 1 Office Dy Dir and 8 Program Managers)

EXTREME R&D, FOR REAL

By Felix Soh
Deputy Editor

IF IT were a reality TV show, its title would be "Extreme R&D".

For the US Defence Advanced Research and Projects Agency (Darpa), no idea is too outlandish to be considered. Nothing is too risky to undertake, no project too expensive to fund.

Radical innovation runs in the veins of the 140 programme managers of the world's most advanced — and most generously funded (2005 budget: US$3.09 billion or S$5.2 billion) — military research and development outfit.

An arm of the US Department of Defence, it was established in 1958 as the first American response to the launching of the Sputnik, an event which stunned the United States because it meant the loss of its technological leadership to the Soviets.

Since then, the US has more than regained the lead. Besides spawning the Internet (no, Mr Al Gore did not invent the Internet as he had claimed), Darpa is also behind a number of ground-breaking technologies.

These include the ubiquitous weapon of infantry men all over the world, the M-16 assault rifle, the Stealth fighter, the Saturn rocket and the Global Hawk and Predator unmanned combat aerial vehicles (UCAVs) which were used with deadly effect to assassinate terrorist leaders in Afghanistan and elsewhere.

Through the years, Darpa has remained true to its mission of maintaining the technological superiority of the US military. It achieves this by sponsoring revolutionary, high payoff research that bridges the gap between fundamental discoveries and their military applications.

The speed with which technology moves from research into an off-the-shelf system is phenomenal. One reason is because the director wields tremendous power over the agency's budget. He does not need to hack his way through the thicket of bureaucracy for procurement but is authorised to sign contracts. This fast-track system is designed to move things quickly.

An admirer has described Darpa as "the ultimate defence science and technology venture fund because it's so good at tapping innovation from everywhere, particularly small, innovative companies and individuals".

Singapore's defence R&D institutions are also being tapped in a series of mutually-beneficial projects.

Darpa's director, Dr Anthony Tether, and 13 of his programme managers were in the Republic recently to seal the organisation's collaboration with its counterpart here — the Defence Science and Technological Agency (DSTA) of the Ministry of Defence.

For Singapore, collaboration with Darpa is a win-win situation. Professor Lui Pao Chuen, Chief Defence Scientist at the Ministry of Defence, says: "We're already working on the projects for which Darpa is seeking collaboration. It is very good reference that Darpa finds value in what we're doing.

"Of course, because we're working on these projects together with Darpa, we also know what it's working on. Both sides are sharing their information. We're increasing our reach into the information generated by Darpa. There's a gold mine of technology and knowledge in Darpa which this channel opens up for us."

The details of these projects, understandably, are under wraps. But they would fall under five areas: Urban warfare, command and control, biology, material science as well as force protection, such as the detection of improvised explosive devices.

While he was here, Dr Tether — a Stanford PhD in electrical engineering — shed some light on the projects his agency would be collaborating on with Singapore. He also spoke to The Straits Times about his agency's out-of-the-box ideas and projects.

>> You spoke previously about your vision of an army of robots hunting down terrorists in caves with soldiers controlling the machines from safe locations. This is a rather attractive idea. But there are limits to the use of technology. For instance, take Iraq. Ultimately, you still need boots on the ground to fulfil the mission.

Yes, you still need boots on the ground. There's no way to not have boots on the ground. If, like in Iraq, you are in the city of Fallujah, which is a very dangerous city to take over. While you have boots on the ground in the city, the soldiers themselves would want to have a robot which they could send around the corner so that they could see what was around it. It could even be a robot which could go up to a door and have a mechanism for blowing up the door.

So the soldiers are still there but they can now operate at a safer distance. By safer distance we don't mean thousands of miles. We may mean something as simple as 10 or 20 metres.

The use of robots would be very effective. So, imagine being in a house and seeing a robot coming towards you. It's very hard to be intimidated by something that's not human. That's where we see the value of robots.

