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The Social Impact of 3G, 4G, and 5G on Hong Kong from 2006-2020
3G，4G 和 5G 從 2006-2020 年對香港構成的社會影響

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Hong Kong is a world leader in the telecommunications industry. Coupled with the amazing ability of Hong Kong's people to embrace the latest and the best technology and services, the Industry continues to spark innovations and novel applications in the 5G era and make it a reality. Because of the advanced connectivity of 5G, its social impact will be much more significant compared with the previous generations. This article is reviewing the development journey starting from 3G and its respective social impact all the way to 5G.

Overview of 3G (2006 - 2009)

The advent of the mobile phone was initially only capable of calling (1G). Later, the introduction of 2G gave rise to short message service (SMS). As the name implies, messages were short since there was limited capacity for information exchange. During 2006-2009, the advent of 3G increased the capability of phones such that phones were no longer limited to calls and texts. New affordances enabled 3G phones to play videos, use apps, surf the web, manage one's calendar, and access one's social media accounts all on one device. Increases in data use was driven by new applications such as the launch of Facebook in 2004, YouTube in 2005, and Twitter in 2006. By 2007, the launch of the first iPhone led to drastic increases with data use. The iPhone was a key shift in the mobile phone industry as it introduced and mainstreamed touch screens over physical keypads. The iPhone can be used as a mini computer where many apps are introduced. People could stream videos and complete various tasks on the smartphone that require rapid data transmission, which in turn prompted many operators to find solutions to keep up with the demand. As sales of the iPhone increased, so did the demand for using data via 3G. By 2008, the introduction of the Android gave operators alternate platforms to disseminate their projects. Across both platforms, there were clear demands for more data transmission.

To keep up with the demand, mobile operators expanded its multimedia services in 2006. Because watching videos on the phone relies on the compatibility of the video format, not all videos could be played and even then there may still be latency. To address this issue, a breakthrough service (multimedia on the move) was launched for phones to go beyond voice. In 2007, public Wi-Fi service became more and more popular around HK. In September 2007, there were more than 7,300 hotspots in more than 4,000 locations around the city.

The increased demand in communications led CAHK to launch the annual observance of World Telecommunication Day (WTISD) in 2007, which marks the founding of the International Telecommunication Union (ITU) on May 17, 1865, drawing attention to the work of ITU and the challenges of global communication. The purpose of this observance is to raise awareness of the possibilities that the internet and other information and communication technologies could bring to societies and economies, as well as of ways to bridge the digital divide.

香港是電訊業的世界領導者。結合香港人掌握最新科技和服務的優秀能力，使電訊業能持續綻放光彩，在 5G 時代裡推動更多的創新科技與新興應用，並使之一一實現。5G 先進的超卓連接力，將會比以往的流動通訊科技帶來更深遠重大的社會影響力。本篇文章旨在回顧由 3G 時代始起的發展歷程，及其對 5G 時代帶來的社會影響。

3G 概覽 (2006 - 2009)

最初推出的流動電話只能進行話音通話（1G），及至第二代流動通訊（2G）增加了短訊（SMS）功能，顧名思義，由於訊息交換的容量有限，所以稱之為短訊。在 2006-2009 年間，第三代流動通訊（3G）加強了流動電話的功能，不再局限於話音通話和發送文字訊息。3G 電話的新屬性更讓用家在同一個終端裝置上進行多項操作，包括播放視頻、使用應用程式、瀏覽網站，管理日曆和連接社交媒體帳戶等。新應用程式的出現令數據使用量增加，例如 2004 年推出的臉書 (Facebook)，2005 年的 YouTube 和 2006 年的推特 (Twitter)；而在 2007 年面世的首部 iPhone 更令數據使用量大幅增加。iPhone 可以說是顛覆了流動電話市場，其引入採用觸控式螢幕，加上推出各式的應用程式，使 iPhone 可以當作微型電腦般使用。用家可以在其智能手機上串流視頻和完成不同的任務，這些都需要快速的數據傳輸，因而促使許多電訊商積極開發不同的應用程式，以迎接市場需求。隨著 iPhone 銷售額遞增，透過 3G 的數據使用量亦同步增長。到了 2008 年，Android 的出現為電訊商提供了另一個選擇平台去發布他們的項目。不論是使用那一個平台，都衍生出對數據傳輸急增的需求。

