

## ASTRI Advances Innovation and Technology by Bridging Collaboration, Communication and Talent

### 應科院通過協作、溝通和人才橋接 推動創新與科技



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The Hong Kong Applied Science and Technology Research Institute (ASTRI) was founded by the Hong Kong SAR Government in 2000 to enhance Hong Kong's competitiveness in technology-based industries through applied research. ASTRI currently has approximately 630 staff and about 70% of them are researchers, of whom a quarter have doctorate degrees.

ASTRI's researchers prioritise projects that are pragmatic and impactful within industries in a bid to improve our society's competitiveness. They offer solutions by first understanding the pain points of clients, whether they are small start-ups, top business conglomerates, government agencies, NGOs, or Fortune 500 companies. Researchers have a mentality of serving the public sector, where projects range from blockchain, cybersecurity, IoT, AI, big data analytics to microchips, sensors, spectrometers, communications, and more. To date, ASTRI has transferred more than 750 technologies to the industry and owns more than 850 patents in the Mainland, the US and other countries.

ASTRI offers integrated technology solutions and cost-effective, reliable 5G equipment for government departments, industries, and institutions to build public or private networks to foster innovations. ASTRI is also at the forefront of 5G development linking local academia and industry partners with top regional and global players to advance innovation & technology (I&T) ecosystem and smart city development in Hong Kong.

As the only 3GPP member of 5G standard in Hong Kong and the largest applied technology research and development centre, ASTRI has established the next-generation communications infrastructure, building Hong Kong into a world-class smart city.

To promote a robust I&T ecosystem, ASTRI serves as three bridges: 1) Bridge of Collaboration – provide the bridge between basic research and commercialisation to turn upstream research from academia into applicable solutions for the market. 2) Bridge of Communication – to raise awareness of ASTRI's support and capabilities to address pain points and make socio-

香港應用科技研究院（應科院）由香港特別行政區政府於2000年成立，其使命是透過應用科技研究，協助發展以科技為基礎的產業，藉此提升香港科技產業的競爭力。應科院現時約有630名員工，逾七成為研究人員，當中四分之一皆擁有博士學位。

應科院致力實踐以市場為導向的科研工作，研究人員會優先考慮行業的實務性及影響性的項目，藉以提高香港的競爭力。不論是小型初創企業、頂尖的商業巨頭、政府部門、非牟利團體，還是《財富》500強的企業，應科院的研究人員都會先了解他們的痛點所在，然後提出適切的解決方案。研究人員要處理的項目範圍十分廣泛，由區塊鏈、網絡安全、物聯網（IoT）、人工智能（AI）、大數據分析至微晶片、感測器、光譜儀、通訊等，他們都抱著以服務公眾利益的態度進行研究。迄今，應科院已將750多項技術轉移至業界，並同時於中國、美國和其他國家/地區擁有超過850項技術專利。

一直以來，應科院為政府部門，不同行業及機構提供集成技術解決方案，以及兼具成本效益和可靠的5G設備，用以構建公共或專有網絡來扶植香港的創科發展。應科院同時處於5G發展的最前沿，肩負聯繫本地學術界和工商業界夥伴與區內及全球的頂尖機構，為推進香港的創科生態系統及智慧城市的發展不遺餘力。

作為香港唯一的3GPP 5G標準的成員和香港最大規模的應用科技研發中心，應科院已建立了新世代通訊基建，致力構建香港成為世界級的智慧城市。

應科院積極推動一個強大健全的創科生態系統，並在這過程中肩負三個橋樑的重任：1) 協作的橋樑 — 連接基礎研究及商業化之間的橋樑，將學術領域的上游研究轉化為適用於市場的解決方案；2) 溝通的橋樑 — 針對應科院解決痛點的能力以惠澤本地社會經濟發展，藉此提高對應科院支援業界及社會的認知；3) 人才培育的橋樑 — 與大

economic contributions to Hong Kong society. 3) Bridge of Talent – to develop various talent development schemes, internship programmes with universities and industry partners to nurture talent in the I&T sector.

