Annual Report
2020-2021

ASTRI

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From Inspiration to Impact

The ASTRI story

Established by the Hong Kong SAR Government in 2000, the Hong Kong Applied Science and Technology Research Institute (ASTRI) has as its mission to enhance the city's competitiveness through applied Research and Development (R&D).

To achieve this, ASTRI is developing innovative and often ground-breaking solutions that address some of the major social, technological and environmental challenges faced by the society. We do this both by anticipating and responding to problems that we see arising, and by working closely with our clients and partners to address their existing needs. The technological solutions that we develop are strengthening our institutions, improving our businesses, and benefitting our communities; in short, they are having a resoundingly positive impact on the world around us.

In its pursuit of Innovation and Technology (I&T) advancement, ASTRI can leverage the many strategic advantages enjoyed by Hong Kong. These include strong institutions, solid rule of law, a business-friendly regulatory climate, favourable geographic positioning, and seamless regional and international connectivity. ASTRI is working in full alignment with the Hong Kong SAR Government's Smart City Blueprint for Hong Kong 2.0.

Over the past 21 years, ASTRI has helped to drive Hong Kong's success as a dynamic, innovative global city, by:

Nurturing technology talent through numerous initiatives and innovation-centric jobs	**Enabling and attracting investment in technological innovation**
Boosting the contribution of the tech sector to Hong Kong's economy and development	**Creating long-term sustainable value for the I&T ecosystem through active collaborations with the industry and other I&T ecosystem players**

Since 2000, ASTRI has:

Completed more than
600
research projects

Been granted more than
900
patents for its innovations

Transferred almost
800
technologies to different industries

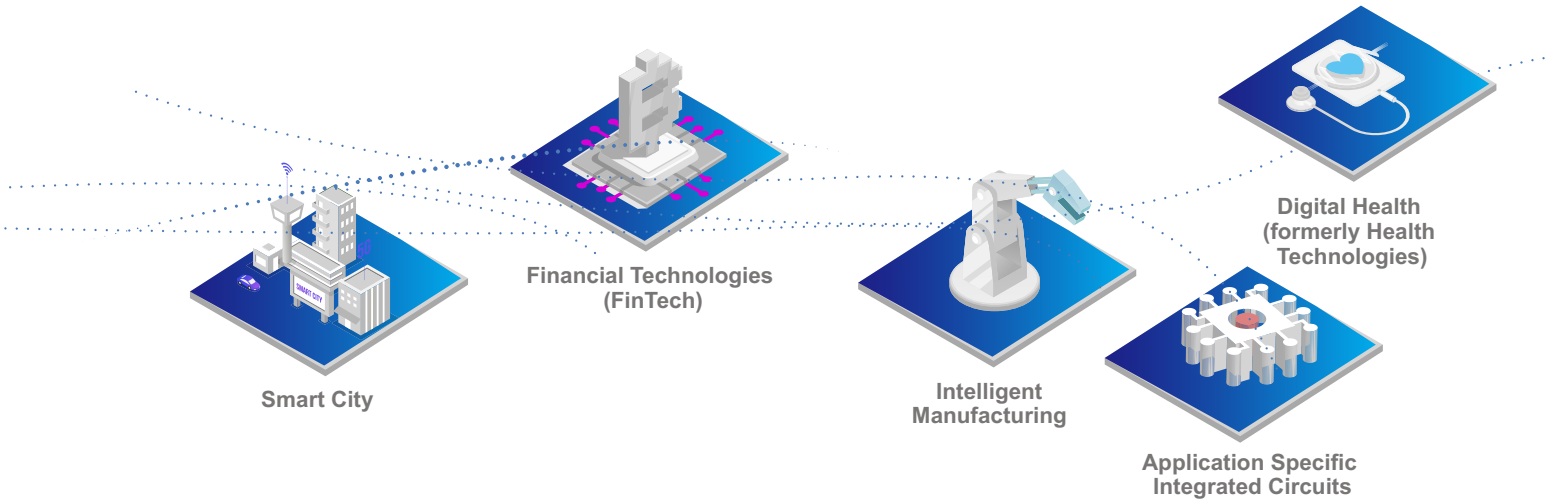
Won numerous
Awards
for its technological contributions

Providing an essential connection

ASTRI acts as a vital bridge that connects two ends of the Information and Communication Technologies (ICT) spectrum: academics pursuing ICT research, and industries looking to apply ICT technologies. As such, ASTRI is playing an essential connective role in our city's technology eco-system.

Our R&D focus

The Hong Kong SAR Government in 2006 set up five R&D Centres to drive and coordinate applied R&D in selected focus areas, and to promote the commercialisation of R&D results and technology transfer. ASTRI has been designated as the R&D Centre for ICT. Our R&D endeavours focus on five key areas of applications:



Helping Hong Kong thrive

ASTRI's R&D initiatives involve collaboration with numerous partners and clients, with the goal of commercialisation. Working with government agencies, quangos, academia, industry leaders and start-ups, we develop high-quality, affordable and innovative ICT solutions for both existing and emerging industries. The aim is to help Hong Kong thrive as a dynamic Smart City and enable it to tap into opportunities across the I&T ecosystem locally, regionally and globally.

By attracting and training a talented technology workforce and partnering with academia and industry, ASTRI is also performing the role of a "partnerships architect" for the ecosystem. As such, it is cultivating the next generation of Hong Kong's technology talents, professionals and entrepreneurs.

Our guiding principles

Our Vision

To be a world-class technology developer and an enabler to enrich lives.

Our Mission

To enhance Hong Kong's competitiveness through applied research.

As the largest applied R&D institute in Hong Kong, ASTRI collaborates with multiple players in the I&T ecosystem on projects designed to strengthen Hong Kong's industries through technological innovations. In the process, it is helping the economy to transition into one powered by technology and achieving innovation-led growth.

ASTRI's activities are shaped by the following core values:

Innovation

We aspire to create ground-breaking innovation that addresses the pain-points in our society.

Accountability

We work in the most ethical, honest, open and fair manner and take full responsibility for our actions.

Respect

We fully respect our employees, partners, stakeholders and others in the wider community, and work to foster and support an environment of teamwork and growth.

Service

We are committed to delivering a world-class service to our clients and partners in a timely manner.

Tenacity

Undeterred by obstacles, we strive to overcome every challenge and to see possibilities instead of problems in every situation.

Our technology roadmap

ASTRI organises its R&D activities across five Technology Divisions (TDs): Artificial Intelligence and Big Data (AIBD); Communications Technologies (COM); Cybersecurity, Cryptography and Trusted Technologies (CCT); Integrated Circuits and Sensors (ICS); and IoT and Sensors (IoTSEN).

These five TDs deliver market-relevant applications in five areas: Smart City, Financial Technologies, Intelligent Manufacturing, Digital Health and Application Specific Integrated Circuits (the last through our mandate as the Hong Kong branch of the Chinese National Engineering Research Centre (CNERC)).

Smart City

ASTRI is combining its ICT talents with sensor, artificial intelligence (AI), and next generation network and security technologies to improve how Hong Kong shares information, with the aim of enhancing the operation and efficiency of the city's infrastructure and improving the quality of life of its residents.

The Hong Kong SAR Government in December 2020 released its Smart City Blueprint for Hong Kong 2.0, aiming to bring benefits and convenience to the public so that residents can better perceive the benefits from smart city and I&T in their daily lives.

The Smart City revolution will impact every aspect of our lives, our businesses and our communities and create enormous opportunities for sustainable economic growth. We are developing tools and platforms that will enable Smart City technologies to seamlessly communicate with one another, by fully utilising 5G capabilities and increasing the functionality of existing smart technologies.

FinTech

Financial Technology (FinTech) is a cornerstone for growth in the financial sector. Advanced FinTech solutions are making financial services faster, more reliable, and more secure. They are also making it easier for banks, insurers and other financial service providers to cater to the needs of their customers. At the same time, they are enabling customers to access their accounts and other financial information in a more secure and personalised way.

Our FinTech teams are developing solutions by leveraging blockchain, strengthening cybersecurity and cryptography technology, improving big data analytics, and providing valuable proofs-of-concept. As one of Hong Kong's strongest FinTech R&D groups, we are finding ways to benefit the entire financial industry and help drive the sector's growth into a new era.

Intelligent Manufacturing

Our Intelligent Manufacturing R&D explores ways of making production processes faster, easier and more efficient. As an emerging Smart City, Hong Kong has the potential to unlock the Industry 4.0 vision by leveraging AI, robotics and data-centric solutions to make manufacturing more reliable and effective, and maintenance of remote sites significantly easier.

Together, Southern China, Hong Kong and Macao make up a leading centre of advanced manufacturing and modern service industries. Hong Kong stands to gain much by leveraging the transformation taking place in the Guangdong-Hong Kong-Macao Greater Bay Area. Through its R&D work in Intelligent Manufacturing technologies, ASTRI is developing advanced platforms, tools and solutions that are being used to create interconnected, fully digital smart factories. They are enabling businesses to streamline their operations, work more efficiently, and become more environmentally friendly.

Digital Health (formerly Health Technologies)

ASTRI is committed to developing healthcare technology solutions that support the medical sector and benefit the community. With support from the Hong Kong SAR Government, we have made breakthroughs in fields such as biomedical imaging and medical data analytics that are providing medical professionals with new tools for treating patients and saving lives.

ASTRI's Digital Health team is applying R&D in ways that are increasing the efficiency of healthcare, enhancing and personalising medical services, and ultimately improving the quality of people's lives. This involves us developing new applications in areas such as eldercare solutions, preventative health monitoring, medical diagnosis and medical computing.

Application Specific Integrated Circuits

Integrated Circuits (IC) are key components for achieving innovation-led growth and development for many high-tech industrial sectors. Reliable and robust IC research is paramount for these sectors as they strive to significantly upgrade their capabilities, especially in telecommunications, Smart City technologies and electronics.

Our R&D initiatives in Application Specific Integrated Circuits arise from the mandate given to us in 2012 when the first-ever Hong Kong branch of the Chinese Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems was established at ASTRI, in collaboration with Southeast University (SEU) in Nanjing. The branch focuses on microelectronics and integrated circuits applied across various industries.

Chairman's Message

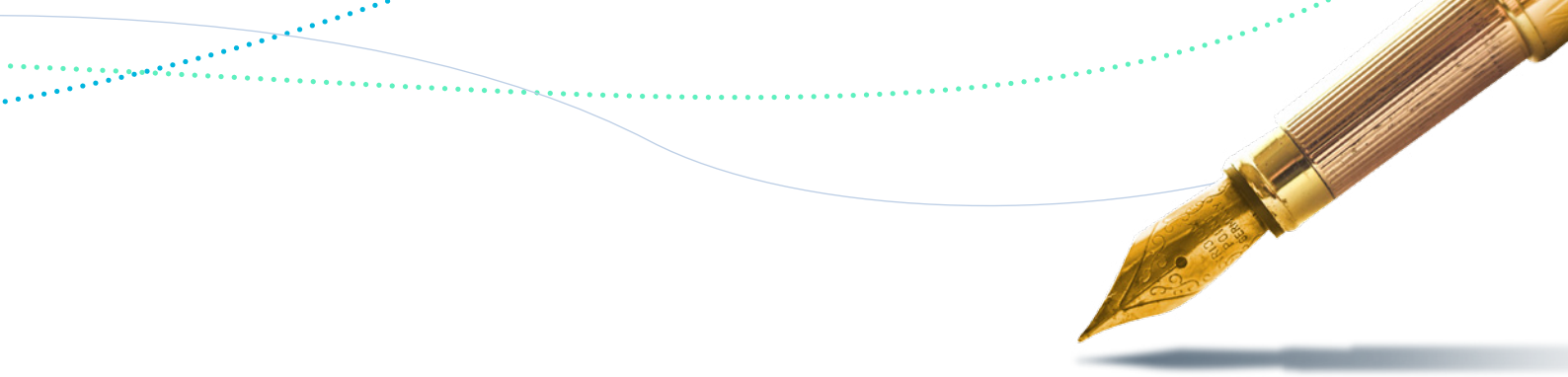
There can be little doubt that the year in review in this Annual Report is one that will remain in the memory for a long time. Life as we had known it and a normality that we had taken for granted was up ended and disrupted by the seismic shock of a global pandemic that had swept the world, forcing employers and employees to adapt to a new environment of remote working, virtual meetings and online training.

However, we continue to face each new challenge with humanity's never-ending determination to innovate and find solutions to the biggest pain points. Chaotic and challenging as it had felt at times, the year in review was also one for ASTRI to celebrate a landmark anniversary as it epitomised – for 20 years – our goal of bringing technological solutions to the pain points in the society. After all, it was innovation and technology that repeatedly helped us navigate the difficult moments during the last twelve months.

Celebrating two decades of Tech for Impact

We marked our 20th anniversary in November with the Impact Conference, a full-day webinar event featuring four keynote speakers and six panel discussions where distinguished thought leaders shared their views on technology going forward and the next impacts and innovations we could expect which would make our society smarter, safer and more efficient. We were delighted to have the Financial Secretary, the Honourable Mr Paul Chan Mo-po, deliver the opening remarks and were grateful for his kind and supportive words.

That innovation forms the bedrock of our mission to make Hong Kong more competitive through applied research. Since our establishment by the Hong Kong SAR Government in 2000, ASTRI has filed 1,286 patents (including 923 have been granted and 23 sold), completed more than 600 research projects and had almost 800 of our technologies developed in-house transferred to and used in various industries. In 2020-21 alone, we filed 66 patents and had 57 granted.



We hosted the Smart City Forum in March, during which government representatives, business leaders and thought leaders shared their views on collaboration and sustainability as essential components to deliver the smart city outlined in the Hong Kong SAR Government's Smart City Blueprint 2.0. It was our great pleasure to welcome the Honourable Secretary for Innovation and Technology, Mr Alfred Sit Wing-hang, who kicked off the event and delivered the welcome remarks.

Together we innovate better

Collaboration with our technology eco-system partners is paramount to the work we do. Through industry engagements, university collaborations and talent development schemes that look to bring every opportunity to the next generation of technology talent, we provide a supportive and nurturing environment to our R&D teams.

For most young graduates, entering the workplace in the past year would have been daunting. ASTRI sought to make that transition easier through a variety of initiatives, including our Graduate Programme 2020 which offered one-time, two-year full-time positions across various departments. We launched two Technology Oriented Practitioner Programmes, each of which created up to 30 paid full-time employment opportunities for master's students and assigning them to one of our ongoing R&D projects. One, with the University of Hong Kong, seeks to develop FinTech talent, and the other, with the Chinese University of Hong Kong, aims to do the same for Smart City transformation.

We will continue to strive to provide the exceptional talent being developed in our world-class educational institutes with the opportunity to create innovation and technological solutions that will bring positive impact to our society.

With the Greater Bay Area comes great opportunities

I must express my deepest gratitude to the Innovation and Technology Bureau and the Innovation and Technology Commission for their support and guidance to ASTRI and my most sincere thanks to every member of ASTRI's Board of Directors for the wisdom and leadership they provide.