為滿足需求，流動電訊商於 2006 年起開始擴展多媒體服務。由於在手機上觀看視頻需倚賴視頻格式的兼容性，因此並非所有視頻都能夠播放，甚至會出現時延。為了解決這個問題，一項突破性的服務（流動多媒體）應運而生，令手機功能超越話音功能的限制。2007 年，公共 Wi-Fi 服務在香港越趨普及，直至 2007 年 9 月，全香港逾 4,000 個位置便設有 7,300 多個熱點。

與日俱增的通訊需求亦驅使香港通訊業聯會於 2007 年起開始主辦「香港世界電訊及資訊社會日」（WTISD），這是為紀念國際電信聯盟 (ITU) 於 1865 年 5 月 17 日成立而設的紀念活動，目的是提醒大眾 ITU 在全球資訊科技發展的工作和面對挑戰上一直不遺餘力。這個活動旨在提高社會大眾對互聯網和創新資訊科技的認識及關注，為社會經濟高速發展奠下重要基石，造就發展成為數碼社會的重要橋樑。

With the principal support of the Office of Communications Authority (OFCA) and a number of sponsors in the industry, CAHK has been hosting the captioned event since 2007, capitalizing on the opportunity to promoting the latest in ICT to the public and especially the youth and the academic communities. In this age of technology revolution, young people are at the forefront, not only the users but also as the innovators.

在通訊事務管理局（OFCA）全力支持，以及得到資訊科技界的贊助，香港通訊業聯會自 2007 年開始主辦 WTISD，藉此向大眾，特別是青少年與學界宣揚創新資訊科技的最新資訊。在這個科技革命的年代，走在最前線的青少年，不再是科技的使用者，更是科技的創新者。

The 6th World Telecommunication and Information Society Day Ceremony - 2012
第 6 屆「香港世界電訊及資訊社會日」典禮 — 2012

But how did initiatives like these alter how the populace's lifestyle? We argue that the open channels of social media platforms make people more cautious of how they communicate online.

然而，這些舉措如何改變大眾的生活方式？我們認為，社交媒體的開放渠道使人們在網上交流變得更為謹慎。

Smartphones and Novel Social Media Contributes to Cautious Online Impression Management

智能電話及新興社交媒體對網上謹慎的印象管理的貢獻

The most notable changes in 3G are 1) the advent of new affordances of smartphones where phones performed like portable computers, and 2) The ability to broadcast one's life and opinions via online photos, videos, and comments. Put together, 3G allows for accessible online interaction on their phones.

3G 帶來最顯著的變化包括：1) 智能電話的新屬性出現，使手機可以如同隨身電腦一樣操作；2) 透過在網上發放圖片、視頻和評論來傳播一個人的生活和觀點意見的能力。綜合來説，3G 容許人們在其手機上進行無障礙網上互動。

In conventional face to face interactions, people are motivated to construct a favorable image to others. This idea stems from impression management theory (Leary & Kowalski, 1990), which proposes that people are motivated to construct a favorable public impression that shows others only what is desirable (while concealing what is undesirable). People consciously display a favorable public self because it affects their status in the social order with the ultimate goal of maximizing rewards and minimizing punishments.

在日常面對面的交流互動中，人們會被激勵去建構一個良好的形象，這個概念來自印象管理理論（Leary 和 Kowalski, 1990 年），該理論提出人們會被激勵去建構一個良好的公眾形象，從而只展現理想渴求的一面（並同時隱藏不理想的一面）。人們有意地呈現一個良好的公眾自我形象，這是因為會影響他們在社會常規秩序裡的地位，而最終目的是取得最大的回報和最小的責罰。

While impression management originated from people's interactions in the offline world, recent research suggests it is also applied in the online world, where people are motivated to portray a favorable public image to those they encounter on their social networks. Online impression management mainly concerns content-based management and network-based management (Walther et al. 2008). Content-based pertains to the contents a user places in the online world. As such, people carefully monitor what is placed online to appeal to those they want to impress. Network-based pertains to portraying one's involvement in certain groups, one's social role within each group, and how one communicates with others in that group. People's sociometers – a term in social psychology that refers to markers of self-esteem based on the degree of inclusion and exclusion in social groups – are broadcasted with public displays of friends, retweets, and followers on various social media sites (Haidt & Rose-Stockwell, 2019). People can assess one's social status to some degree based on who one connects with online. In other words, who one connects with on social networks influences how one's online profile is perceived (Walther et al., 2008).

