KEYNOTE SPEECH BY DR MARVIN LEE, DIRECTOR (SMART NATION AND DIGITAL ECONOMY), NATIONAL RESEARCH FOUNDATION, AT THE ADVANCED SEMICON TECH CONFERENCE (ASTC) ON 16 NOVEMBER 2023

Harnessing opportunities at the convergence of Semiconductors and Emerging Digital Tech

Ms Linda Tan, President, SEMI Southeast Asia,
Distinguished Guests, Ladies and Gentlemen, a very good afternoon to you.

Introduction

1. Allow me to first convey my sincerest apologies for not being able to join you in person at the 6th ASTC this afternoon. It is, nevertheless, a great pleasure for me to share on the topic of the convergence of semiconductors and the emerging digital technologies. Many thanks again to SEMI for the kind invitation!

Semiconductors as foundation for modern technology, including emerging tech like AI, Cybersecurity

2. Semiconductors form the backbone of modern technology. They power everything from our smartphones to cars and medical devices. This ever-expanding global semiconductor market is poised to grow to become a trillion-dollar industry by 2030. The strong growth will be driven by leading end applications in the automotive (particularly electric vehicles), data storage, and wireless markets. Advancements in AI and the increasing adoption of relevant emerging technologies continue to influence the upsurge in demand for leading-edge semiconductors, underscoring their importance in shaping our future.

3. Today, Singapore is home to many top global semiconductor companies. The semiconductor industry is one of the dominant contributors to our manufacturing output, accounting for 7.7% of GDP in 2020. In fact, it continues to be the fastest growing segment of the electronics industry and is projected to grow by as much as ~30% year-on-year. As we position ourselves to be the global hub for semiconductors, Singapore continues to keep in step along with the global move towards a smarter and connected future through our commitment to invest in the development of research capabilities and talent development.

4. Our Research, Innovation & Enterprise or the RIE 2025 plan was launched in December 2020 with a S$25 billion budget. This is the largest investment dedicated to R&D in Singapore to date. It is testament to the Government's sustained, long-term commitment to R&D over the many economic cycles. Our efforts are largely organised along 4 strategic RIE domains, namely the Manufacturing, Trade and Connectivity (MTC), Human Health and Potential (HHP), Urban Solutions and Sustainability (USS), as well as the Smart Nation and Digital Economy (SNDE) domains. I will spend some time to share more about the MTC and SNDE domains given their relevance to our discussion topic and the semiconductor community here today.

5. Our investments in the MTC domain have allowed our public research institutions to foster long standing partnerships with strategic industry players and to jointly develop strong R&D capabilities to reinforce Singapore's position as a global business and innovation hub for advanced manufacturing and connectivity. Specific to the semiconductor industry, our strengths in microelectromechanical systems (MEMS) research, in particular, have anchored manufacturing activities of several leading players in Singapore. We saw STMicroelectronics open its wafer fabrication facility here in 2019, and soon after that in 2020, the company partnered A*STAR and Japanese manufacturing tool vendor ULVAC to launch a cutting-edge R&D line in its Singapore facility. This world's first "Lab-in-Fab" produces Piezoelectric MEMS, which have applications across various market segments, such as smart glasses, healthcare apparatus, and 3D printing. In the current RIE 2025 funding cycle and beyond, there are also plans for the MTC domain to partner other RIE domains, such as SNDE, to deepen manufacturing capabilities through the use of emerging digital technologies, including AI, to streamline processes and enhance productivity.

6. The SNDE domain focuses on the development of research capabilities in the digital space that helps us progress toward achieving technology leadership in the respective digital tech focus areas, such as AI, cybersecurity, quantum tech, 5G/6G and trust technologies, amongst others, with the ambition to anchor Singapore's position as a trusted digital innovation hub. Today, our scientific publications in AI, quantum and trust tech are amongst the most cited in the world. In fact, our early investments in AI have positioned Singapore as a thought leader, with Singapore topping the list of 105 cities most ready for AI disruption.

7. One of the key initiatives that had brought international recognition to our efforts is the setup of the AI Singapore in 2017, also known affectionately by many in the community as AISG. The

programme office was established to consolidate our AI research capabilities at the national level and was designed to exercise agility in responding to opportunities in the rapidly evolving digital space. Specifically, the 100Experiment, or 100E project, is AISG's flagship programme to solve industries' problem statements through AI within a short span of 9 to 18 months, for which there are no existing commercial off-the-shelf solutions. This initiative runs in tandem with the AI Apprenticeship Programme, or the AIAP, to identify, train and groom a core group of AI talent working in Singapore and helps these companies build up their own AI teams. As of late 2022, a total of 96 projects have been awarded, including those with direct links to semiconductor companies. More than 200 AI apprentices have also been trained in the process. The goal is to train, up to 600 apprentices, by early 2026.

8. ChatGPT took the world by storm since November last year. One year on, the AI revolution is certainly not showing any signs of slowing down. With generative AI models quickly becoming a part of our everyday life, semiconductors designed to execute AI workloads will represent a multibillion-dollar revenue opportunity for the semiconductor industry in 2023. According to the latest forecast from Gartner Inc., this is likely an increase of 20.9% from 2022. By 2027, AI chips revenue is expected to be more than double the size of the market in 2023, reaching close to $120 billion. It is expected that the semiconductor industry will reap the most profit by supplying computing, memory, and networking solutions.