In both the Chief Executive's Policy Address and the Financial Secretary's Budget Speech, the HKSAR Government has made crystal clear its staunch commitment to developing talent and infrastructure in our city, striving toward making Hong Kong a hub of innovation. We at ASTRI are committed to playing our part in contributing to the continued growth and development of this technology ecosystem.

This will enable Hong Kong to play a significant role in the Greater Bay Area (GBA) where our city's expertise in financial services, creative design, technology research, flow of information, legal and IP frameworks, among other areas, will create huge opportunities for those ambitious and curious enough to seize them.

As we begin to emerge from a world that has in many ways changed beyond all recognition, the positive impact technology and digitalisation have on our lives and our society is being felt in literally all walks of life. The pace of technological change and adoption has accelerated and I have no doubt innovation and technology will continue to provide the solutions to the biggest challenges. As we march forward and front up to the challenges ahead, ASTRI's innovative solutions and the talents we have carefully nurtured will keep us at the forefront of Hong Kong's technological ecosystem.

Ir Sunny Lee Wai-kwong, JP
Chairman, Board of Directors

Acting Co-Chief Executive Officers' Report

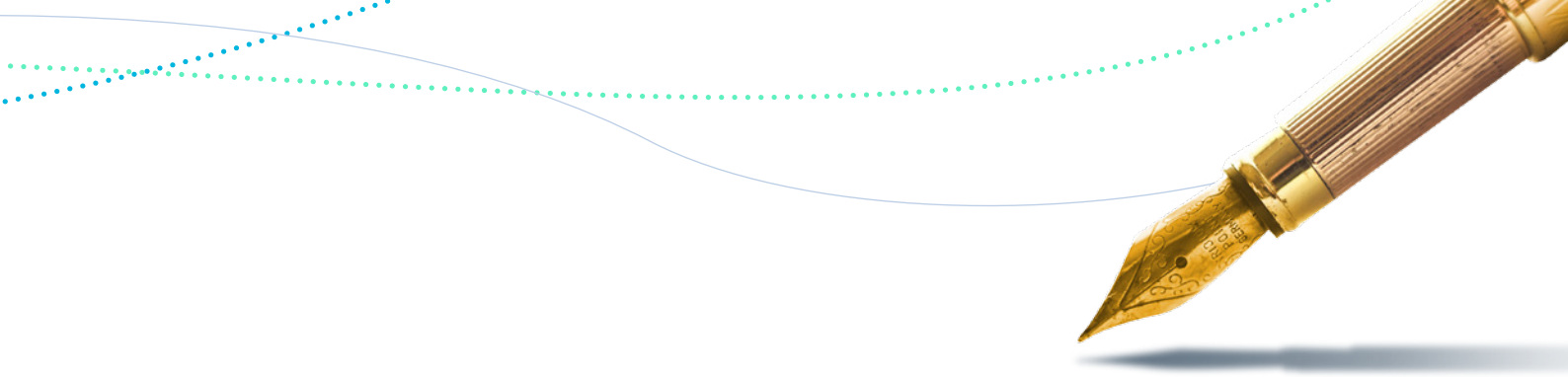
The only constant in life is change. And while this maxim was first coined in ancient Greece, it remains pertinent to our lives in the 21st century and is something we continue to adhere to in our work at ASTRI.

In March 2021, we capped this triumphant year by launching one of the world's largest cellular vehicle-to-everything (C-V2X) public road tests, covering a 14km route from the Hong Kong Science Park to Sha Tin town centre. The trials, which will last about nine months, will study and test the technology's application scenarios on the roads of Hong Kong, as well as evaluate the network and infrastructure required for the project's success.

C-V2X will make real-time communication possible between vehicles and every aspect of the road, from pedestrians to infrastructure, networks and other vehicles. It will bring greater safety and efficiency to our transport network and acts as a crucial transition technology toward the future development of autonomous vehicles.

Crucial to the further success of this technology will be the wide uptake and roll-out of 5G technology in Hong Kong, and ASTRI has been working hard all year to make that possible. We showcased portfolios of these technologies, including our 5G O-RAN solutions, our 5G SA Core Network and 5G Smart City Infrastructure, alongside many others, at both MWC Shanghai 2021 in February and PT EXPO 2020 in Beijing in October.

Together with CITIC Telecom CPC, we introduced an Augmented Reality (AR) solution designed to transform field engineers' operations and maintenance processes, improving efficiency and enhancing real-time operations, while a white paper, commissioned by the Hong Kong Monetary Authority (HKMA), was published by ASTRI



which provided a framework for banks to use FinTech solutions to collect and utilise alternative data to evaluate the creditworthiness of micro, small and medium-sized enterprises (MSMEs) to speed up bank loans.

Throughout a year repeatedly disrupted by the need to isolate and work together while working apart to tackle the COVID-19 pandemic, many of the leading local, regional and international industry events we would normally take part in to promote our city's growing I&T development were delayed or cancelled.

But humanity quickly evolves. We moved online and webinars became a vital way to communicate and network. Our experts dialled in alongside others from all over the world to share their ideas and insights.

Our own event, the Impact Conference, celebrated two decades of achievement and technological innovation. Initially scheduled in March 2020, we changed it to a full-day webinar in November and the event was a great success.

In the challenging environment for everyone, we stepped up our talent development initiatives, seeking to nurture a love of STEM education through our work with the Hong Kong Academy for Gifted Education (HKAGE), establish vital connections with the universities through our Work-Study Programmes and invest as much as possible in the next generation of talent.

This is just a brief overview of the numerous initiatives and events we took part in during the 12 months covered by this report but it is a snapshot that demonstrates our commitment to technological solutions that bring a better quality of life and a positive impact to Hong Kong's economy and community.

Across our five Technology Divisions, we undertook 103 projects in 2020-21 and, in total, 37 technologies were transferred to different industries, generating HK$127.32 million in income from those industries. ASTRI filed over 66 patent applications in China, the US and other countries, while 57 new patents were granted.

For the third consecutive year, we took part in the world's largest innovation expo in Geneva, the International Exhibition of Inventions, bagging 23 awards – medals for every innovation that we submitted. We also won two awards at the prestigious Hong Kong ICT Awards.

The evolution of technological advancements will continue to gather pace and with the Hong Kong SAR Government's Smart City Blueprint and the goal under the 14th Five Year Plan to establish Hong Kong as an international innovation and technology hub, we have the roadmap to contribute to our city's role in the Greater Bay Area.

Change it may be, but it is change for positive and better lives for us all.

Dr Lucas Hui and Dr Martin Szeto
Acting Co-Chief Executive Officers

Board of Directors

Composition of the Board

As of 31 March 2021, the Board was made up of a Chairman and 19 other members, two of whom were ex-officio members.

Chairman

Ir Sunny Lee Wai-kwong, JP
Vice-President (Administration),
City University of Hong Kong

Official Members

Ms Annie Choi Suk-han, JP
Permanent Secretary for Innovation and Technology, Innovation and Technology Bureau

Ms Rebecca Pun Ting-ting, JP
Commissioner for Innovation and Technology, Innovation and Technology Commission

Members (in alphabetical order of surname)

Professor Chan Chun-kwong
Programme Director, MSc in Financial Technology, Faculty of Engineering,
Professor of Practice in FinTech,
Department of Systems Engineering and Engineering Management,
The Chinese University of Hong Kong

Mr Stephen Chau Kam-kun
Executive Director & Chief Technology Officer, SmarTone Telecommunications Holdings Limited

Members

Mr Charles Chow Sai-keung

South China & Hong Kong Assurance Leader, PricewaterhouseCoopers

Mr Steve Chuang Tzu-hsiung

Chairman and Chief Executive Officer, ProVista Group

Mr Ha Yung-kuen, BBS

Mr Stephen Ho Wai-chung

Founder and Chief Executive Officer, n-hop technologies Limited

Professor Lam Tak-wah

Head, Department of Computer Science, The University of Hong Kong

Mr Edmund Lee Chi-wai

Chief Executive Officer, Application Technology Company Limited

Members

Professor Sabrina Lin Man-yee

Senior Advisor to the President, Office of the President, The Hong Kong University of Science and Technology

Mr Andy Liu An-ting

President of Healthcare & International, BaseBit Technologies Company Limited

Vice Chairman, Hong Kong Biotechnology Organization

Mr Theodore Ma Hen

Managing Partner, CoCoon Ignite Ventures

Mr Peter Ng Hon-yu

Vice President, Technology, Enabling Technology Group, ASM Pacific Technology Ltd.

Ir Professor Joseph Ng Kee-yin

Professor, Department of Computer Science, Hong Kong Baptist University

Dr Alfred Ng Man-cheuk

Chief Technology Officer, Suga International Holdings Limited

Ir Dr Samson Tai Kin-hon

Distinguished Engineer and Chief Technology Officer, IBM Hong Kong

Mr Anthony Tong Tat-hay

Managing Partner, Robin Bridge & John Liu

Ms Ada Wong Yin-man

Executive Director, Wong's International Holdings Limited

Board Functional Committees

Three functional committees assist the Board in its oversight of ASTRI: the Finance and Administration Committee (FAC), the Technology Committee (TC) and the Audit Committee (AC). The FAC oversees ASTRI's financial and administrative arrangements; the TC oversees its R&D initiatives; and the AC ensures that internal and external audit processes are properly carried out.

The members of the committees as of 31 March 2021 were as below:

Finance and Administration Committee (FAC)	Technology Committee (TC)	Audit Committee (AC)
Mr Ha Yung-kuen, BBS (Chairman)	Mr Stephen Ho Wai-chung (Chairman)	Mr Charles Chow Sai-keung (Chairman)
Mr Stephen Chau Kam-kun	Mr Steve Chuang Tzu-hsiung	Professor Chan Chun-kwong
Professor Sabrina Lin Man-yee	Mr Ha Yung-kuen, BBS	Mr Edmund Lee Chi-wai
Mr Andy Liu An-ting	Professor Lam Tak-wah	Dr Alfred Ng Man-cheuk
Mr Theodore Ma Heng	Mr Edmund Lee Chi-wai	Ms Rebecca Pun Ting-ting, JP
Ms Rebecca Pun Ting-ting, JP	Ir Sunny Lee Wai-kwong, JP	Ir Dr Samson Tai Kin-hon
Mr Anthony Tong Tat-hay	Mr Andy Liu An-ting	Ms Ada Wong Yin-man
	Mr Peter Ng Hon-yu	
	Ir Professor Joseph Ng Kee-yin	
	Dr Alfred Ng Man-cheuk	
	Ms Rebecca Pun Ting-ting, JP	

Changes in Board Directors

New Directors

	Date of Appointment
Mr Edmund Lee Chi-wai	21 October 2020
Mr Theodore Ma Heng	21 October 2020
Dr Alfred Ng Man-cheuk	21 October 2020
Ir Dr Samson Tai Kin-hon	21 October 2020
Mr Anthony Tong Tat-hay	21 October 2020

Retired Directors

	Date of Retirement
Ms Cally Chan Shan-shan	21 October 2020
Mr Duncan Chiu	21 October 2020
Mr Kwong Chi-keung, JP	21 October 2020
Ir Dr Alan Lam Hiu-fung	21 October 2020
Dr Davy Lo Kwok-wai	21 October 2020

Meeting Attendance

A total of five Board meetings were convened during the 2020-21 year. The attendance records of members at Board meetings as well as Board Functional Committee meetings held between 1 April 2020 and 31 March 2021 are as follows:

Board Meetings	24 Jun 2020	7 Oct 2020	16 Nov 2020 (Special Meeting)	16 Dec 2020	31 Mar 2021
Total number of directors during the period	20	20	20	20	20
Total number of directors present at meeting	19	19	15	19	20
Total number of apologies	1	1	5	1	0
Percentage in attendance	95%	95%	75%	95%	100%

FAC Meetings

	20 May 2020	27 Aug 2020	20 Nov 2020	26 Feb 2021
Total number of FAC Members during the period	8	8	6	7
Total number of FAC Members present at meeting	6	7	4	7
Total number of apologies	2	1	2	0
Percentage in attendance	75%	88%	67%	100%

TC Meetings

	2 Jun 2020	3 Sep 2020	23 Nov 2020	9 Mar 2021
Total number of TC Members during the period	12	12	11	11
Total number of TC Members present at meeting	11	12	10	8
Total number of apologies	1	0	1	3
Percentage in attendance	92%	100%	91%	73%

AC Meetings

	27 May 2020	1 Sep 2020	28 Sep 2020 (Special Meeting)	13 Nov 2020	5 Mar 2021
Total number of AC Members during the period	7	7	7	4	7
Total number of AC Members present at meeting	7	5	7	3	6
Total number of apologies	0	2	0	1	1
Percentage in attendance	100%	71%	100%	75%	86%

Our organisation

Operating under the auspices of the Hong Kong SAR Government's Innovation and Technology Commission (ITC), ASTRI is led by a Chief Executive Officer, who is accountable to the Board of Directors. The CEO is responsible for all matters relating to the overall management of the organisation. The CEO is assisted by a Senior Management team of C-Officers, who are responsible for R&D, operations, finance, marketing, administration and other supporting functions, and the Technology Division Heads, who lead ASTRI's five R&D teams and are overseen by the Chief Technology Officer.

C-Officers

In 2020-21, the following C-Officers were members of the Senior Management team:

Mr Hugh Chow*
Chief Executive Officer

Dr Lucas Hui*
Acting Co-CEO cum Chief Technology Officer

Dr Martin Szeto*
Acting Co-CEO cum Chief Operating Officer

Ms Cammy Yung
Chief Financial Officer

Mr Aaron Ho
Chief Administrative Officer

Ms Seraphina Wong
Chief Marketing Officer

* Mr Hugh Chow stepped down from his role as CEO on 15 January 2021, and the duties have been shared in the interim by Acting Co-CEOs, Dr Lucas Hui and Dr Martin Szeto.

Technology Division Heads

ASTRI's five Technology Divisions are responsible for the development of their respective technologies. Each is headed by an experienced leader in the field. The Division Heads in 2020-21 were as follows.

Dr Justin Chuang
Vice President, Communications Technologies (COM)

Mr Alan Cheung
Senior Director, Cybersecurity, Cryptography and Trusted Technologies (CCT)

Dr Daniel Shi
Senior Director, Integrated Circuits and Systems (ICS)

Dr Tsai Chen Jung
Senior Director, IoT and Sensors (IoTSEN)

Dr James Lei**
Senior Director, Artificial Intelligence and Big Data Analytics (AIBD)

** Dr James Lei left ASTRI on 29 January 2021.

Annual remuneration of staff in the organisation's top three tiers who were in service as of 31 March 2021

Post	Annual Remuneration*** 1 Apr 2020 – 31 Mar 2021 (HK$)
First tier Chief Executive Officer	$3,416,500
Second tier Five senior executives	$11,574,380
Third tier Six functional leaders/ senior technology experts	$10,682,970

Annual Remuneration*** (HK$)

Annual Remuneration*** (HK$)	Number of staff in the top three tiers
1,000,000 or below	1
1,000,001 to 1,500,000	0
1,500,001 to 2,000,000	6
2,000,001 to 2,500,000	1
2,500,001 to 3,000,000	2
3,000,001 to 3,500,000	2

*** Annual remuneration includes base salary, salary adjustment, acting allowance, performance-linked payment, variable payment, and cash award (Inventor Award) for 2020-2021. It is rounded to the nearest HK$10. The annual remuneration of staff who were appointed during the financial year has been calculated on a prorated basis, while staff in the second and third tiers who left ASTRI before 31 March 2021 has been excluded.