## Pioneering Core Networks and Base Stations to Power Smart City Applications

As the largest government-funded applied research institute, ASTRI has a plethora of smart applications. But before these smart applications can be used, core networks must be in place. ASTRI's 5G Standalone (SA) Core Network – developed in collaboration with Intel, has shattered key Terabit-per-second performance barrier, reaching 1.34Tbps live throughput running on Intel's high-volume platform. This milestone enables Intel to deliver quick time-to-market 5G SA core network rollout for its customer partners. Additionally, ASTRI's software-configurable 5G O-RAN Base Station reduces barriers of adoption for public and enterprise networks and achieves significant savings on development costs (approximately 20-50%).

As the pioneer of technology, ASTRI has been developing the Internet of Vehicles and autonomous driving technologies since 2016. ASTRI has participated in large-scale pilot projects in Hong Kong and around the world. ASTRI, in collaboration with the Transport Department, is planning for the C-V2X live trial in Hong Kong. The trial road is 14km in Shatin, the largest V2X testbed in the region. Networks and base stations like these enable ASTRI to pursue numerous cutting-edge projects.

## Innovating for Smart Economy

Smart manufacturing will reap the benefits of 5G adoption in the medium term. Smart factories allow connectivity and automation on an unprecedented scale with advanced robotic automation solutions. ASTRI has built a bespoke, cost-effective robotic system by enabling simulation and testing using digital twins that transform its traditional magnetic head assembly lines into an automated, non-stop production facility.

ASTRI's technology also enables smart industrial applications for Hong Kong's enterprises, setting reference for future field management services support and boosting operational efficiency. The AR technology and field service management solution can be applied to a wide range of industries such as construction, public utility, transportation, automotive and real estate sectors. With the introduction of AR head-mounted display with sensing technology, ASTRI also helps shape the way people work, taking remote work capabilities to a whole new level.

## Improving Education and Health

Leveraging enhanced broadband, low latency and massive IoT capability, 5G would help accelerate the introduction of ICT to enhance user experiences as well as enhancing e-learning platform. ASTRI has developed Hong Kong's first AI-enabled personalised, distance learning for special educational needs (SEN) students. This is a timely response to support learning and teaching needs for many teachers and parents due to school closure arising from the emerging COVID-19 pandemic. Students' profiles and learning behaviours are analysed to identify patterns, which in turn generate individual education plan by AI and machine learning for continuous self-improvement. These projects have reduced about half the programme cost for the SEN students, alleviating much of their financial burden.

Moreover, in collaboration with Hong Kong Jockey Club and the Chinese University of Hong Kong, ASTRI has also developed the

學和業界夥伴共同開展人才發展及實習等計劃，為創科領域培養科研人才。

## 運用領先的核心網及基站推動智慧城市應用

應科院作為全港最大的政府資助應用研發機構，擁有眾多智能應用。但是，在落實這些應用之前，必須先構建一個核心網。應科院與英特爾 (Intel) 合作開發的 5G 獨立組網 (SA) 核心網，突破 1Tbps 數據處理速度，在英特爾高容量平台上成功達到 1.34Tbps 實時數據吞吐。這個令人鼓舞的里程碑促使英特爾加快把 5G 獨立組網 (SA) 核心網推出市場，供其客戶及合作夥伴使用。再者，應科院採用的 5G 開放式無線電接入網絡 (O-RAN) 軟件配置基站，減低了公共及企業網絡的運用障礙，並大大節省了開發成本 (約 20% 至 50%)。

作為科技先驅，應科院自 2016 年起已投入發展車聯網及自動駕駛技術，同時積極參與香港及世界各地的大型試驗項目。現時，應科院正與運輸署合作在香港進行公開道路移動車聯網 (C-V2X) 試驗，試驗路線設置在沙田，全長 14 公里，屬區內最大型的車聯網 (V2X) 試驗項目；而輔助此類型研究的網絡和基站可使應科院進行眾多尖端項目。