9. With the corresponding expansion of the digital space brought about by the explosion of generative AI, the need to strengthen our cybersecurity capabilities is therefore becoming more critical than ever. This calls for the need to have secure semiconductor chips in a world that is witnessing an increasing reliance on digital technologies. Semiconductor R&D will have to consider how sensors, memory, and microprocessors enable and support emerging AI applications as well as the need to ensure the build in of security features to minimise cybersecurity vulnerabilities. To this end, our National Cybersecurity R&D Programme, or the NCRP, was set up in 2021 to focus on the development of indigenous research capabilities to enhance our national security resilience, explore and generate economic opportunities, as well as to inject vibrancy into our R&D ecosystem in Singapore.

Semiconductors as a beneficiary of emerging technologies such as AI/ML

10. As much as semiconductors are the enablers and the foundation for the development of digital technologies, the semiconductor industry is also a key beneficiary of the advancements in these technologies, in particular AI and machine learning.

11. For one, the demands generated by AI, in terms of the amount of data processed and stored, will have lasting influence on semiconductor design and production. Beyond speed and power, semiconductor manufacturers must now also think about the efficiency of compute. To make AI products practical for the everyday consumers, more innovation must be done in these areas.

12. The application of AI and machines learning is also expected to spark a new wave of innovation and dramatically accelerate the semiconductor industry over the next few years. Many companies are already moving in to capture the benefits of these technologies. Some of the use cases are in research and design, primarily resulting from the automation of chip design and verification.

13. For instance, Nvidia's ChipNeMo is a domain-adapted large language model for chip design. This customized model trained on Nvidia's proprietary data will generate and optimize software, as well as aid human designers in building semiconductors. With as few as 13 billion parameters, ChipNeMo can outperform the much larger general-purpose large language models such as LLaMA2, which has 70 billion parameters, in terms of chips design. Manufacturers who can meet the needs of both AI and IoT for semiconductor chips will likely rise to the top in future markets.

Talent development undergirds the success of our partnerships in the digital domain

14.   Importantly, the availability and access to talent undergird the success of everything that we set out to do. Having the right mix of talent is also especially critical to foster and strengthen our partnerships in the digital domain and is necessary to sustain our competitiveness in both the semiconductor industry and in the emerging tech space.

15.   We need to continue pushing for peaks of research excellence through the cultivation of top-tier research talents but at the same time, also grow and maintain a broad base of scientists, entrepreneurs, and engineers who will drive translation and adoption of technologies.

16.   The Electronics ITM2025 was announced in 2022, in part to strengthen the local talent pipeline by working closely with companies and institutions of higher learning, amongst other priorities. Specifically, there are plans to develop and groom more semiconductor research, engineering and design talent, with the aim of training 1,000 PhDs over the next 10 years. Agencies have already started to work closely with the industry, IHLs and the Ministry of Education in this talent initiative to address this growing demand for R&D talents in Singapore. Apart from this, there are also efforts to encourage students to consider a career in the semiconductor industry through work-study training programmes, immersion and internship opportunities, which many of you are already familiar with. Micron and GlobalFoundries, for instance, are already partnering with our ITEs to provide students with the opportunities for internships and to attain the SkillsFuture Work-Study diplomas.

17.   Keen global competition for AI talent demands that we double down our efforts to ensure Singapore's leadership in AI. Beyond the AI Apprenticeship Programme, the Accelerated Master's programme (AMP) and PhD scholarship managed by AISG, we have also launched the NRF Investigatorship in AI earlier in July this year. There are also ongoing efforts with our SNDE stakeholders to explore new talent attraction and development initiatives to capitalise on the limited window of opportunity to secure AI talent for both the public and private sectors. Singapore must act fast in this space to maintain our competitive edge.

18.   Likewise for Cybersecurity, CSA is also working closely with the NRF and relevant partners to assess and explore new talent support schemes, beyond the existing Sg Digital Postgraduate Scholarship, the CSA-National Cybersecurity R&D Lab Scholarship (NCLS), and the CSA-iTrust Master of Science in Security by Design Scholarship (CiMS).

Closing

19.   The convergence of semiconductors and emerging digital technologies is a rapidly evolving field and is transforming every industry and sector of our economy. It is creating new opportunities for businesses of all sizes to innovate, grow and compete globally.

20.   Singapore has a strong foundation of relevant research capabilities, critical infrastructure and the talent base to build on. With the sustained commitment from government and continued support from industry, we are well positioned to capitalise on the opportunities presented by this convergence to forge ahead in strengthening resilience, creating new jobs and growing the

economy. This is the chance for us to reinvent ourselves and progress toward becoming a global leader in the digital age.

21.   Semiconductors will continue to play a vital role in shaping our digital future and help us address some of the world's most pressing challenges, such as climate change and ageing population. I look forward to uncovering many more new opportunities ahead in the intersection of these spaces.

22.   Thank you and I wish you an invigorating and fruitful conference ahead!