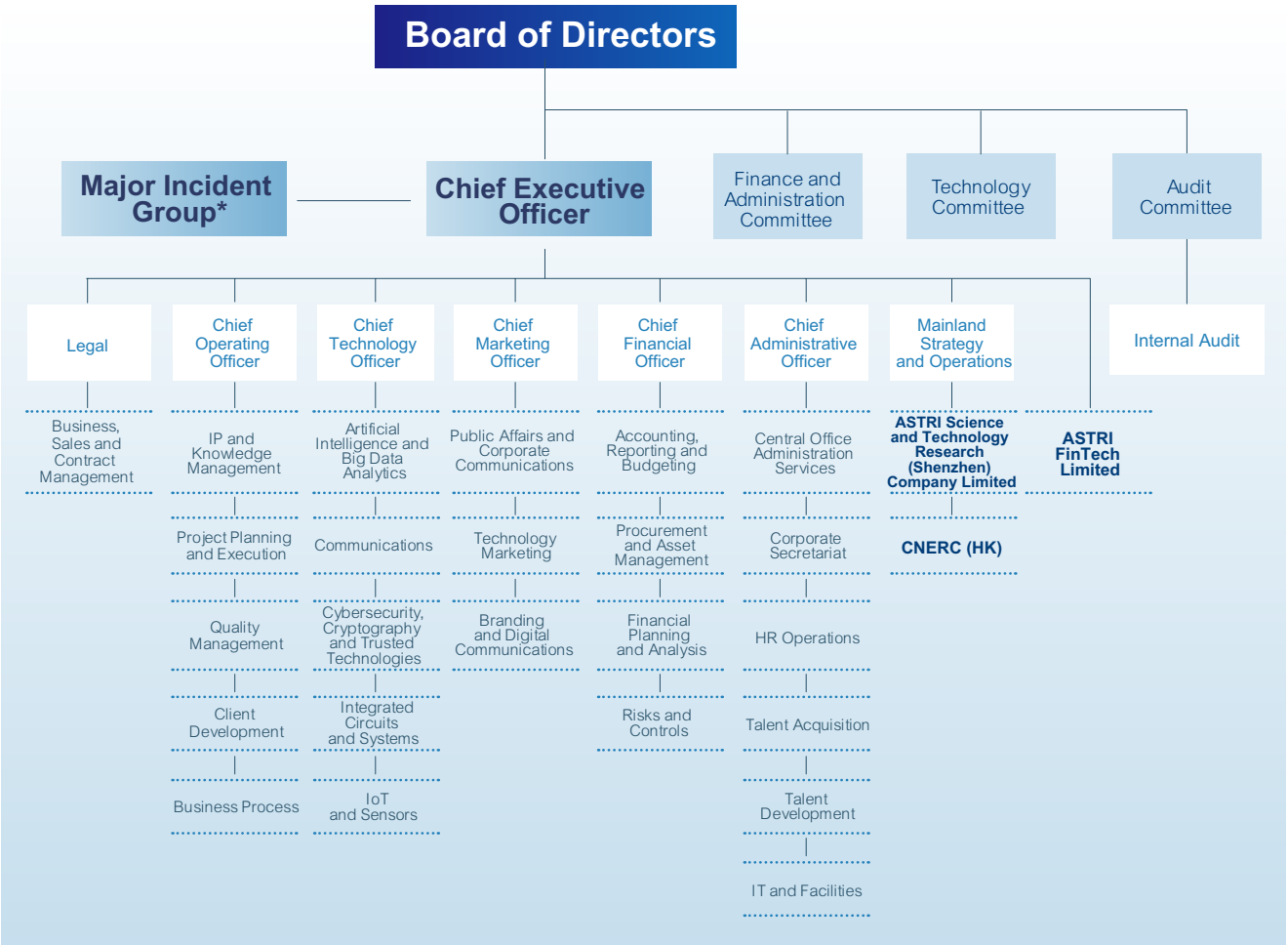
The importance of our people

People represent the most important part of our organisation. Our success stems from our combination of a highly skilled workforce, strong leadership and guidance, and a dynamic organisational structure. As at 31 March 2021, we had 612 dedicated and highly competent individuals all working as a single team towards a common goal, that of creating a better future for Hong Kong and our nation.

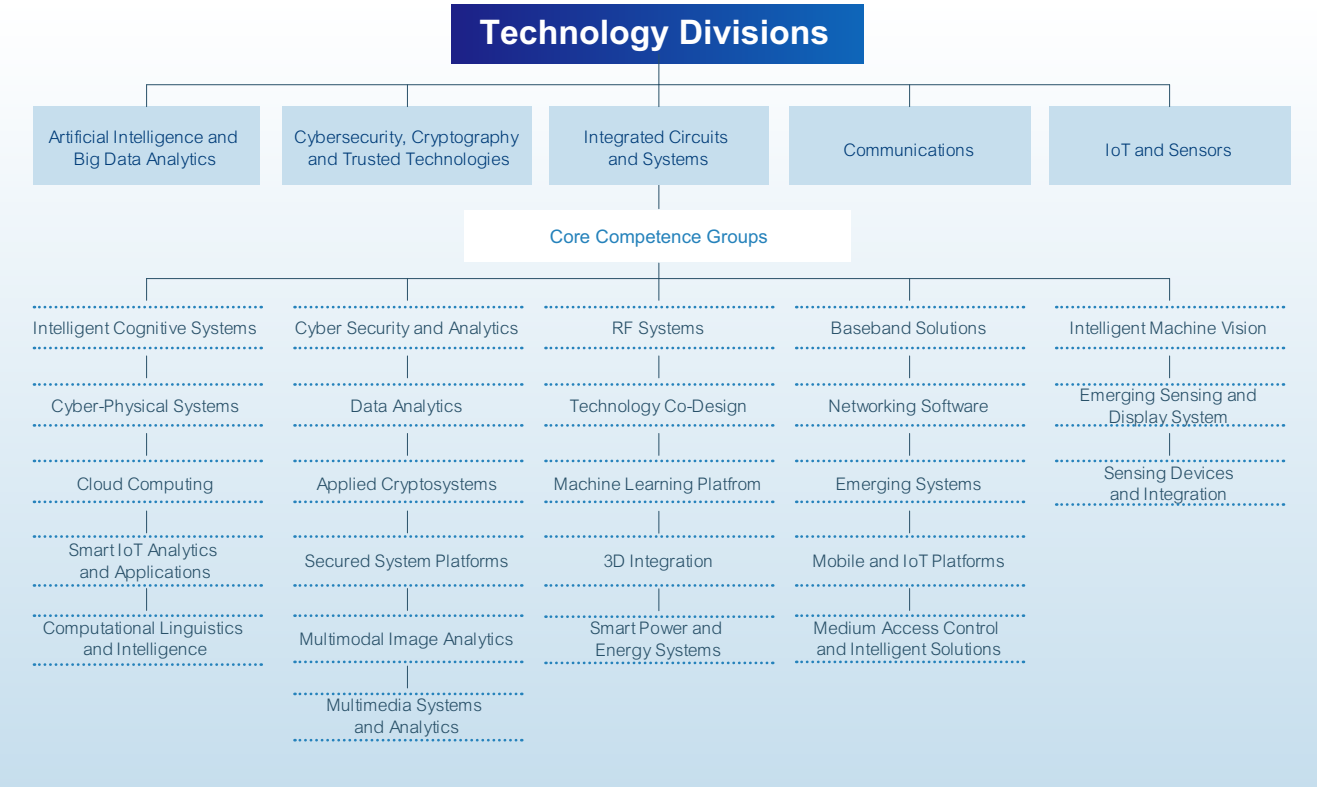
Our R&D teams, organised into five Technology Divisions, make up 70% of the total workforce. The remaining portion is made up of personnel providing various support services and functions. They include teams working in our departments of Finance and Accounts, Marketing, Procurement, Legal, Information Technology, Facilities Management, Human Resources, Client Development, Intellectual Property and Knowledge Management, and Project Management.

ASTRI's organisational structure as of 31 March 2021 is laid out in the chart below:

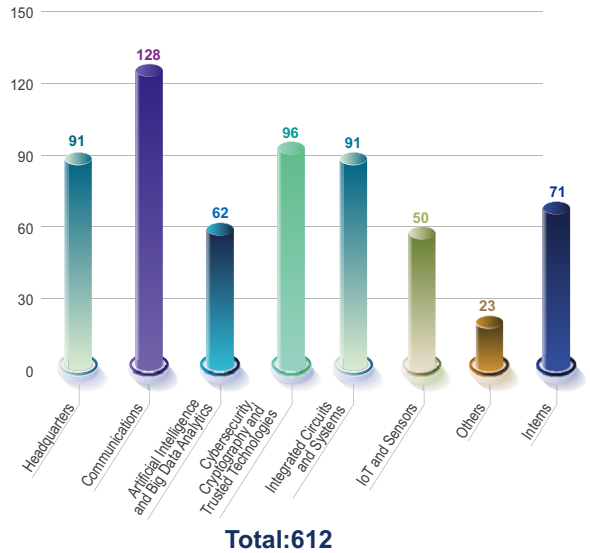
ASTRI organisational structure



ASTRI R&D organisational structure

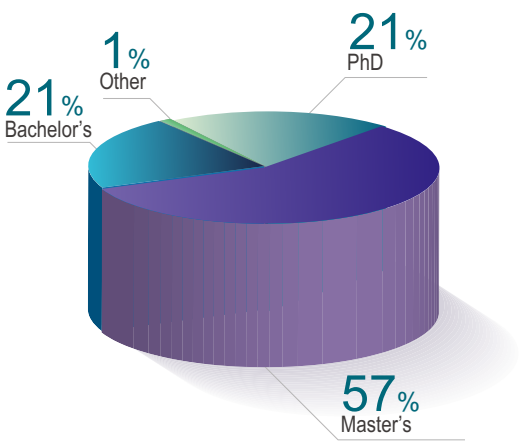


Employee numbers by functional area



Total:612

Academic qualifications of R&D staff as of 31 March 2021



Governance and Control

As a publicly funded R&D centre, ASTRI adheres to the highest standards of corporate governance.

ASTRI operates in accordance with its Corporate Governance Manual, which clearly articulates its policies and principles. The Manual also guides the efforts of the Board and Senior Management to ensure ASTRI always operates in a transparent and accountable manner.

The Manual contains comprehensive guidelines on:

Organisation and management structure

HR policies and staff conduct

Financial management and controls

Internal controls and external reporting

Risk management

The Manual is updated periodically to incorporate any developments needed to improve ASTRI's operations, and to reflect the changing business environment.

Internal audit

ASTRI has an Internal Audit Department (IAD) under the Audit Committee. Its role is to ensure effective corporate governance and to provide the Board with information about and assurance of the effectiveness of ASTRI's internal controls.

The IAD provides objective reviews and assurances that provide us with a systematic, disciplined approach to evaluating and improving our risk management, control, and governance processes.

Over the past year, the IAD has conducted internal audit reviews on various areas of ASTRI's operations in line with the risk-based rolling 3-year Internal Audit Plan approved by the Audit Committee. These areas have included project management, inventory management, intellectual property management, staff recruitment management, insurance management, user education and awareness on cybersecurity, corporate governance, and secretariat support management. While these reviews identified some areas for improvement, they confirmed that ASTRI had significant controls in place and that the existing regulations and procedures were being observed in all material respects. The IAD submitted half-yearly reports of these reviews and their recommendations to the Audit Committee.

Compliance

As the Compliance Officer, the Head of Internal Audit helps the Board to ensure good governance by reporting any significant non-compliance issues identified by a team of Departmental Compliance Officers. The Compliance Officer submits quarterly reports to the Audit Committee on important compliance matters.

Safeguards against conflicts of interest

ASTRI has strict controls and safeguards in place against conflicts of interest. The Code of Conduct is regularly reviewed and updated as necessary to ensure that potential conflicts are always declared and adequately managed. All ASTRI employees are required to make an annual declaration to confirm that they have read, understood and are compliant with the Code.

Workplace policy

ASTRI has zero tolerance for discrimination and harassment. We organise regular seminars on relevant policies and regulations, with the aim of promoting equal opportunities and preventing discrimination and harassment in the workplace.

Risk management

ASTRI has a Risk Management (RM) framework in place to identify, evaluate and mitigate risks. It has been designed based on ASTRI's RM policy, which covers issues such as the roles and responsibilities of different parties, the RM process and risk communication.

A Risk Register is also maintained to keep track of various risks that ASTRI encounters. The Risk Register covers the following broad thematic categories:

Strategy and partnership	**Corporate governance and ethics**	**Compliance**	**Corporate communications and relations**	**Research and development**
Human resources	**Finance**	**Information technology**	**Health and safety, premises and facilities**	**Reporting**

Updated on a regular basis, the Risk Register is reported periodically to the Board via the Audit Committee.

Quality management system

Quality is paramount for all ASTRI's research deliverables, and this is supported by our organisation-wide adoption of the ISO 9001 Quality Management standard. The ISO 9001 standard helps ASTRI to deliver consistently high-quality products and services that meet the expectations and enhance the satisfaction of our clients and partners. In June 2020, international quality assurance body Bureau Veritas Certification conducted an ISO 9001 surveillance audit on ASTRI's operations and found no non-conformance. ASTRI actively seeks opportunities to improve the quality of its operations through effective communication and exchanges with all its stakeholders.

Information security management system

ASTRI has adopted the ISO 27001 Information Security Management standard for its R&D endeavours in Financial Technologies to safeguard the confidentiality, integrity and accessibility of information. This standard is helping us mitigate cybersecurity risks and improve our cyber-defence capabilities. Our FinTech R&D professionals regularly attend information security awareness training sessions on the latest and most advanced tools for mitigating cyber-risks.

Every quarter, an external consultancy company performs vulnerability assessment and penetration tests on ASTRI's Information Technology infrastructure and network equipment to ensure our security controls remain effective. In October 2020, the certification body SGS Hong Kong Limited conducted an ISO 27001 surveillance audit of ASTRI's operations and found no non-conformance. ASTRI is continuing to improve and strengthen its data, information and operations security, staying abreast of the latest technologies to combat evolving cybersecurity risks.

Achievements

Awards and recognitions

23 awards for ASTRI at world's largest innovation expo

ASTRI continued its streak of success at the Special Edition 2021: Invention Geneva Evaluation Days in March 2021, with a 100% success rate as all 23 technologies submitted won awards. In total, ASTRI received seven Gold medals and 16 Silver medals.