## 為智慧經濟的科技創新努力不懈

智能製造將成為 5G 技術應用的中期受惠範疇，智慧工廠可利用先進的自動化機器解決方案以空前的規模進行連接和自動化操作。應科院更利用數字雙胞胎機器人 (Digital Twins) 技術進行模擬化及測試，建立一套可定制兼具成本效益的機器人系統，從而把傳統的磁頭裝配生產線轉化成全自動及無間斷的生產設施。

應科院的智能製造技術同時為香港的企業帶來創新的工業應用，並為未來的前線管理服務支援及提升營運效益，提供行業參考基準。擴增實境 (AR) 技術操作及維護服務管理解決方案可以廣泛應用於不同行業，例如建築業、公共設施、交通運輸、汽車業及房地產業等。另外，應科院研發具傳感技術的 AR 頭戴式顯示設備有助塑造未來工作方式，並將遠程工作能力提升至一個全新的水平。

## 致力改善教育與健康福祉

藉助優化的寬頻網絡，低時延和龐大的 IoT 能力，5G 將會加快引入資訊及通訊科技 (ICT)，以提升用戶體驗和強化電子學習平台的應用。在新冠肺炎疫情下學校停課，應科院研發香港首個專為特殊教育需要 (SEN) 的學生而設的人工智能遙距學習解決方案，不單為老師及家長提供了及時支援，更解決學生的學習需要和老師的教學需要。此應用是將學生的個人資料及學習行為模式進行分析，然後由人工智能及機械學習產生個人化學習計劃，讓學生得以持續改進，及減少了學生近一半的學習成本，大幅舒緩他們的經濟負擔。

此外，應科院亦與香港賽馬會及香港中文大學攜手合作，研發了一套用於活動數據跟踪的智能物聯網平台，這是一個採用雲框架和基礎架構的個人和團體數據管理系統，旨在改善本港體育課程的發展。由

Smart IoT Platform for Activity Tracking, a cloud framework and infrastructure for individual and group-based data management, aiming to improve the physical education curriculum in Hong Kong. Doing so the issue of obesity and cardiovascular-related diseases among school children arising from physical inactivity could be addressed. This technology has been successfully deployed to over 30 primary schools to review students' physical prowess.

From telehealth to infection control, 5G, edge computing and the Internet of Medical Things are transforming healthcare industry. ASTRI has made breakthroughs in fields like biomedical imaging that have opened up new routes in medical sciences that could better treat patients and even save lives. Examples of ASTRI's health technologies range from cervical cancer diagnosis and capsule endoscopy to smartphone-enabled spectrometer and smart elderly and preventative healthcare. ASTRI's advanced imaging and deep learning of medical image analysis has reduced 80% of diagnostic time for cervical cancer from 15 minutes to 3 minutes. This technology can also be applied to other diagnoses such as glomerulus detection in the kidney. Through machine learning, ASTRI provides more accurate and faster auxiliary diagnostics on capsule endoscopy cases with each case allowing a video of over 8 hours which processes more than 80,000 images.

Another new invention from ASTRI is smartphone-enabled spectrometer which can help ensure public safety and promote healthy living. Using the spectrometer, ASTRI provides an affordable way to check if face masks are too dirty to be worn, and whether sanitisers meet a specific composition standard. In view of ageing population, ASTRI also offers smart elderly and preventive healthcare technologies – which include electronic wristband, bed sensor, smart mattress, physical training system, healthcare applications and devices, interactive games, etc. to enhance patient care and family support.

## Serving Society with Tech for Impact

ASTRI seeks to address pain points in society through innovation and technology. To support the Hong Kong community amidst soaring unemployment, ASTRI has launched its first Graduate Programme 2020, offering fresh university graduates a unique opportunity to kickstart a career in technology research environment.

All these applications have huge potential in the 5G era. But what are the opportunities and challenges more broadly?

## 5G Opportunities and Challenges

5G brings telecom services to an entirely new level. Unlike 4G, 5G will extend mobile connectivity beyond traditional mobile devices (e.g. cellphones and tablets) to wearable devices, VR/AR glasses, robotics, intelligent manufacturing machines that usher in a brand new version of a connected world in the next few years. 5G brings better mobile broadband efficiencies and experiences and extends the overall reach of 5G to new devices, services, and industries.