>> Still on the question of robots, which is a very interesting concept. In Iraq, American troops found that instead of using huge unmanned aerial vehicles (UAVs), they are finding more satisfaction in terms of fulfilling their military objectives by using micro aerial vehicles. What is Darpa doing in this area of miniaturising surveillance aircraft?

We have an airplane that we call Wasp, which is about nine inches in width. It's launched like a model airplane, you just throw it. It's electrically driven. It has a camera on board. It has communications. You fly this out 30 miles an hour in the air. It has over an hour's endurance.

So you can imagine if you are a soldier in the city, you have this little plane you can take out of your pocket. You fly it to survey the buildings around you, including what's up on the rooftop and see very clearly.

These are robots or aircraft that can be used at an individual soldier or squad type of level. It is one of the projects we're going to be collaborating on with Singapore this fall. We're going to bring some of these Wasps to Singapore to have experimentation done with them. We are now experimenting with them in the US. In fact, we are building many that will go to Iraq. It is already deployed on US ships and on exercises in the US.

>> All the technology that the US can muster has been brought to bear on the enemy in places like Afghanistan and Iraq. My question is: With all these resources, why is Osama bin Laden still free?

We don't really know where bin Laden is. We learn from the media that he is in the Afghan-Pakistan border area. If you look at the map, these are very rough areas with very high mountains and canyons which make it very difficult to have a surveillance system that sees what's going on there. The terrain is in the way. He obviously knows that. That's why he's staying put there.

But we believe that we do have him isolated in that part of the world. Sooner or later, he will be caught.

>> You have almost daily occurrences in Iraq of soldiers belonging to the most high-tech army in the world, the US military, being killed or hurt by low-tech weapons like improvised explosive devices (IEDs). These are, in many cases, artillery shells rigged to explode by remote control. What is Darpa working on to protect the foot soldier?

We have many projects in that area. We have been moderately successful in finding IEDs. In fact, you never hear about the IEDs that didn't go off because they were found. Today, my information is that we are finding perhaps 60-70 per cent of those which have been planted. So, our hit probability is high.

But there are still the ones that go off. So we are trying to use technology not so much to find the IED but to find where it came from.

If we can backtrack and find the factory that takes these artillery shells and makes them into bombs, then that's the way we're going to end the threat. We are working techniques to do th

>> Darpa and DSTA have teamed up to develop warfare concepts. What are some of these new ideas and concepts?

We started last year with a smaller group on a simulation effort. However, this trip is really where our collaboration starts. We brought over 13 programme managers, people who create projects. They spent a whole week here and we're going over the results of the week. I would say the outcome is in the order of 15 separate projects that we will be collaborating on with Singapore — with DSTA and some of the industries and universities here.

They are in all areas — in biology, force protection, material science, command and control and urban warfare. The specifics of the projects I would hesitate to disclose.

What I mean by collaboration is that we will enter into agreements to develop technologies in these areas, most of which Singapore is already developing. We see great benefits in joining up with Singapore because the labs and equipment here are very good and world class in many cases. We can progress more rapidly together by cooperating.

>> Can you be as specific as you possibly can and explain the area you refer to as "biology"?

This refers to the ability to read the impulses of the brain to develop a brain/machine type of interface. Singapore has developed a very interesting, advanced technique of being able to read the signals in the brain, sometimes by just wearing a special helmet. We're very interested in this technology which, together with our own technology, we can use to further develop a brain/machine interface.

>> Darpa is actually the father of the Internet. What do you see as the future of the Internet, say, in the next 10 years in terms of military applications?

The Internet is wireless communications, like your cell phone. Right now, when we create a wireless situation, we need to have towers. The US forces, and I believe the Singaporean forces in the [illegible] are going to rely more and more on the network to give them [illegible] what's

[illegible] means is that when our forces go into an area, we can't spend time putting up the infrastructure for the network that network will have to create itself.

So the new technology will be where, rather than you having your cellphone connect to a tower, your cellphone may use another person's cellphone which then uses somebody else's cellphone to relay messages around. This is what we're building for the military because it needs that.