The International Exhibition of Inventions of Geneva, the world's most prestigious event for inventors, is organised annually jointly by the World Intellectual Property Organisation (WIPO), the Swiss Federal Government, the State and the City of Geneva.

It is acknowledged as the most prestigious event for inventors around the world, with about 600 inventions from 20 countries and regions judged on the online platform.

To remain close to inventors and encourage global innovation during the global COVID-19 pandemic, the organisers of the International Exhibition of Inventions decided to host a special virtual-only edition in 2021: Inventions Geneva Evaluation Days – Virtual Event. Inventors from all over the world could participate in the competition, presenting their inventions via a 3-minute video. The competition was judged by a panel of professionals.

The full list of awards won by ASTRI this year is as follows:

Gold Medals	
Smart Behaviour Analysis System	IoT Data Exchange Using Blockchain Technology
Mobile Mission-Critical Communications Terminal	5G and Vision-Based AI Improvements for Automated Guided Vehicles (AGV)
Wide-Bandgap-Based Power Converters for Next Generation Data Centres	3D High-efficiency Power Electronics Modules for Metro Train Energy Storage Systems
Enhanced Long-Distance Wireless Power Transmission Platform	

Silver Medals	
Smart Water Data Analysis	Document Auto-Summarisation
Apparatus and Method for Virtual Walkthrough Generation	Apparatus for Measuring Objects in 3D Scenes
Zero Knowledge Proof Hardware Accelerator	Improving User Data Delay and Throughput Experiences for Cellular System over High Latency Backhaul
5G O-RAN Base Station with Frequency Domain Signal Extraction Technology	Improved Multi-Beacon Wireless Indoor Positioning System
Advanced Mobile Energy Technology for Scalable and Safe Energy Storage for Smart Robotics Applications	Interconnect Technologies for Electronic Circuit Fabrication and Through-Silicon-Via Technologies for IC Integration
ElectroStatic Discharge Protection Solutions for Advanced CMOS FinFET Process for 5G Applications	Low-Capacitance Transient Voltage Suppressor for Mobile Electronic Surge Protection
Advanced Breaker for Energy Efficient DC Buildings	AI Quality Assurance System for Smart Manufacturing
Compact Non-mechanical Light Detection and Ranging (LIDAR) Beam Steering System	Instant and Non-contact Determination of Materials Concentration in Solutions

ASTRI wins two awards at Hong Kong ICT Awards

ASTRI won two awards at the Hong Kong Information and Communications Technology Awards (ICT Awards) 2020. It won a Silver Award for Smart Living for its iGem Guard Raman spectrometer, and a Bronze Award for Smart Mobility for its gantry-free Electronic Road Pricing (ERP) System.

The cost-efficient and portable iGem Guard can distinguish the category, authenticity, and rank of more than 3,000 different kinds of gems in just three seconds. Using a one-touch optical inspection process, the device can swiftly determine whether a diamond is natural or synthetic, whether a jadeite is classifiable as "Grade A" or has been chemically-processed ("Grade B" or "Grade C"), and whether a pearl was formed in freshwater or saltwater.

ASTRI has leveraged its expertise and selected fine optical components to develop a spectrometer that is about 20 times smaller than conventional ones. The relevant patented mini-spectrometer technology was also awarded a Gold Medal with Congratulations of the Jury at the International Exhibition of Inventions of Geneva in 2019.

Rush-hour traffic charges to tackle traffic congestion traditionally involve the setting up of enormous gantries over roads, with cameras on them to detect passing vehicles. However, ASTRI's award-winning ultra-wide broadband (UWB) + vehicle-to-everything (V2X) ERP System does not require this set-up. ASTRI has been a market pioneer in combining C-V2X and UWB technology to enable the precise estimation of a vehicle's position. ASTRI uses existing roadside infrastructure for its ERP system, not only eliminating the need to build expensive gantries and lay optical fibres but also reducing the number of sensors required, and effectively reducing the time and cost of adoption. The system is also easy to install and transfer, and can be adjusted when necessary.

The nature of V2X and UWB allows the system to perform reliable real-time smart transport management and accurately locate vehicles, all with low power consumption. It can also ensure data security and protect user privacy.

Established in 2006, The Hong Kong ICT Awards recognise and promote outstanding Information and Communications Technology (ICT) inventions and applications.

ASTRI scoops 'Top Talent Team' award through clever use of online platforms

ASTRI scooped a "Top Talent Team" Award from professional recruitment platform LinkedIn in December 2020, based on the frequency and usage of the site's search engines to find talent and the response rate from potential candidates.

ASTRI recruits local as well as global professionals to conduct innovative applied technology research projects, solve problems for the industry and improve the quality of life in Hong Kong. ASTRI recruits through multiple channels, including various online platforms, introducing ASTRI's mission and job opportunities to professionals around the world, and inviting them to follow ASTRI's social platforms with a view to familiarising them with the company.

ASTRI Thought Leadership Events

Distinguished guests and thought leaders celebrate ASTRI's 20th anniversary at Impact Conference

On November 11, ASTRI presented the Impact Conference, a full-day webinar that brought together some of Hong Kong's thought leaders. The conference explored how innovations in the technology sector will impact Hong Kong in the near- and long-term, and considered ways in which innovation and technology could have an immediate impact on Hong Kong life amid the global pandemic.

The conference, held to mark ASTRI's 20th anniversary, was opened by the Financial Secretary the Honourable Mr Paul Chan Mo-po, GBM, GBS, MH, JP, and ASTRI Chairman Ir Sunny Lee Wai-kwong, JP.

In his speech, Mr Chan praised ASTRIANs for having seen the future and for passionately believing in their mandate. He also reflected on the vision of Hong Kong's first Chief Executive Mr Tung Chee Hwa of the city becoming a high-powered innovation and technology hub, and on the importance of boosting Hong Kong's technological collaboration with other cities in the Greater Bay Area.

ASTRI Chairman Ir Sunny Lee provided an overview of ASTRI's 20 years of success, from its first patents to key partnerships that have been formed. He also laid out his own vision of a future where connected devices operate on ASTRI technology, smart factories rely on ASTRI robotics, and consumers conduct their day-to-day lives on platforms developed by ASTRI.

Keynote speakers

The event featured four keynote speeches. The first was Professor Tsui Lap-chee, GBM, GBS, JP, from The Academy of Science of Hong Kong, who detailed the inseparable link between scientific investigation and technological development in a speech titled 'Advance Through Collaboration'. He also emphasised the importance of sharing, trust and open communication in the technology ecosystem.

Professor Zexiang Li, from the School of Engineering at the Hong Kong University of Science and Technology, delivered a keynote speech titled 'Visionary Outlook of I&T'. This looked at the significant impact robotics could have on the construction industry in terms of improving efficiency, safety and quality.

In his keynote speech 'A Day in the Life of a Future MTR Customer', Dr Jacob Kam, CEO of MTR Corporation Limited, looked at how technology will bring greater efficiency to all aspects of travel, including navigating stations, utilising facial recognition technology on ticket gates, booking cross-border travel journeys, and recommending alternative routes to avoid delays. Dr Kam also explained how IoT sensors can improve train conditions, performance, and maintenance.

Dr Lam Ching-choi, SBS, JP, Executive Council member and CEO of the Haven of Hope Christian Service, focused on four areas of digital health, namely smart hospitals, Virtual Reality (VR) technology, telehealth, and wearable technology, in a speech titled 'Future of HealthTech in the Post COVID-19 World'.

Panel discussions

Six panel discussions explored how innovations in FinTech, 5G, smart city technology, smart manufacturing, health technologies and blockchain will be an essential part of Hong Kong's future prosperity and success. They also offered insights into ways of nurturing, developing, and sustaining a technology-focused workforce in the face of the global shortage of talent in the sector.

The first panel discussion, 'How Technology Will Drive the Next Economies', was joined by Colin Pou, Executive Director (Financial Infrastructure) at the Hong Kong Monetary Authority; Bénédicte Noella Nolens, head of the BIS Innovation Hub Centre, and Raymond Cheng, former Group General Manager and Chief Operating Officer, Asia Pacific at HSBC. It was moderated by ASTRI CEO Mr Hugh Chow.

It explored the challenges faced by the financial sector during the pandemic, and how Hong Kong can become an international digital trading hub through the development and risk management of FinTech innovations. Talking points included a central bank digital currency (CBDC), e-wallets, distributed ledger technology (DLT), the importance of regulation, blockchain, the use of AI and big data analytics, green finance and sustainability, open finance and MSME inclusion.

The huge potential of 5G was the focus of the second panel discussion, titled 'How 5G will Accelerate Hong Kong's Smart City Aspirations'. It featured Ir Alex Kwan, Chief Executive Officer, Asia at Global Infrastructure Solutions Inc., Rex Wong, JP, Chief Executive Officer at Kum Shing Holdings, and ASTRI's Vice-President, Communications Technologies, Dr Justin Chuang. The panel discussion moderator was Bien Perez, a senior production editor on the technology desk of the South China Morning Post, ASTRI's media partner for the Impact Conference.

The discussion focused on the transformations and opportunities that an ultrafast low-latency network could bring to our society. From autonomous driving and cellular vehicle-to-everything (C-V2X) technology to remote surgery and the future of work, the panellists considered the possibilities and challenges created by a city full of connected devices and machine-to-machine technology.

Addressing the disruption of the pandemic and ways to recover from it, the third panel discussion was titled 'Business as Usual in the Next Normal: How to Engage Technology-Empowered Consumers'. It was moderated by Director of Strategy at ASTRI, Ivan Lam, and featured Steve Chuang, Deputy Chairman of the Federation of Hong Kong Industries, Duncan Chiu, President of the Hong Kong Information Technology Joint Council, and Gilly Wong, Chief Executive at the Hong Kong Consumer Council.

The session explored the shifting behaviour of consumers during the COVID-19 pandemic, what businesses should be doing to adapt, and how innovation and technology can help them. From manufacturing to SMEs, it considered the importance of maintaining a steady supply chain and the increasing need to consider customer loyalty.

This was followed and complemented by the fourth panel discussion, 'Globalisation and a Safer, More Efficient New World'. This took the local business issues raised in panel three and looked at them from a global perspective, exploring how technology will be essential to reopening borders and strengthening supply chains in post pandemic times.

It was joined by Stephen Ho, Founder and Chief Executive Officer of n-hop technologies, Mr Jimmy Tam, Assistant Commissioner (Excise and Strategic Support) of the Customs and Excise Department, and Dr Lucas Hui, ASTRI's Chief Technology Officer. The discussion was moderated by ASTRI's Chief Marketing Officer Seraphina Wong.

The focus of the fifth panel discussion was healthcare and how technologies such as artificial intelligence and IoT can usher in changes to the ways in which diseases are prevented, diagnosed or treated. Titled 'How Will HealthTech Impact the Future Population?', the discussion covered a range of medical and health issues, including addressing the emerging demographic crisis by which one-third of Hongkongers are expected to be over 65 by 2036, the chronic shortage of doctors in Hong Kong, and ways of detecting, treating and even preventing mental health issues.

It featured Dr Joanna Pang, Chief Manager (Health Informatics) at the Hong Kong Hospital Authority's Information Technology and Health Informatics Division; Dr Terence Kwong, Medical Director and Member of the Doctor Advisory Board at Human Health; and Dr Lydia Leung, Chief Executive Officer of Belun Technology Company Ltd. It was moderated by ASTRI's Chief Operating Officer, Dr Martin Szeto.

Finally, the sixth panel discussion, 'The Road Ahead: How Technology Can Sustain the Future Workforce', delved into talent development and ways of maintaining the expertise required to sustain a thriving technology ecosystem. It considered how the technology industry can appeal to students to choose technology over the more traditional and trusted career paths of law, finance and medicine, how to make workplaces more appealing, and approaches for nurturing existing staff and reducing staff turnover.

The panel included Professor Christopher Chao, Dean of Engineering and Chair Professor of Mechanical Engineering at the University of Hong Kong; Ir Dr Alan Lam, Chief Executive Officer of Sengital Limited; and Stephen Wong, Deputy Executive Director of Our Hong Kong Foundation. It was moderated by ASTRI Chief Executive Officer Hugh Chow, who then delivered the event's closing remarks.

ASTRI explores the future of Hong Kong's tech ecosystem at Smart City Forum

On March 22, ASTRI hosted a Smart City Forum in which government representatives, business leaders and thought leaders shared their views on the essential collaboration needed to create a smart city, and what a "tech-backed" sustainable future might look like for Hong Kong.

The event was opened by the Honourable Secretary for Innovation and Technology, Mr Alfred Sit Wing-hang, JP, following welcome remarks from ASTRI Chairman Ir Sunny Lee Wai-kwong, JP.

The first panel, titled 'The Essential Collaboration for a Smart City,' was joined by Stephen Ho, founder and CEO of n-hop technologies; Ir Lee Tai-on, JP, Assistant Director/Mechanical and Electrical of the Water Supplies Department (WSD); Dan Wong, General Manager, Global Innovation at MTR Corp; and Rex Wong, CEO of Kum Shing Holdings. The panel was moderated by Guy Parsonage, Partner and Leader of the PwC Experience Centre at PwC.

The discussion explored how the best results can be achieved not only by working together, but also by finding the right balance between healthy and stimulating competition and cross-sector collaboration.

The second panel was titled 'What Does a Tech-backed Sustainable Future Look Like?' and featured Leonard Chan, Chairman of the Hong Kong Innovative Technology Development Association (HKITDA); Duncan Chiu, President, Hong Kong Information Technology Joint Council; Dr Lam Ching-choi, SBS, JP, Executive Council member and CEO of the Haven of Hope Christian Service; and Dr Martin Szeto, Acting Co-CEO and COO at ASTRI. It was moderated by Alaric Chu, from Metro Radio Corporation.

The panel discussed various aspects of a smart city, from perspectives such as talent development, gerontech and healthtech, FinTech, blockchain, and artificial intelligence. It considered how these technological applications will impact Hong Kong, and particularly small and medium-sized businesses in the city, as a smart economy.

The event was held at the Asia Society Hong Kong Center and streamed live to an online audience.

Leading expos and industry events

ASTRI launches one of the largest C-V2X public road tests in the world

ASTRI launched one of the world's largest cellular vehicle-to-everything (C-V2X) public road tests in Hong Kong on March 30, to study and test application scenarios of the technology on the city's roads, as well as the network and infrastructure required. Covering a 14km route from the Hong Kong Science Park to Sha Tin town centre, ASTRI's C-V2X public road test will last about nine months.

ASTRI's C-V2X system makes real-time communication possible between vehicles and pedestrians, road-side infrastructure, networks and other vehicles. Information and warnings can be generated instantly to enhance road safety and assist driving. C-V2X technology can also be applied to real-time traffic monitoring, incident management, and route planning to improve efficiency. In the longer term, C-V2X paves the way for the development of autonomous driving technology, by assisting in detecting hidden dangers and improving road safety.

The test lays an important foundation in Smart Mobility, offering enhancements in road safety and efficiency, as well as taking the next step towards the future development of autonomous vehicles.