The COVID-19 pandemic has clearly demonstrated the value of connectivity in daily life. Internet connections have become a virtual lifeline that is enabled by wireless networks, cloud applications, and IoT innovations. There is also growing interest in enhancing corporate Wi-Fi networks, cellular connectivity options, as well as installing private 5G networks. 5G is a game-

於缺乏運動，學童出現肥胖和心血管相關的疾病的情況越趨增多，冀藉此技術能提高兒童健康福祉，應科院利用此技術成功地為 30 多家小學的學生進行體能審查。

由遙距醫療到感染控制，5G，邊緣計算及醫療物聯網 (Internet of Medical Things) 正在為醫療界帶來轉變。應科院已在多個範疇取得突破，其中一例是生物醫學影像技術，為醫療科技開闢蹊徑，讓病人獲得更適切的治療，甚至拯救生命。應科院推出多項應用健康科技，涵蓋子宮頸癌診斷，膠囊內視鏡檢查，以至智能手機光譜儀，智能長者護理和預防性醫療保健等。應科院的先進影像技術和醫學影像分析深度學習，能減少八成的子宮頸癌診斷時間，由 15 分鐘縮減至 3 分鐘。此技術還可以應用至其他病症的診斷，如腎臟中的腎小球檢測。此外，應科院通過機器學習，為膠囊內視鏡病例提供了更準確，更快速的輔助診斷，每個病例記錄超過 8 小時的視頻，處理多於八萬張圖像。

應科院另一項新研發技術是智能手機光譜儀，這有助保障公共安全並促進健康生活。應科院透過運用光譜儀，提供了一種經濟實惠的方法來檢查口罩是否太髒而無法佩戴，亦可測試消毒劑是否符合特定的成分標準。鑑於人口越趨老齡化，應科院還提供智能長者護理和預防性醫療技術——包括電子腕帶、睡床傳感器、智能床褥、體能訓練系統、保健應用程式和設備，以及互動遊戲等，使之能更有效地照顧長者的身心需要及加強家庭支援。

## 研發具影響力的科技服務社會

應科院致力透過創新和科技解決社會的痛點，面對香港社會日趨嚴重的失業率，應科院推出首個「畢業生人才培育計劃 2020」，為應屆大學畢業生提供投身科研事業的獨特機會。

在 5G 時代裡，以上這些應用都可以發揮巨大潛力。然而，從廣義上來說，5G 的機遇和挑戰又是什麼？

## 5G 的機遇與挑戰

踏入 5G 世代，5G 技術將電訊服務升級至全新的水平。有別於 4G，5G 的流動連接由傳統的流動裝置（如手提電話及平板電腦）擴展至穿戴裝備、VR/AR 眼鏡、機器人、智能製造機器等，未來數年將進入萬物互聯的新紀元。5G 提供更高質的流動寬頻效率和體驗，並將 5G 技術延伸至全新的終端裝置、服務及不同行業。

新冠肺炎大流行雖然帶來了多方面的影響，但亦清楚展示了網絡連接在疫情下日常生活的價值。互聯網連接已成為由無線網絡，雲應用及物聯網創新驅動的虛擬生命線。與此同時，亦為增強企業的 Wi-Fi 網絡，蜂窩連接選項和安裝 5G 專網帶來了商機。5G 毋庸置疑是改變遊戲規則的先導者，它提供了業務的復甦機會和全面的業務轉型，以及從新冠肺炎疫情影响中更快地恢復運作。

changer that provides business recovery opportunities and full-scale business transformation, as well as faster recovery from the impact of COVID-19 pandemic.

Hong Kong saw the commercial launch of 5G services in April 2020, but some issues might need to be addressed to ensure sustainable development of the services. These include the installation of 5G equipment, co-existence of 5G with satellite earth stations, availability of cybersecurity specialists, and safeguards against personal data breaches.