We believe that in the future, that will become commercial. Why? Because you have less infrastructure to put up, which means less cost. And less cost is why people will go to that.

On the other hand, that creates a problem. If your cellphone is constantly switched on to relay my message, it means it is constantly using up energy. So we need also to solve the problem of energy, maybe not a battery but a fuel cell which you literally fill up with methane or propane or some other fluid that has a higher energy density than a battery. That's the technology that we are working hard on.

In Singapore, you have people also working on very small, high-energy sources because you have the same problem. We are going to collaborate with Singapore on projects in this area as well.

>> Network-centric warfare has immense possibilities. But it is also very vulnerable. Recent events have shown how the masses in a populous country can meet over the Internet and shut down or cripple parts of another country's system. What is Darpa working on to counter this?

Because the network is going to be the thing that makes our forces, the glue, our enemies in the future — and that goes for Singapore too — will no longer attack the weapon platforms but instead attack the network. If they can take the network down, they have basically degraded the force.

We are working on technologies to prevent that from happening. Unfortunately, I can't tell you what they are, because if I do, then other people would know what they are. But let me assure you that we're working hard in creating networks that can not only form themselves, like communicating through anything that's around, but also networks that are designed to survive an attack.

What is happening to our network systems today is that they were never really developed with an attack in mind. That is, they collapse. But we are trying to create networks that can degrade in performance but perhaps never collapse.

>> And, of course, you are developing systems to attack the other side's network.

Could be, who knows?

>> Darpa's US$2 million Grand Challenge, open to all individuals and organisations, is a [illegible] idea. It involves the [illegible] of a robotic vehicle [illegible] travel 142 miles [illegible] over desert terrain [illegible] Los Angeles to Las [illegible] — 10 hours without a human driver or operator. The winner takes US$2 million. What are the military applications of such a vehicle?

[illegible] is simple convoy driving. If you look at the forces in Iraq, you will find that many of the people we have there do nothing more than bring supplies to the soldiers. Not only do you have convoys which are constantly on supply missions, we also need people to drive these convoys. For every person who's driving, there are four or five more people who have to support and protect him.

Our use of the Grand Challenge is to take this technology and develop a convoy without people. This, by the way, is very hard to do. Maybe you have a couple of armoured vehicles travelling with it to protect the convoy but you can't get rid of the people who have to do the driving.

PHOTO: LIM WUI LIANG

NEVER SAY DIE

Darpa is trying to create networks that can degrade in performance but perhaps never collapse.

DR ANTHONY TETHER

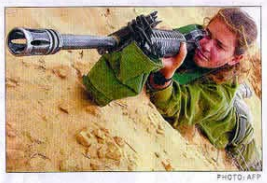


PHOTO: AFP

PHOTO: AP

GROUND-BREAKING TECHNOLOGIES: Did you know that the M-16 (top) and the Stealth fighter (above) are both the creations of Darpa?

DSTA
Defence Science & Technology Agency

Tony Tether's 3rd Visit !
Why Singapore ?

" This trip is really where our collaboration starts … … We see great benefits in joining up with Singapore because the labs and equipment here are very good and world class in many cases. We can progress more rapidly together by cooperating… "

Dr Tony Tether

Straits Times, 2 June 2005

Preparing for the Future

- Surprise

Ensuring Maritime Security …..

…requires a systems approach

- Systematic risk assessment
- Policy-Operation-Technology integration
- Integrated solutions roadmap enabled by technology
- International cooperation

Preparing for the Future

- Surprise
- Fundamental Surprise

Singapore Today

- GDP per capita US$21825
- Busiest port in the world (1b gross tons); Changi Airport handled 30m passengers
- 2nd most competitive globally, after US
- 2nd in personal safety among world's top 50 cities

"…We inherited the island without its hinterland, a heart without a body …"

Lee Kuan Yew, 9 August 1965

Thank You