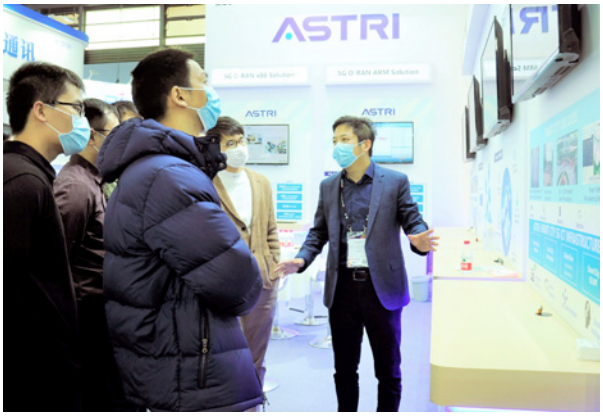
ASTRI is an active participant in all aspects of the Hong Kong SAR Government's Hong Kong Smart City Blueprint 2.0, published last December, as well as its earlier iteration in December 2017. With the support of the Innovation and Technology Commission and the Transport Department, ASTRI has been taking the initiative to promote Smart Mobility through its C-V2X related projects.

The launch ceremony was attended by Ms Rebecca Pun, JP, Commissioner for Innovation and Technology, Mr Michael Law, Assistant Commissioner for Transport, Ir Sunny Lee, JP, Chairman of ASTRI, Dr Martin Szeto, Acting Co-CEO cum Chief Operating Officer of ASTRI, Dr Lucas Hui, Acting Co-CEO cum Chief Technology Officer of ASTRI, Dr Justin Chuang, Vice President (Communications Technologies) of ASTRI, and partners who have contributed to the project.

The officiating guests were invited to take a ride in the test vehicle to personally experience the advantages that C-V2X will bring, which include safer, more reliable and more convenient journeys for road users.

Connected 5G for Impact: ASTRI presents 5G innovations at Mobile World Congress Shanghai 2021

ASTRI showcased a portfolio of its cutting-edge 5G technologies at MWC Shanghai 2021 in February. Adopting the theme of "Connected 5G for Impact", ASTRI demonstrated technologies and innovations that will enhance the competitive strength of enterprises in Hong Kong, the Greater Bay Area and around the world. These technologies included:



5G

- O-RAN x86 Solution
- O-RAN ARM Solution
- Industrial IoT
- OpenUPF
- SA Core Network
- Smart City Infrastructure
- Smart Mobility – Cellular Vehicle-to-Everything (C-V2X) Pilot in Hong Kong

MWC Shanghai 2021 was a three-day event hosted by the GSMA. It is one of Asia's largest and most influential Information and Communications Technology events, showcasing and exploring the impact of next-generation technologies across a variety of industries, as well as trends in the market. This year's event focused on how technology and connectivity can lead the global recovery.

ASTRI showcases cutting-edge 5G technologies at PT EXPO China 2020 in Beijing

ASTRI participated in the PT EXPO China 2020 in Beijing from 14-16 October, where it demonstrated a range of its 5G technologies under the theme of "Promote 5G for an Intelligent Future". These technologies included:

5G O-RAN Solution	Industrial IoT applications
5G OpenUPF	Ground-breaking Terabit 5G Standalone Core Network
AR Intelligent Maintenance	IoT Blockchain

5G Smart Mobility solution

The PT EXPO China 2020 is hosted by the Ministry of Industry and Information Technology. The event was held in an exhibition space of approximately 30,000 square metres, hosted more than 300 well-known Chinese and foreign exhibitors, and had more than 800 speakers share their thoughts in nearly 50 forum sessions.

Building the tech ecosystem

ASTRI sets up joint innovation lab with railway operator for smarter railway

ASTRI and the MTR Corporation signed a Memorandum of Understanding in April 2020 to establish the MTR ASTRI Joint Railway Innovation Laboratory. The initiative will see ASTRI explore innovations that will apply its award-winning technology solutions in a collaboration with MTR Corporation, helping the railway system in Hong Kong become smarter and safer.

ASTRI and CITIC Telecom CPC Transform Customer Experience with AR-based Operations and Maintenance Solution

ASTRI and CITIC Telecom International CPC Limited (CITIC Telecom CPC), a wholly-owned subsidiary of CITIC Telecom International Holdings Limited, introduced a jointly developed Augmented Reality (AR) solution designed to transform field engineers' operations and maintenance processes in September.

The DataHOUSE AR Remote Hand Service (AR Remote Hand), which leverages wearable AR technology, has introduced CITIC Telecom CPC's field engineers and customers to a new era by slashing the time and cost of troubleshooting and maintenance.

The AR Remote Hand employs AR glasses to stream real-time intelligence, troubleshooting logs, graphics and encrypted data from back-end systems to on-site engineers and maintenance staff, boosting field productivity by up to 50%. When wearing the glasses, field engineers do not have to stop their work to communicate with back-end support teams via a laptop or phone, or refer to a paper manual. The AR Remote Hand provides field engineers with a heads-up display for remote visualisation in real time as they install, maintain or troubleshoot equipment, thus speeding up the whole process.

In their collaboration, ASTRI worked on the software platform and customisation, while CITIC Telecom CPC provided related information and opinions based on business cases of various scenarios and applications.

ASTRI publishes white paper on alternative credit scoring of Micro, Small and Medium-sized Enterprises (MSMEs)

Commissioned by the Hong Kong Monetary Authority (HKMA), ASTRI published a white paper titled "Alternative Credit Scoring of Micro-, Small and Medium-sized Enterprises (MSMEs)" in November. The paper outlined how FinTech could be adopted to collect and utilise alternative data to evaluate borrowers' creditworthiness, and thus improve the scale of banks' existing MSME financing services and enhance access to finance for MSMEs.

MSMEs account for more than 98% of the business establishments in Hong Kong and employ about 46% of the workforce in the private sector. Yet many face significant challenges in securing a bank loan due to their lack of financial information and the significant burden faced by banks in conducting credit assessments and monitoring related processes.

The white paper set out how Hong Kong could take advantage of artificial intelligence and machine learning to collect a wide variety of data from many sources to assess the creditworthiness of MSMEs, including cash flow, point-of-sale transaction records, utility bill payments and even information from online accounting software programs. The paper laid out the technological components needed to handle and process the alternative data used in alternative credit scoring. Further, it proposed building an effective alternative credit scoring ecosystem for banks and providers of alternative data in Hong Kong that can handle data management, credit assessment automation, and monitoring. It also suggested further steps that need to be taken by ecosystem players, and offered a roadmap for the adoption of alternative credit scoring in Hong Kong.

ASTRI enhances functionalities of Smart Pet Dog as an elderly companion

ASTRI introduced a smart pet dog which can cater to the needs of the elderly, during the four-day Gerontech and Innovation Expo cum Summit 2020 from 19-22 November. The smart dog can chat in Cantonese and Mandarin and even remind the elderly to take their medicine if the Bluetooth function is enabled.

The smart pet dog originally had Japanese language capabilities. ASTRI introduced it to Hong Kong with a view to enhancing and localising it to suit the needs of the elderly here. About 200 to 300 sets of Cantonese and Putonghua dialogues will be added to the smart pet dog so that it can "listen" to the elderly in Hong Kong and the Mainland and respond accordingly.

GERONTECH 樂齡科技博覽暨高峰會
Gerontech and Innovation Expo cum Summit

CityU Chengdu Research Institute and ASTRI sign MOU to strengthen collaboration

ASTRI and the City University of Hong Kong Chengdu Research Institute (CityUCRI) signed a memorandum of understanding (MOU) on December 2, with a view to promoting the close collaboration of industry, universities and research institutes within the "Guangdong-Hong Kong-Macao Greater Bay Area – Sichuan Province".

In accordance with the MOU, ASTRI and CityUCRI will cooperate in three major areas: communications technologies, artificial intelligence and big data analytics, and integrated circuits and systems. The parties plan to build a scientific research collaboration platform, hold regular academic forums in professional fields, jointly promote the implementation and commercialisation of their scientific and technological achievements, and cultivate technological talents. The goal is to deepen the scientific exchanges and strengthen complementary advantages and resource sharing, creating mutual benefits for Sichuan and Hong Kong.

Both parties also established a three-year cooperation plan which includes holding large-scale exchange activities to showcase the scientific research outcomes of ASTRI and CityU to Mainland enterprises, and promoting the commercialisation of their scientific research outcomes. When appropriate, ASTRI and CityU will jointly apply for Sichuan Province scientific research projects. The parties also plan to establish a joint laboratory or a knowledge transfer centre at CityUCRI.

Partnership architect and innovation enabler

ASTRI launched Graduate Programme 2020, giving talented students a unique opportunity to launch career in an R&D environment

ASTRI launched its first Graduate Programme 2020, offering university graduates from 2019-20 a unique opportunity to begin a career in the technology research environment. The initiative was a timely response to soaring unemployment in the city.

The Graduate Programme offered one-time, two-year full-time job positions with potential job rotation. It opened doors for Hong Kong's new graduates from universities and higher education institutes to work across a wide range of disciplines in technology research and corporate development, alongside world-class professionals and in a multi-cultural environment.

ASTRI and the University of Hong Kong to nurture FinTech talent of the future

ASTRI signed a Memorandum of Understanding (MOU) with the University of Hong Kong (HKU) in September 2020, making a joint commitment to nurture the talent of tomorrow and create the FinTech expertise of the future.

The agreement saw both parties develop the Technology Oriented Practitioner (TOP) programme, a Work-Study Scheme for first-year students enrolled on the MSc programme in FinTech and Data Analytics at HKU, with ASTRI providing paid full-time employment for up to 30 students for a nine-month period and assigning them to one of ASTRI's many ongoing FinTech projects.

The Commissioner for Innovation and Technology Rebecca Pun Ting-ting, JP witnessed the signing ceremony at the University of Hong Kong.

ASTRI and CUHK Pull Together to Launch Smart City Technology Oriented Practitioner Programme

ASTRI signed a memorandum of understanding (MOU) with the Faculty of Engineering of The Chinese University of Hong Kong (CUHK) in March, agreeing to implement a Smart City Technology Oriented Practitioner (TOP) programme for up to 30 master's students.

ASTRI committed to providing paid full-time employment opportunities to enrolled students for a period of four to eight months and to engage them in one of ASTRI's ongoing smart city-related projects, with a view to developing future leaders for smart city transformation.

The TOP programme supports the HKSAR Government's Smart City Blueprint for Hong Kong 2.0 which aims to build Hong Kong into a world-class smart city.

ASTRI's Smart Water technology provides challenge at international mathematics competition

ASTRI's technology was used as one of the challenges at the 2020 International Mathematical Modelling Challenge (IM2C), which aims to nurture STEM talent and innovative entrepreneurship among secondary school students in Hong Kong and the rest of the Greater China region through problem setting, field studies, summer internships and presentation competitions.

Established by the Consortium for Mathematics and its Applications (COMAP, USA) and NeoUnion ESC Organization (NeoUnion, Hong Kong) in 2015, the IM2C is a global innovation contest for secondary school students to explore the application of mathematical modelling in real-life situations to solve problems of importance today.

Using ASTRI's simulated scenarios from the real-life project on Smart Water Data Analysis, the Hong Kong team from Diocesan Girl's School won the Outstanding Award for the 2020 IM2C Greater China Contest, featured in the July issue of the Newsletter of Hong Kong Laureate Forum. The problems set for the IM2C 2020 in Greater China covered a wide spectrum of issues including Smart Water Data Analysis, Credibility in Online News, Grid Frequency Response and Cyber Insurance Incentive Strategy.

The 2020 contest, the sixth IM2C, saw 650 teams from the Mainland, Hong Kong SAR, Macau SAR and Taiwan compete – a tenfold increase since its establishment.

Helping to build a FinTech talent pipeline for Hong Kong

The FinTech Career Accelerator Scheme (FCAS) nurtures Hong Kong's financial and technological talents to meet emerging and evolving needs of the industry. Along with Hong Kong Cyberport and the Hong Kong Science Park, ASTRI is a co-organiser of this scheme, spearheaded by the Hong Kong Monetary Authority. FCAS Participants go through a year-long programme of technical and regulatory training, along with internship placements in Hong Kong and Shenzhen and a gap-year industry placement. More than 500 students from local universities have benefited from the programme since its initiation in 2016.

Cultivating students' interest in sport with the help of technology

ASTRI has partnered with the Hong Kong Jockey Club and the Chinese University of Hong Kong in the 'Fun to Move @JC' initiative, a five-year pilot programme that is developing a sustainable model to enhance physical activity among primary students. The programme aims to improve students' motivation to engage in sports and their efficiency in doing so by prompting systemic changes in their lifelong physical activity attitudes and habits. The initiative, now in its fourth year, aims to serve over 30,000 students from 35 primary schools in Hong Kong and remains on target to meet this goal.

Artificial Intelligence and Big Data (AIBD)

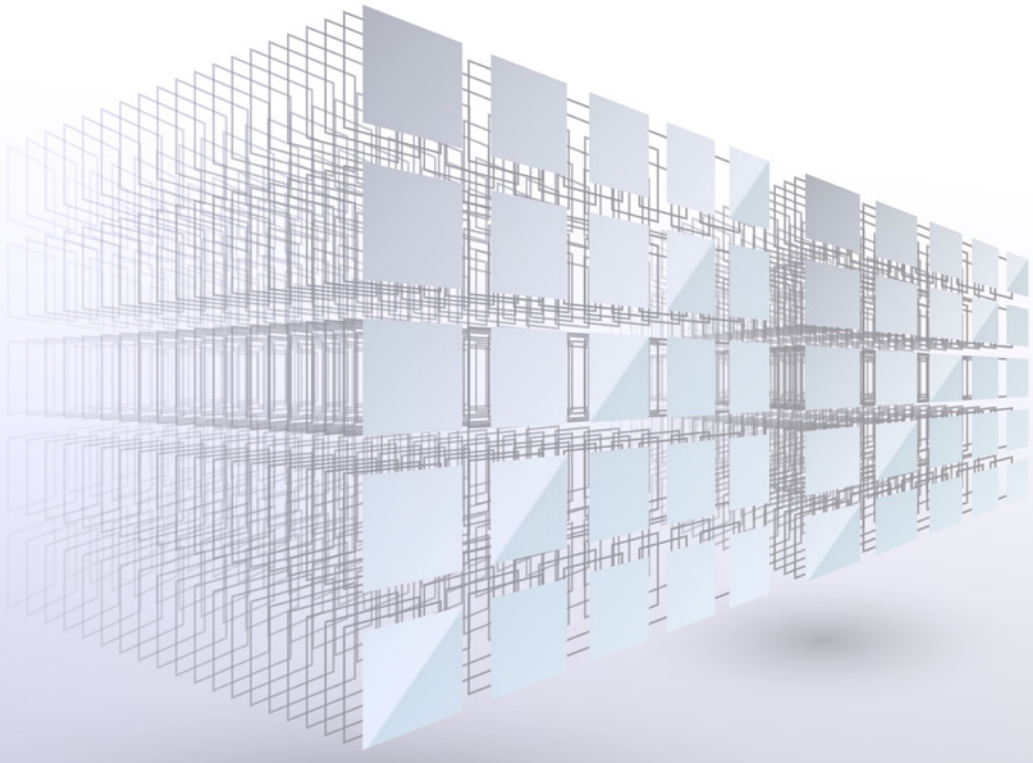
The Artificial Intelligence and Big Data (AIBD) Division conducts applied research addressing real-world problems using Artificial Intelligence (AI) and Big Data (BD). Its work covers theoretical foundations (data processing, computational models, and reasoning mechanisms), system capabilities (including sensors getting data, networks exchanging data, and interaction with people), and application domain technologies. The work of the AIBD Division ranges from data processing (distributed, edge Internet of Things (IoT), blockchain), to computational models (consensus, high performance, quantum computing), to intelligence (analytics, cognitive, linguistics).