A major challenge to widespread 5G coverage would be Hong Kong's high-rise buildings and mountainous landscape. 5G's high spectrum has less coverage and relatively weaker penetration power, which calls for demanding investments in 5G base stations. Due to the high cost of terminals, wide industrial applications are still in the initial stage.

5G in Hong Kong is still in the initial deployment stage that relies on existing 4G network equipment. In time, Hong Kong will evolve to a standalone pure 5G architecture. 5G operators in Hong Kong are also proactively initiating large-scale deployments and accelerating the diversification via 5G mobile phones. So how does Hong Kong compare to the Greater Bay Area in 5G development?

## Collaborating with the Greater Bay Area

Technology enhances connectivity between countries and will become increasingly critical to GBA's booming development. R&D investment continues to be a key catalyst for taking mainland enterprises and start-ups to go global and bringing top R&D facilities to Hong Kong.

Leveraging ASTRI's pioneering 5G tech and successful cross-border collaboration projects will be vital in creating synergy and thriving GBA development. ASTRI serves as the IC research center for Chinese National Engineering Research Centre ( ), and the Co-Director in the Guangdong, Hong Kong, Macau GBA Committee of the China 3rd Generation Semiconductor Technology Innovation Strategic Alliance, and actively participates in the R&D work of the 3rd Generation Semiconductor sector, intellectual property strategy and talent development programmes across the Guangdong, Hong Kong, Macau Greater Bay Area.

Ultimately, the three critical elements for developing the GBA into an international I&T hub are government policy, access to finance, and talent supply. ASTRI will be the entity to enact these three elements. By recruiting strong talent to collaborate with various organisations in HK and GBA, ASTRI's teams would identify pain points with the goal of enhancing smart education, smart healthcare, smart transport, FinTech, smart entertainment, and more. The future of 5G involves better coverage, capacity, mobility, power, and low latency. ASTRI will utilise these benefits to bring a new version of a connected world. ●

香港於 2020 年 4 月正式推出 5G 商用服務，但有一些問題仍需要解決才能確保服務的可持續發展，這包括 5G 設備的安裝，5G 與衛星地面站的共存，網絡安全專才的供應，以及防止個人數據洩露的保障。

另一方面，香港山多建築物高的地形是 5G 廣泛覆蓋的一大挑戰。5G 的高頻譜覆蓋範圍較小，訊號滲透力相對較弱，因此投資建設 5G 基站的需求大增。再者，礙於終端的成本高企，廣泛的工業應用仍處於起步階段。

香港現時的 5G 網絡仍處於倚賴現有 4G 網絡設備的初步部署階段，隨著時間演進，香港將會過渡至使用獨立組網的純 5G 架構。香港的 5G 營運商也積極進行大規模網絡部署，並透過 5G 流動電話加快推出多元化功能。那麼，香港在 5G 發展方面與大灣區相比又是如何？

## 與大灣區合作

科技加強了國與國之間的連繫，亦對大灣區蓬勃發展尤關重要。研發投資繼續成為內地企業和初創企業走向全球，並將頂尖研發設施帶到香港的催化劑。

充分利用應科院領先的 5G 技術和成功的跨境協作項目，對創造協同效應及大灣區的蓬勃發展至關重要。應科院作為中國國家專用集成電路系統工程技術研究中心的香港分中心（工程分中心）及第三代半導體業技術創新戰略聯盟的共同主任，會繼續積極參與帶動粵港澳大灣區第三代半導體產業研究、知識產權策略及人才培養計劃。

總括來說，要把大灣區發展成為國際創新科技樞紐的三個關鍵要素包括：政府政策，融資渠道和人才供應。應科院將會是實踐這三個要素的機構。通過招募具有實力的人才與香港和大灣區的不同組織緊密合作，應科院的團隊將以增強及優化智能教育、智能健康技術、智慧交通、金融科技和智慧娛樂等為目標，找出痛點，提出方案。5G 的未來包含更好的覆蓋範圍、容量、流動性，功率和低時延，應科院亦矢志利用這些優勢，帶來全新的互聯世界。 ●



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