Distinguished guests,
Ladies and gentlemen,

I am very pleased to be here today to officiate at the opening of the Temasek Laboratories at Nanyang Technological University and the Electromagnetic Effects Research Laboratory.

Need for Our Own R&D Base
Today’s security environment is complex. Countries around the world face a wide spectrum of security threats and challenges. Singapore is no exception.

The Singapore Armed Forces (SAF) needs a range of capabilities to respond swiftly and effectively to different threat scenarios. To succeed in the modern battlefield, it is no longer sufficient to merely have technologically advanced aircraft, ships and tanks. They need to be customised and optimised for the environment and specific needs.
Equally important is the capability to network these platforms as a system of systems based on sound operational concepts.

To achieve this, we have built up a strong indigenous technological base as a key enabler of the Third Generation SAF. This allows us to develop technologies and
capabilities to enhance the systems that we procure and to integrate and network them effectively.

**Investment in R&D**

Towards this end, MINDEF has been making steady investments in research and development over the years. Today, we spend four percent of our defence budget on R&D. This consistent level of funding by MINDEF has enabled the development of a vibrant defence R&D ecosystem in Singapore, which comprises the Defence Science and Technology Agency or DSTA, and the DSO National Laboratories, as well as a rich network of collaboration with the Universities and A*STAR on R&D programmes relevant to defence.

The local research institutes augment the resources of DSTA and DSO, both in terms of the number of researchers as well as their science and engineering disciplines. They bring fresh ideas, innovation and vibrancy to our R&D ecosystem. They are, and will continue to be an important resource to meet the SAF’s demand for advanced technologies to serve operational needs.

**Strategic Partnership with NTU**

MINDEF values NTU’s role as a strategic R&D partner. This partnership dates back to 1988. We started modestly by funding small R&D projects in NTU. The strong uptake and good results gave MINDEF the confidence to increase its investment through the initial launch of R&D programmes, and later in defence-centric research centres.

The research projects have made significant contributions, particularly in the areas of Communications, Signal Processing, Protective Technology and Advanced Electronics. The XSAT micro-satellite project undertaken by the Centre for Research in Satellite Technologies has also made good progress.
Temasek Laboratories @ NTU

It is therefore a natural development for MINDEF to set up the Temasek Laboratories here in NTU or TL@NTU for short. TL@NTU complements the Temasek Laboratories that we set up in NUS seven years ago.

TL@NTU will represent the cornerstone of MINDEF’s strategic partnership with NTU. It will serve as a focal point for developing technologies that have a wide range of applications in modern defence systems. TL@NTU has made excellent progress since it began operations in 2003. The number of researchers has grown tenfold in the past four years.

They undertake research in areas ranging from Advanced Materials and Monolithic Microwave Integrated Circuits (or MMIC) to Radar Technology and Signal Processing.

Let me cite the research in MMIC technology as an example. MMIC is a key enabling technology for many advanced defence applications, such as sensors and communications. To provide responsive solutions to meet local demands for MMIC, the MMIC Design Centre has been set up under TL@NTU to embark on advanced MMIC R&D and fabrication work.

Today, the Design Centre has demonstrated state-of-the-art MMICs such as wide band MMIC amplifiers using submicron gate technology and Gallium Arsenide semiconductor technology. These high performance amplifiers potentially offer significantly larger bandwidths over prevailing technologies and enable new capabilities in defence applications. Our soldiers have to train and operate in difficult littoral and urban environments, which pose significant challenges to conventional sensors.

TL@NTU has therefore been conducting R&D in new radar concepts and techniques to explore ways to overcome these challenges.
Some of the R&D work includes Wall Penetration Radars, High Frequency Surface Wave Radars, and Foliage Penetrating Radars. These technologies will give our soldiers a better situational picture so that they can fight more effectively.

**Electromagnetic Effects Research Laboratory**

In 2004, the Electromagnetic Effects Research Laboratory (or EMERL) was established jointly by DSO and NTU, with support from DSTA and A*Star, to spearhead research on Electromagnetic Interference and Electromagnetic Compatibility (EMC) technologies.

EMERL is a major electromagnetic test facility that can support the testing of large vehicles such as armoured fighting vehicles. Of course, it can also support other commercial applications. EMC technologies are critical to the SAF as they ensure that our platforms and equipment are able to function well even in a dense electromagnetic environment without posing a safety hazard or overly disturbing other electronic devices.

A case in point is the Republic of Singapore Navy’s Formidable-class stealth frigate. During the design and construction of these frigates, detailed analyses and validation of the EMC between every transmitter and receiver on board the ship had to be carried out to ensure combat effectiveness in various operational scenarios.

Besides conducting EMC measurements to support such projects, EMERL has also undertaken research projects such as the EMC testing of electronic components and systems, and the EMC Design of military equipment.
New Synergies
Both TL@NTU and EMERL are creating new synergies. Within NTU, EMERL working in conjunction with Temasek Laboratories have developed a lightweight, high performance material that can reduce the effects of electromagnetic transmissions by up to 99.99%. This material can be used as a protective shield for computer security in critical installations.

Beyond the university itself, NTU has also leveraged on DSTA's international linkages to build its own collaborative partnerships with renowned research agencies around the world such as the US’s Defence Advanced Research Projects Agency and the French aerospace laboratory, ONERA.

Today, we have an engineer from the US Air Force Research Laboratory working at NTU in collaboration with DSTA. These collaborative partnerships highlight the high quality of research that is carried out at NTU.

Conclusion
R&D collaboration between NTU and MINDEF is now into its 20th year. The official opening of the Temasek Laboratories at NTU and EMERL are significant milestones in this strategic partnership. It is a partnership that is mutually beneficial. The research capacity at NTU augments the technological resources in DSTA and DSO and is invaluable to the SAF. At the same time, the challenging nature of defence work also motivates and attracts good researchers to NTU, strengthening its reputation as a global university.

MINDEF’s defence research partnership with NTU is an integral part of the defence ecosystem that MINDEF has painstakingly built up over the last 40 years. The technological demands of the SAF will continue to grow, ensuring MINDEF’s commitment to invest steadily in R&D in the defence ecosystem.
Let me conclude by congratulating DSTA, DSO and NTU on the opening of Temasek Laboratories@NTU and EMERL. Thank you.

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