Industries served

AIBD Division contributes to many sectors and industries, including banking, manufacturing, government organisations, the disciplined services, and the health sector. The technology platforms, solutions, designs, and development services it provides mean that its partners and customers can focus on their core businesses.

Core Competence Groups

Cloud Computing	Computational Linguistics and Intelligence	Intelligent Cognitive Systems	Smart IoT Analytics & Applications	Cyber-Physical Systems



Cloud Computing (Cloud)

Built on multi-disciplinary research and development in networking, computing, and machine learning, Cloud Computing team provides high performance and large-scale distributed computational platforms that offer efficiency, reliability, performance, and flexibility for a range of cloud computing applications, including communication systems over LoRaWAN, industrial IoT cloud platforms, IoT data analytics, and blockchain.

Computational Linguistics and Intelligence (CLI)

Computational Linguistics and Intelligence team leverages state-of-the-art AI algorithm and machine learning technologies to provide machine perception-related speech recognition, natural language processing, image analysis, and pattern recognition to the industry and key stakeholders.

Intelligent Cognitive Systems (ICS)

Intelligent Cognitive Systems team applies AI, IoT, sensor technologies and big data analytics to the fields of Health Tech and Smart City. ICS focuses on developing technologies targeted at specific Smart Living domains such as healthcare and elderly care, Smart People, and Smart Mobility, in support of Hong Kong SAR Government initiatives.

Smart IoT Analytics and Applications (SIAA)

The Smart IoT Analytics and Applications team develops efficient, secure smart contract solutions in both private and public blockchain networks, for FinTech and Smart City applications. The core technologies involved are cross-chain communication protocols, digital asset tokenisation and life-cycle management, and AI-based security analysis and vulnerability detection algorithms. The team also provides end-to-end IoT data analytics solutions for anomaly detection with the aid of edge computing, LoRa low-power network for sensor grid, and artificial intelligence.

Cyber-Physical Systems (CPS)

Cyber-Physical Systems team analyses the dynamics of physical processes, providing abstractions and modelling, design, and analysis techniques for the integrated whole system. The economic and societal potential of such systems for smart manufacturing and new industrial applications is vast.

Key Technologies

Speech recognition of Cantonese mixed with English and Mandarin	Language processing of Cantonese, Mandarin, and English	Text to speech in Cantonese and Mandarin	Sentiment analysis of tone and text	Chatbot and Voicebot
Edge computing	Image classification	Domain specific language programming	IoT networks simulation/ implementation	Cryptocurrency trading

R&D highlight

A Hong Kong Smart Water Metering Communication Standard and Reference Design

This project involves developing a smart water meter communication standard and its reference design for the demanding environment of Hong Kong's water supplies system. An open Hong Kong Smart Water Meter Communication Standard is being drafted that will enable equipment and software from different smart water meter manufacturers to work together seamlessly and be integrated into the Water Supplies Department's system. A reference design will also be built for a low-energy smart water meter platform for new and existing buildings. In summary, this project focuses on the development of a smart water meter communication standard (technical, communication, security, inspection, and data storage standards) and its reference platform (meter interface unit, data concentration unit, LoRa low-power star network and cloud platform). It will enable commercial manufacturers to build, develop and deploy automatic water meter reading systems for use within Hong Kong's water supplies system.

R&D highlight

AI Analytic Engine providing tailor-made training targeting students with special educational needs (SEN)

This project involves developing a cost-effective SEN software application that will enable non-experts to carry out SEN training. The number of SEN students in mainstream schools in Hong Kong has increased by more than 34% since 2013. SEN students face many challenges. An effective intervention programme usually requires intensive one-on-one training, but tuition fees are high and therapists are in short supply.

ASTRI is building an AI-based Applied Behaviour Analytics (ABA) software application that will enable parents to carry out some training tasks with their SEN children. ABA is a proven solution that promotes desired behaviours and reduces problem behaviours among children with autism spectrum disorder. The AI analytic engine will help speed up the assessment process and enable educational psychologists to create a more efficient Individualised Education Plan (IEP) for each student. Our customer expects the system will help reduce their operation costs by 50% and will enable them to serve many more SEN students.

Other R&D projects

Project	Focus
Intelligent Platform for Fleet Operations	Smart City
Digitalised Elderly Services Platform	Digital Health
Adopting the Digital and Physical Twins Approach for the Realization of Robotic Manipulation System for Manufacturing Assembly Process	Intelligent Manufacturing
Noise Recognition Platform with Decentralized AI for Active Noise Management in HK	Smart City
Automation System for Water Quality Monitoring	Smart City
Trial: Enhancing facility management security through IoT and smart analytics (EFMS)	Smart City
Intelligent Knowledge Management Platform - by AI and NLP for Smart Government	Smart City
Multilingual Speech Transcribing on Specialised Domains	Smart City

Communications (COM)

The Communications Technologies (COM) Division delivers cutting-edge tools and applications based on 5G and other next-generation network solutions. Its innovative applications are helping equipment manufacturers and operators to introduce faster and more intelligent services for network users, benefitting both industries and the community.

Industries served

The Division works closely with agencies of the Hong Kong SAR Government, telecommunication service providers, universities and R&D institutions to deliver market-driven and commercial-quality solutions. It supports Hong Kong's overall Smart City development in terms of standards, solutions and infrastructure, especially in 5G-related technology.

Its Core Competence Groups (CCGs) develop open broadband wireless networks and applications, as well as 5G small-cell infrastructure. They focus on creating new technology infrastructure and platforms for a wide range of sectors and applications. The Division offers end-to-end system solutions across Hong Kong's technology ecosystem.

Core Competence Groups

Baseband Solutions	**Emerging Systems**	**Networking Software**	**Mobile and IoT Platforms**	**Medium Access Control and Intelligent Solutions**

Baseband Solutions (BSOL)

Baseband Solutions team develops industry-leading 5G wireless solutions and reference designs (i.e. technical blueprints for others to copy) for the industry. The team specialises in baseband algorithms, L1-L3 embedded software, digital signal processing (DSP) and field-programmable gate array (FPGA) reference designs based on open platforms. The team is dedicated to developing low-cost, high-quality cutting-edge 4G and 5G radio communications systems for both public and private telecommunication networks. Its technology competences include enhanced mobile broadband (eMBB), ultra-reliable and low latency communications (URLLC), and massive machine-type communications (mMTC).

Emerging Systems (ESYS)

Emerging Systems team develops open platform-based network technologies for 5G cellular systems that increase spectrum efficiency, thus reducing both hardware costs and energy consumption. The group also develops forward-looking radio access technologies that are addressing the needs of new and quickly maturing sectors. These include 4G/5G C-V2X communications and solutions, such as roadside units (RSUs) and in-vehicle units (IVUs) for connected-vehicle applications, wireless technology supporting Unmanned Aerial Systems (drones) connectivity, and mmWave communication for enhanced mobile broadband applications.

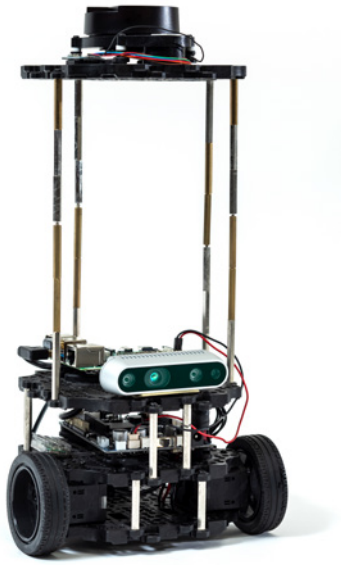
Networking Software (NSOFT)

This NSOFT team is engaged in developing end-to-end networks that leverage next-generation network connectivity to serve Smart Mobility and Smart City infrastructure and applications.

The team's competences include the development of 5G Core Network technology with high throughput packet processing software and network formation – network virtualisation, software-defined networks, and orchestration to allow flexible and manageable 4G/5G/V2X network deployment scenarios.

The team is playing a major role in enabling Smart City infrastructure using the 4G/5G/C-V2X networking solutions with software systems and algorithms to enable smart mobility applications, including connected cars with enhanced road safety, V2X-based traffic management systems, roadside sensing capabilities, enhancing autonomous vehicle safety and more.

The NSOFT team has achieved many technological breakthroughs, including launching one of the world's largest C-V2X public road tests in Hong Kong in 2021 to promote Smart Mobility while enhancing road safety and efficiency, and achieving over 1.3Tbps throughput on 5G Core in 2020. The NSOFT team is actively working with local collaborators on deploying C-V2X for road safety in Hong Kong and applying 5G to enable future Smart City infrastructure.



Mobile and IoT Platforms (MIP)

Mobile and IoT Platforms team develops technologies and total system solutions that enable communication systems to accommodate the vast amounts of network traffic triggered by millions of devices and mobile users, while working cohesively with cloud resources that can scale horizontally instead of vertically. The CCG focuses on developing and advancing proximity, geographic information, and real time telemetric-related technologies for applications such as positioning, navigation, map rendering, sensor data processing, smart distributed gateways, IoT blockchain and advanced IoT tracking systems.

Medium Access Control and Intelligent Solutions (MACI)

The MACI team develops medium access control technologies and conducts technical cooperation and system integration with other CCGs, providing 5G overall solutions for smart factories, smart mobility, smart cities and 5G enterprise networks. The team has a good track record in commercialising wireless technologies and enabling multiple customer tenders for design commercialisation. Extensive collaborations are expected within ASTRI, industry partners, particularly in Hong Kong and the Greater Bay Area, as well as government agencies and public groups.

Key Technologies

- **Easy 5G technologies (5G O-RAN base station, 5G Core, Mobile Edge Computing, Orchestrator)**
- **C-V2X network infrastructure and solution for smart mobility**
- **3D GIS Indoor Navigation, and 5G Edge Rendering of 3D Indoor Map**
- **Long-haul IoT and location service for smart visiting platform**

R&D highlight

Next-Generation Mobile Core for Vertical Applications

This project involves developing pre-5G ("prepare for 5G") mobile core software with capabilities that include B-TrunC and Control User Plane Separation (CUPS).

The use of mobile communications, mobile broadband and voice-recognition technology with applications is a global industry trend. Release 14 of the 3rd Generation Partnership Project (3GPP) introduced CUPS, an architecture enhancement that enables flexible network deployment and operation, by distributed or centralised deployment and independent scaling between control plane and user plane functions.

B-TrunC is the communications standard in China for mission-critical trunking communications. MulteFire is a new standard that operates in unlicensed and shared band LTE technologies. The project team has been working with the industry to provide specialised mobile core networks to support applications such as B-TrunC, MulteFire, One-to-many multi-media trunking, and more.

The capabilities developed in this project enable smoother migration to the 5G core network. The project team is collaborating with wireless and network equipment vendors on the deployment of the licensed technologies.

R&D highlight

5G Evolution for Mobile Broadband

The 3rd Generation Partnership Project (3GPP) defines the 5G standard, which is structured as a set of releases. The first 5G standard was Release 15. Release 16, in 2020, covered the necessary technologies for achieving the 5G requirements defined by the International Telecommunications Union (ITU) International Mobile Telecommunication system 2020 (IMT-2020). These included spectral efficiency, interference mitigation for flexible duplexing, handover interruption reduction and positioning support. It also introduced new physical layer core algorithms and control procedures.

ASTRI's project will deliver a new Release 16 enhanced mobile broadband (eMBB) base station design, which will support new multiple-input and multiple-output (MIMO) beam selection for enhancing beamforming accuracy and efficiency, multiple transient receptor potential (Multi-TRP) channels to enhance cell edge terminals' throughput and reliability, cross-link interference mitigation for flexible duplexing, dual-connectivity based handover to reduce interruption, and 5G positioning.

The deliverables of this project will contribute to industries developing IMT-2020 compliant base station solutions through various business models or technology transfers.

R&D highlight

Adaptation of Cellular Vehicle-to-Everything (C-V2X) Technology in Hong Kong and New Radio Enhanced Vehicle-to-Everything Communications

These two projects are part of ASTRI's Cellular Vehicle-to-Everything (C-V2X) technology in Hong Kong which aims to improve road safety and enhance road efficiency in the future.

The first project will verify the feasibility of deploying C-V2X in Hong Kong and address the technical challenges and solutions from both R&D and other perspectives. The first C-V2X trial on public roads was carried out on a 14km stretch of designated roads in Hong Kong, with the support of the Transport Department and other stakeholders. The trial tested different C-V2X use cases relating to road safety and traffic efficiency, all specific to Hong Kong's deployment considerations.

Vehicle to Everything (V2X) communication – which consists of Vehicle to Vehicle, Vehicle to Pedestrian, Vehicle to Infrastructure and Vehicle to Network communication – has drawn increasing attention as an enabling technology for an Intelligent Transportation System (ITS). The 3rd Generation Partnership Project's (3GPP) Release 16 standard supports advanced V2X use cases and requirements for advanced transportation applications like platooning, advanced driving, extended sensors and remote driving. The 3GPP R16 standardises new V2X physical layer features that only 5G technology can support, such as New Radio Enhanced Vehicle-to-Everything (NR-V2X) communications.

ASTRI plans to develop a standard-compliant NR-V2X Base Station design and a NR-V2X User Terminal design to be installed in vehicles for V2X communications, and a link level simulation framework for developing and verifying the performance of the NR-V2X features.

ASTRI's C-V2X technologies can be applied to enable an ITS and contribute to Smart City development in Hong Kong.

Other R&D projects

Project	Focus
Mobile Core towards Service Based Architecture (5GSBA)	Smart City
Evolution of Mission Critical and Reliable Communications	Smart City/Intelligent Manufacturing
Next Generation Narrow-Band IoT Baseband Solution	Smart City
IoT Blockchain for Data Exchange	Smart City
Long-Haul IoT and Location Services for Smart Visiting Platform	Smart City
Edge Computing Platform for 5G Enterprise	Smart City
5G NR Optimised Heterogeneous Networks	Smart City
Smart City 5G ICT Infrastructure	Smart City
Smart Mobility Roadside Infrastructure	Smart City
5G Mobile Broadband Small Cells	Smart City
5G NR O-RAN for Configurable Network Deployment	Smart City
3D Geographic Information System (GIS), Indoor Navigation, and Feasibility Study on 5G Edge Rendering of 3D Indoor Map	Smart City
5G Standalone (SA) Core Network	Smart City

Cybersecurity, Cryptography and Trusted Technologies (CCT)

The Cybersecurity, Cryptography and Trusted Technologies Division applies advanced technologies to enhance the reliability, protection, and trustworthiness of data in various domains.

Industries served

The division's research expertise is applied across a wide variety of sectors and industries, including banking, insurance, retail, logistics, law enforcement, public services, and telecommunications. Six core competency groups within the division support these industries. One of the division's major goals is to help to position Hong Kong as a premier international FinTech hub.

Core Competence Groups

- Applied Cryptosystems
- Cybersecurity & Analytics
- Data Analytics
- Multimodal Image Analytics
- Multimedia Systems and Analytics
- Secured System Platforms

Applied Cryptosystems (ACS)

The Applied Cryptosystems team explores technologies related to the application of cryptography in different industry sectors. The team's R&D experts develop trusted technologies for privacy preservation, FinTech security, crypto tokens, and multimedia analytics.

Cybersecurity & Analytics (CSA)

The Cybersecurity & Analytics team conducts research on cyber-threat hunting and analysis. In an age where the bulk of business, institutional and personal data is stored online, the increasing frequency and sophistication of cyberattacks poses a major threat to society. To help businesses and the community cope with this, the CSA team applies data analytics, machine learning and AI-powered tools to combat cyber threats, combining human skills with advanced hardware-software capabilities.

Data Analytics (DATA)

The Data Analytics team specialises in developing scalable, real-time big data analytics platforms and advanced AI solutions using deep learning/machine learning technologies to support various industries. The team develops technologies for the whole data lifecycle, from data acquisition to data correlation/transformation, data management, data analytics and visualisation. The team's recent work focuses on AI document analysis for regulatory compliancy, knowledge graphs for crime analytics and intelligent recommendations and time-series and predictive data analytics for fraud detection. These technologies support applications in Fintech, Regtech, digital marketing and Smart City.

Multimodal Image Analytics (MMIA)

The Multimodal Image Analytics team engages in acquiring, analysing and processing multi-modal images. Its technology development covers hardware, firmware, software and algorithms, with algorithms focused on image processing, ML/DL, CV and SLAM. The team's current focus areas include Intelligent Medical Imaging Devices and image CAD, Smart Maintenance, and Intelligent 3D Metrology. The goal is to provide high-performance and intelligent application solutions for partners in Digital Health and Smart City.

Multimedia Systems and Analytics (MSA)

The Multimedia Systems and Analytics team provides solutions across different captured media in multiple dimensions, which are currently being deployed in FinTech, InsurTech and Smart City. Algorithm development covers image/video processing, handwritten character recognition (ICR), artificial intelligence, computer vision, natural language processing (NLP), document analysis and processing, simultaneous localisation and mapping (SLAM) with GPS for urban navigation, face with voice recognition, generation and synchronisation and biometrics authentication. The team's output includes Automated Form/Document Processing System, Automated Content Processing Platform, Fraud Detection for insurance claims, and Character Recognition Engines.

Secured System Platforms (SSP)

Secured System Platforms team develops blockchain system protocols to enhance and optimise blockchain security, performance, and scalability. It also carries out research into hardware accelerators and hardware security for blockchain and IoT systems. The group has served multiple corporations by building robust blockchain platforms for property mortgage, insurance and supply chain. The group is also working on open data and banking development, in support of the Hong Kong Monetary Authority (HKMA) Open Banking API initiative, and is researching AI enabled robotic process automation (RPA) technology to raise financial process efficiency.

R&D highlight

Smart Personal Assistant for Open Banking

This project is building on the HKMA's Open Banking API initiative to provide smart and automated assistance to the bank customers. This initiative encourages banks to publish their APIs for accessing customer bank accounts in their computer systems. With this access, FinTech developers can provide innovative applications including a Smart Personal Assistant platform to serve various customer needs.

Customers can use the Smart Personal Assistant for Open Banking to get personal financial reports and advice. It can also generate a privacy protected credit rating for the customer, while third-party FinTech apps can be added for additional operations.

The secure platform supports user authentication, privacy protection and data protection.

R&D highlight

Deployment environment of Privacy Preserving Profiling Applications for Federated Learning

Although there are considerable benefits in sharing enterprise data with machine-learning technology, there are also concerns over data privacy and compliance. Federated learning is considered the "last mile" in machine learning, with the ability to resolve issues around data privacy. Recent advancements in federated learning can consolidate results from distributed machine learning models in private data sets owned by different enterprises. Yet enterprises remain reluctant to embrace this, due to the lack of application integration support.

This project is designing and implementing an effective application integration software platform to facilitate the deployment of a federated learning network that is compliant with data privacy regulations. It aims to help enterprises to upgrade applications such as credit assessment and anti-money laundering applications so that they use federated learning models rather than individual machine learning models.

This platform will be beneficial for a wide variety of users including financial regulatory authorities, organisations using AI technology, research communities, and the public.

R&D highlight

Customs Crime Analytics System (CCAS) for C&ED

This project is building an all-in-one smart analytics platform to consolidate and mine voluminous data from disparate sources in various formats (both structured and unstructured) and build a crime knowledge base to facilitate enforcement work by the Customs & Excise Department (C&ED).

Every day, C&ED officers need to analyse and correlate huge amounts of information from both internal systems and external sources, such as data from external counterparts, to conduct their enforcement work. This includes case investigations and cross-border risk assessments. Their biggest challenge is a lack of advanced data analytics tools.

This project will also develop artificial intelligence (AI) and predictive models to unveil hidden trends, and predict patterns, relations and anomalies that enable proactive risk management. The platform will assist C&ED in crime detection, case investigation, cargo profiling and intelligence processing.

Other R&D projects

Project	Focus
Deep Text Analysis and NER for Financial Documents	FinTech
Cognitive Robotic Process Automation for Digital Banking	FinTech
3D Metrology Technologies for Cross-Platform Applications	Smart City
Robust Form Recognition Platform	FinTech
Continuous Intelligence Platform for Actionable Multimedia Analytics	FinTech
Processor Module Design with Agile Hardware Development Technology to Improve Design Efficiency	ASIC

Integrated Circuits and Systems (ICS)

The Integrated Circuits and Systems (ICS) Division develops high-value adding technologies for power and radio frequency (RF) related ICs and Systems. These are helping to enhance local industrial competitiveness in Smart City and Industry 4.0. The division specialises in advanced semiconductor technologies, covering 3rd generation semiconductor devices, AI chips, wireless IoT chips, 3D integration, Silicon Carbide (SiC) and Gallium Nitride (GaN) based new power and energy storage systems, and more. ICS is also a key constituent of the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC), which is located within ASTRI and focuses on Application Specific Integrated Circuits research, technology transfer, and talent training.

Industries served

ICS caters to various technology-centric vertical markets, including data centres, robotics, new energy vehicles, power and charging systems and high-speed trains.

Core Competence Groups

3D Integration	Smart Power and Energy Systems	RF Systems	Technology Co-Design	Machine Learning Platforms (MLP)

3D Integration (3DI)

The 3D Integration group provides advanced solutions for power electronics products, specialising in Silicon Carbide (SiC) and Gallium Nitride (GaN) based devices, control/driver ICs, packages, modules, and subsystems. These are used in 5G networks and infrastructure, data centres, industrial robots, new energy vehicles, power and charging systems, and railway transportation.

Smart Power and Energy Systems

The Smart Power and Energy Systems group develops innovative new SiC- and GaN-based power and energy storage technologies that are enhancing energy efficiency and optimising power usage in Smart City and industrial applications.

RF Systems

The RF Systems group provides wireless connectivity chips with a state-of-the-art low power integrated circuit design for IoT applications. Its solutions are used in areas that include Bluetooth Low Energy (BLE) supporting audio streaming applications (LE Audio), Narrowband Internet of Things (NB-IoT) and 5G IoT (NR-light). All these technologies enable a wide range of connectivity solutions for personal, industrial and other systems, facilitating Smart City and Smart Home development.

Technology Co-Design

The Technology Co-Design group develops and models advanced semiconductor devices. It provides solutions to protect against electrostatic discharge (ESD),

semiconductor sensors, and other novel semiconductor devices. Its technological core competences include virtual fabrication and compact model extraction, which make it possible to virtually develop processes and devices in an optimised, efficient manner. The group has developed comprehensive IP portfolios for device design and modelling, including area-efficient ESD structure IPs, process independent scalable input/output (I/O) libraries, and Berkeley Short-channel IGFET Models (BSIM). It collaborates closely with IC foundries and design houses in the development of unique advanced devices and model IPs using Complementary Metal-Oxide-Semiconductor (CMOS) technologies. It has successfully delivered device and model IPs from 0.5nm to 16nm FinFET processes.

Machine Learning Platforms (MLP)

The Machine Learning Platforms group develops AI chips for image processing and computer vision applications. The team has a strong specialisation in Deep Neural Network (DNN) optimisation, dataflow neural network processor design, and AI algorithms. It also innovates hardware-enabled solutions for intelligent video production, smart cameras, smart locks and various smart devices.

Key Technologies

DC Building | Wireless Power Transfer | Energy storage systems | Smart power hubs | High-density power modules

FinFET | NB-IoT | RF Transceiver | AI chips

R&D highlight

Next Generation Power Delivery Solution for Smart City Applications

This project is developing a series of generic platform technologies at the component, module and sub-system levels. The aim is to create an ultra-high density and efficient AC-DC power delivery solution that addresses the coupled electrical-thermal challenges faced by next generation Smart City applications, utilising the following key platform technologies:

(1) A totem-pole bridgeless topology that leverages the merits of GaN switching devices – such as low drain-source on resistance (RDS(on)), a high operating speed and zero reverse recovery loss – with a novel control algorithm (TP-GaN), to break through the efficiency limits of silicon devices and reduce loss at the power stage by up to 50%;

(2) A brand-new Modularised Power Razor Architecture (M-PRA) and 3D Magnetic Integration (3D-MI) technology developed in a previous seed project, to double the system-level power density; and

(3) Flatness and conduction-driven product architecture to improve thermal performance by 30%.

The proposed platform technologies in this project may be suitable for data centres and other smart city applications where AC to DC power delivery is desired, such as telecommunications, home appliances and consumer electronics. Our final target is to provide not only a technology platform but also a high efficiency and high-density power delivery solution beneficial to all Smart City applications worldwide.

R&D highlight

SiC-based Power Supply System for Smart Building Application

This project involves developing a platform to power smart buildings by DC instead of AC, enabling significant power saving. Although many appliances within buildings already use DC power, the buildings themselves are still powered by AC, requiring a conversion process that results in an incremental loss of power due to inherent inefficiencies.

DC power systems rely on centralised, more efficient devices to convert AC to DC power and then distribute to various loads, reducing energy loss dramatically.

ASTRI is building a SiC-based power supply system platform with key features that include an adaptive multilevel converter (AMC) structure to achieve 97%±0.3% efficiency without a fan, a solid-state DC circuit breaker (SDB) with fault identification in microseconds (μs), and preventative maintenance via an online capacitor diagnosis (OCD).

The project team will also conduct theoretical analysis with the assistance of computer simulation and iterative prototyping throughout the project.

It is anticipated that DC building power infrastructure technologies can reduce electricity loss by 25%-67% and cable costs by about 40% compared to existing AC building infrastructure.

R&D highlight

Sensor Hub SoC Embedded with NB-IoT Connectivity

This project is developing a sensor signal processing (SSP) system-on-chip (SoC) platform embedded with Narrowband Internet of Things (NB-IoT) connectivity to provide a compact, low-cost solution in support of the huge demand for Smart City IoT sensing applications.

Several key technologies will be developed, including reconfigurable sensor interfaces, low-power analogue-to-digital converters (ADC) with scalable resolution, power management units (PMU), sensor drivers and light-emitting diode (LED) drivers, and embedded digital signal processing (DSP) algorithms for data processing and NB-IoT connectivity.

The sensor interface, low-power ADC, DSP algorithm, NB-IoT connectivity and module IPs can all be licensed to the industry, helping customers to capture a share of the huge IoT market.

This project will greatly help Hong Kong embrace a leading role in IoT, and will provide local integrated circuit design houses, IoT solution vendors, original equipment manufacturers (OEM) and original design manufacturers (ODM) with a distinct competitive edge.

Other R&D projects

Project	Focus
Eco-Friendly Power System for 5G Applications	Smart City
Hardware Enabled Privacy and Security Technology for Smart Home	ASIC
Next Generation SiC-based Matrix Converters	ASIC
GaN-based High-density Power Module for Next Generation Power Conversions	ASIC
Cross Platform IO Design for FinFET Technology	ASIC
Visual-based Heart-rate Monitoring	Digital Health
Architecture for Wireless Connectivity SoC in Next Generation Capsule Endoscopy	Digital Health
RISC-V Based Architecture for NB-IoT Applications	ASIC
Multi-phase Power Management IC for GaN-based Power Converters	ASIC
Intelligent-ISP for Video Enhancement under Extreme Light Conditions	ASIC

Internet of Things and Sensors (IoTSEN)

The Internet of Things and Sensors (IoTSEN) Division has three core competence groups that develop and commercialise market-driven solutions. It has accumulated more than 200 granted invention patents and made 160 technology transfers to the industry. In recent years, IoTSEN has moved into new areas such as deep learning-based defects classification technology for intelligent manufacturing, palm fusion biometric sensing technology for security control, and mini-spectroscopy technology for smart living.

Industries served

IoTSEN Division serves many different industries in Hong Kong, the Greater Bay Area and beyond. Its sophisticated sensing and optical solutions, which enable automation and can boost productivity, support smart factories and a wide range of smart city applications. Its industrial business partners include tier-1 manufacturers of mobile phones, electrical and optical components, and head-mounted display products, along with Mainland and local enterprise companies and new start-ups looking for sensing solutions for smart security control, smart education, and smart living. The division has also brought efficient solutions to some local government departments.

Core Competence Groups

Intelligent Machine Vision	Emerging Sensing and Display System	Sensing Devices and Integration

Intelligent Machine Vision (IMV)

Intelligent Machine Vision team focuses on vision technology. It deals with advanced and miniaturised optical engines, as well as image understanding and deep learning algorithms. It works with technologies such as Automatic Optical Inspection (AOI) and high-precision 3D Metrology, Automated AI generation systems, intelligent industry robot vision and cognition, and medical and healthcare image sensing.

Emerging Sensing and Display System (ESDS)

Emerging Sensing and Display System team develops smart devices for various applications. It focuses on diffractive and holographic optics for display and sensing, human-centric sensing fusion for biometrics and human machine interaction (HMI), and next generation mixed reality (MR) displays.

Sensing Devices and Integration (SDI)

Sensing Devices and Integration team develops integrated optical modules for environmental sensing and for use in manufacturing. Three major technological platforms are being explored by this team: sensing devices and module integration for environmental sensing, hyperspectral imaging for industrial inspections, and smartphone-based spectroscopy.

Key Technologies

- Biometric sensing devices for access & security control
- Diffractive nanostructures for anti-counterfeit solutions
- Augmented reality (AR) display technologies for head-mounted displays (HMDs)
- Human Centric Sensing Fusion platform
- Mobile spectroscopy for environmental sensing and personal everyday applications
- High-resolution and high-speed area confocal technology for biomedical uses (such as dental classification, tumour detection, eye examinations, new material classification, initial diagnosis of Alzheimer's disease, etc.)
- Deep-learning-based software platform for defect detection and classification
- Flexible display inspection system for OLED/Miro-LED lighting-on tests
- Intelligent 2D/3D Eye-in-Hand (EiH) visual sensing module for industry robots
- Automated AI generation system for quality inspection & automatic pick-&-place

R&D highlight

Eye-in-hand Flexible Visual Inspection System (EiH)

This project has developed a 2D and 3D Eye-in-Hand flexible inspection platform with important features that include hybrid light field illumination, one-shot multi-illumination control for image capture, and 3D EiH measurement and defect inspection algorithms. The platform solves problems that can arise when inspecting free form surfaces, and enables automatic surface inspection of products with a complex shape.

Some of these technologies have been applied to different industries and deployed in customers' factory production lines. They include optical isolator surface inspection for O-Net Communications, a 3D illumination and image capture optical system for inspecting small and large objects and a high-precision 3D measurement optical inspection module for Shenzhen InnoMaxim, and ceramic substrate surface defect inspection for InfoBright.

The project has received an industry contribution of HK$4.9M, equivalent to 27.7% of the total project budget, and ASTRI has successfully transferred the technologies developed to its industry partners. The team has received industry recognition when showcasing the technologies at exhibitions and forums. In addition, the team partnered with O-Net Communications, an industry contributor in this project, in the Hong Kong Awards for Industries (HKAI) 2019 for its "Fast Multi-Focus Automatic Inspection Equipment for Optical Communication Components", which won a Certificate of Merit in the Equipment and Machinery Design category. The team is now integrating the existing platform to create more applications for wider adoption by manufacturers.

R&D highlight

Biometric Sensing Fusion (BSF) for AR/VR Display

Head mount displays (HMDs) will act as next generation information providers. Using eye-gazing and iris identification technology, this project delivered a large field of view (FOV) see-through HMD solution to a tier-1 communication device manufacturer and a local STEM education company.

The solution enables users to "point and click" with their eyes, freeing up both hands for other tasks such as driving or operating industrial machinery. This technology can be implanted in wearable display devices intended for a wide variety of markets, including education, training and design. A large FOV see-through HMD with internal and external sensing could also be used in public places such as airports, exhibition centres and museums, to support the development of Hong Kong's tourism and exhibition industries.

R&D highlight

Noncontact Healthcare Multimeter (NCTHM)

Besides designing and constructing a portable, affordable and broad spectral range Raman device with multi-excitation sources, this project also delivered a complete prototype of an embedded optical system with a programmable spectral range in 200-3600 cm-1, a resolution of 2 cm-1 and a control and analysis algorithm, ready for field testing. It also delivered a performance verification of ASTRI's Raman spectrometer, which was originally designed to measure multiple pesticides on food, including Chlorpyrifos, Malathion and Carbofuran, with an alarm threshold of 10 ppm.

The Raman device has since been adapted to quickly test other materials, such as jewellery or health products. The COVID-19 pandemic made regulating and managing many healthcare materials, such as alcohol-based hand sanitiser, particularly challenging, and there was an urgent need for an easy-to-use device that could quickly screen such products. In the longer term, this project will also further promote ASTRI's Raman device and enhance opportunities for product commercialisation.

Other R&D projects

Project	Focus
Flexible Display Inspection System (FDIS)	Intelligent Manufacturing
Confocal spectral image sensing technology	Intelligent Manufacturing/ Digital Health
Feasibility study on Diffractive Optical System for Anti-Counterfeit	Smart City
Diffractive & Holographic Optics for See Through AR Display (DHOD)	Smart City
Portable Remote-gas-sensing Device for Firefighters	Smart City
Integrated Smart Inspection and Identification System for Jewellery and Antiques	Smart City
Feasibility Study of Active Illumination Enhanced Hyperspectral Imaging Platform	Smart City

Engaging with the Community

Key visits to the ATC during FY 2020/2021

Hong Kong Exchanges and Clearing Limited

17 November, 2020

Hong Kong Examinations and Assessment Authority

1 December, 2020

Deputy Commissioner for Innovation and Technology

8 February, 2021

Liaison Office of the Central People's Government

15 March, 2021

Electrical and Mechanical Services Department

17 March, 2021

Key Performance Indicators

Level of Industry Income	2020-2021 Target	2020-2021 Actual
Industry Contribution (HK$ million)	90.91	56.00 *
Industry Income (HK$ million)	93.70	83.11 *
Level of Income Received from the Industry [1]	34.8%	34.4% *
R&D Projects		
Number of on-going R&D Projects as at end of the reporting period	74	69 *
Number of on-going R&D projects as at end of the reporting period involving industry participation	41	34 *
Number of companies participating in these on-going R&D projects	98	91 *
Utilisation of research output of ITF-funded R&D projects		
Number of licensing agreements signed	28	21 *[2]
Number of contract research projects undertaken[3]	58	56 *[4]
Other performance indicators		
Number of patents filed (Number of inventions)	66 (33)	66 (33) [5]
Number of patents granted	55	57
Number of academic/ industry awards	N.A.	26

Reasons for KPI not meeting the targets

* Due to impacts of COVID-19, it took longer time to sign agreements with industry partners and get ITF platform projects approved in FY2020/2021.

[1] Level of income received from the industry (%) is calculated by

$$\frac{\text{Industry Contribution Pledged } \hat{} + \text{Other Source of Financial Contribution Pledged}\hat{} + \text{Commercialisation Income Received}^*}{\text{Approve Project Expenditure } \hat{}} \times 100\%$$

^ Excluding public sector trials projects, seed projects and public sector platform projects with sponsorship waived by CIT.

* Commercialisation income received refers to income arising from licensing, contract services, royalties and others (e.g. sale of IPs etc.) but excluding those from public sector trials projects, seed projects and public sector platform projects with sponsorship waived by CIT.

[2] The number of licensing agreements signed has recorded an increase of 31% from 16 in FY2019/2020.

[3] Referred to projects in which a company pays the full costs for the project.

[4] The number of contract research projects undertaken has been on a rising trend since Q1 FY2020/2021. Growth of this number was also recorded quarter-on-quarter during FY2020/2021.

[5] The number of patents granted and filed in Hong Kong in FY2020/2021 are 1 and 22 respectively.

Financial Report

Overview

For 2020-21 financial year, the consolidated income and expenditure of ASTRI amounted to HK$565,384,926 and HK$574,265,342 respectively, resulting in a deficit of HK$8,880,416.

The funds from the Government comprised HK$171,361,547 from recurrent subvention, HK$7,869,402 from ITF for reimbursement of administrative overheads, HK$227,532,108 from ITF project funds ("ITF"), HK$1,735,224 from ITF General Support Programme ("GSP"), HK$15,955,768 from ITF Public Sector Trial Scheme ("PSTS"), HK$25,297,240 from ITF Research Talent Hub, HK$23,917 from the Ministry of Science and Technology of the People's Republic of China and HK$9,489,445 from ITF for Chinese National Engineering Research Centre for Application Specific Integrated Circuit System (Hong Kong Branch). In 2020-21 financial year, the income from the industry amounted to HK$103,766,420. The total administrative expenses amounted to HK$192,044,233 (comprised of administrative expenses of HK$190,821,971 and finance cost of HK$437,857 under subvention and administrative expenses of HK$784,405 funded by accumulated surplus from other income), which represented an increase of HK$14,929,140 (8%) compared with the previous year.

ASTRI's operation remained steady with prudent financial management throughout the year. The total expenditure of the ITF, GSP and PSTS projects amounted to HK$328,740,335, of which 75% of the expenditure was spent on manpower and 25% of the expenditure was spent on equipment and other direct costs.

The total expenditure mainly represented the actual cash outflow incurred during the year for 82 full projects, 40 seed projects, two GSP projects and six PSTS projects. Meanwhile, the expenditure relating to Research Talent Hub amounted to HK$25,297,240, which represented the actual cash outflow of salary payment for research talent engaged in 44 full projects and 14 seed projects.

The consolidated financial statements of ASTRI for the year ended 31 March 2021 have been audited by independent auditors with unqualified audit opinion, an extract of the Consolidated Statement of Income and Expenditure, Consolidated Statement of Comprehensive Income and Consolidated Statement of Financial Position are set out on pages 66-69.

Consolidated Statement of Income and Expenditure and Comprehensive Income		
Year ended 31 March 2021	**2021 (HK$)**	**2020 (HK$)**
SUBVENTION		
Income from Government subvention	171,361,547	146,215,191
Administrative expenses	(190,821,971)	(166,527,764)
Finance cost	(437,857)	(736,571)
Deficit on subvention	(19,898,281)	(21,049,144)
FUNDING SUPPORT FROM INNOVATION AND TECHNOLOGY FUND		
Reimbursement of administrative overheads	7,869,402	-
	(12,028,879)	(21,049,144)
PROJECT FUNDING FROM INNOVATION AND TECHNOLOGY FUND AND INDUSTRY CONTRIBUTIONS		
Project fund income		
- Innovation and Technology Fund	227,532,108	269,001,346
- Industry contributions	82,317,235	85,966,025
Project expenditure	(309,849,343)	(354,967,371)
Balance on project funding	-	-
Project fund income - General Support Programme		
- Innovation and Technology Fund	1,735,224	1,284,165
- Industry contributions	1,200,000	2,400,000
Project expenditure	(2,935,224)	(3,684,165)
Balance on project funding	-	-
Project fund income - Public Sector Trial Scheme		
- Innovation and Technology Fund	15,955,768	3,661,969
Project expenditure	(15,955,768)	(3,661,969)
Balance on project funding	-	-
Project fund income – Research Talent Hub		
- Innovation and Technology Fund	25,297,240	17,092,030
Project expenditure	(25,297,240)	(17,092,030)
Balance on project funding	-	-
PROJECT FUNDING FROM MINISTRY OF SCIENCE AND TECHNOLOGY OF THE PEOPLE'S REPUBLIC OF CHINA		
Project fund income	23,917	535,396
Project expenditure	(23,917)	(535,396)
Balance on project funding	-	-

Consolidated Statement of Income and Expenditure and Comprehensive Income (continued)		
Year ended 31 March 2021	**2021 (HK$)**	**2020 (HK$)**
FUNDING SUPPORT FROM INNOVATION AND TECHNOLOGY FUND FOR CHINESE NATIONAL ENGINEERING RESEARCH CENTRE FOR APPLICATION SPECIFIC INTEGRATED CIRCUIT SYSTEM (HONG KONG BRANCH) ("CNERC-ASIC")		
Expenditure incurred in relation to Funding Support from Innovation and Technology Fund	(9,489,445)	(9,349,478)
Amount for reimbursement	9,489,445	9,349,478
	-	-
RESERVE FUND		
Reserve Fund - income	2,353,855	1,287,715
Reserve Fund - expenditure	(2,353,855)	(1,287,715)
	-	-
OTHER INCOME/(EXPENSES), NET		
Other income	20,249,185	23,906,806
Other expenses	(14,340,038)	(24,376,805)
Other income/(expenses), net	5,909,147	(469,999)
AMOUNT RETURN TO THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION	**(2,742,012)**	**(3,412,961)**
DEFICIT BEFORE TAX	(8,861,744)	(24,932,104)
INCOME TAX EXPENSE	(18,672)	(14,360)
DEFICIT FOR THE YEAR	**(8,880,416)**	**(24,946,464)**
OTHER COMPREHENSIVE INCOME/(LOSS) THAT MAY BE RECLASSIFIED TO SURPLUS OR DEFICIT IN SUBSEQUENT PERIODS		
Exchange differences arising on translation of foreign operations	**71,916**	**(62,821)**
TOTAL COMPREHENSIVE DEFICIT FOR THE YEAR	**(8,808,500)**	**(25,009,285)**

Consolidated Statement of Financial Position

31 March 2021	2021 (HK$)	2020 (HK$)
NON-CURRENT ASSETS		
Property, plant and equipment	10,281,928	15,755,378
Right-of-use assets	20,737,117	43,986,131
	31,019,045	**59,741,509**
CURRENT ASSETS		
Accounts receivable, other receivables, contract assets, prepayments and deposits	16,350,716	32,870,291
Amount due from the Government of the Hong Kong Special Administrative Region	36,141,977	25,984,036
Tax recoverable	1,215,326	1,215,326
Cash and cash equivalents	352,161,228	260,094,956
	405,869,247	**320,164,609**
CURRENT LIABILITIES		
Accounts payable, other payables and accruals	88,088,316	86,757,923
Deferred government grants	11,214,830	10,826,673
Receipts in advance	240,587,452	158,538,317
Amount due to the Government of the Hong Kong Special Administrative Region	3,227,702	1,257,708
Lease liabilities	17,894,571	22,100,460
Tax payable	16,489	13,983
Provision	11,460,469	-
	372,489,829	**279,495,064**
Net Current Assets	**33,379,418**	**40,669,545**
Total Assets Less Current Liabilities	**64,398,463**	**100,411,054**
NON-CURRENT LIABILITIES		
Lease liabilities	609,001	16,352,623
Provision	-	11,460,469
	609,001	**27,813,092**
Net assets	**63,789,462**	**72,597,962**
EQUITY		
Share capital	2	2
Reserves	63,789,460	72,597,960
Total equity	**63,789,462**	**72,597,962**

Note:

These financial statements have been prepared in accordance with Hong Kong Financial Reporting Standards (which include all Hong Kong Financial Reporting Standards, Hong Kong Accounting Standards and Interpretations) issued by the Hong Kong Institute of Certified Public Accountants, accounting principles generally accepted in Hong Kong and the Hong Kong Companies Ordinance. They have been prepared under the historical cost convention and are presented in Hong Kong dollars ("HK$").

The financial information relating to the years ended 31 March 2021 and 31 March 2020, included in the Consolidated Statement of Income and Expenditure and Comprehensive Income, and the Consolidated Statement of Financial Position set out on pages 66-69, is not part of the Company's statutory consolidated financial statements for those years but is derived from them. Further information relating to those statutory financial statements required to be disclosed in accordance with section 436 of the Hong Kong Companies Ordinance is as follows:

As the Company is a private company, the Company is not required to deliver its financial statements to the Registrar of Companies and has not done so.

The Company's auditor has reported on the consolidated financial statements of the Group for both years. The auditor's reports were unqualified; did not include a reference to any matters to which the auditor drew attention by way of emphasis without qualifying its reports; and did not contain a statement under sections 406(2), 407(2) or (3) of the Hong Kong Companies Ordinance.

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