印象管理源於人們在現實世界的互動，然而，最近的研究建議，這理論同樣適用於網上世界，因為人們同樣會在其社交網絡上，被激勵去建構一個有利和良好的公眾形象；而網上印象管理主要涉及基於內容的管理和基於網絡的管理（Walthe 等, 2008 年）。人們在網上世界發放的內容屬於基於內容的管理，因此，他們會慎重地管控在網上發布的內容來吸引他們想要打動的對象。而基於網絡的內容管理則屬於個人在特定的群組裡所展現的參與度，個人在每個群組中所展現的社會角色，及在群組裡如何與其他個體溝通。人們的社會測量儀 — 這是社會心理學上的一個術語，意指基於在社交群組裡的融合性和排他性的自尊標記 — 是從他們不同的社交媒體上公開展示的朋友，轉發的貼文和關注者（Haidt 和 Rose-Stockwell, 2019 年）上傳播。人們可以根據一個人在網上和誰人聯繫，便可在某程度上評估一個人的社會地位。換言之，一個人在社交網絡上與誰聯繫，便可影響人們如何看待他自己在網上的個人資料（Walther 等, 2008 年）。

社交網絡對自我的影響導致印象管理有巨大的含意，這是由於網絡空間容許來自不同社交群組的多個用戶可以同時進行互動，而且回應

The influence of social networks on the self has vast implications for impression management. This is because the cyberspace allows multiple users from different social groups to interact simultaneously, and responses do not have to be synchronous. Different social media accounts encourage people to highlight different parts of them (e.g., LinkedIn vs. Facebook). Hence, the audience across social media platforms is often conceptualized as 'imaginary' since users cannot be certain if they are currently being monitored and by how many people. Public social media accounts (e.g., public Twitter and Instagram accounts) can be viewed by anyone anonymously, which potentially allows people's online impressions to be under constant scrutiny. Since people cannot immediately react and cater to the audience, they may report feeling under constant surveillance.

Managing one's impression with the 'imaginary' audience is difficult because the nature of connectivity of the Internet makes a user connected to people from various social contexts (e.g. colleagues, family, friends, acquaintances) simultaneously and thereby collapses the context of different norms and different social groups into one broad audience. This concept, known as 'context collapse,' forces people's self-presentation strategies to cater to various groups simultaneously. Groups that were previously detached in the offline world come together in the online world (Gil-Lopez et al., 2008). When one posts to a targeted audience, they also have to consider that other recipients can view the post. Since any online post can be seen by potentially anyone in that particular social network, online impression management tends to be more apprehensive as more social spheres collide.

Owing to context collapse, what people put online are broadcasted to various groups simultaneously. Since people want to create a favorable impression online, sometimes people publicly post opinions, political views, and disagreements they do not personally believe in to win the approval of others. These cases lead to people publicly posting content online they do not actually believe privately, known as preference falsification (Kuran, 1987). In other words, there is high public endorsement for certain opinions, but little private endorsement.

Preference falsification has implications on how people construct their online persona. To cater to various groups at the same time, people become hesitant to voice out their potentially controversial views to avoid disapproval. To cater to more groups, people tend to increase their linguistic variability and reveal personal information about oneself only when it is universally appropriate. Marwick and Boyd (2010) surveyed Twitter users who have hundreds of thousands of followers and asked them who they tweet to, when they self-censor, who they imagine reading their tweets, and what makes them authentic. Results show that public tweets mix the personal and professional, and are suited for a general audience. Those Twitter users try to be authentic as best they can without too much self-disclosure. Similarly, Gil-Lopez et al. (2008) found that one's self-presentation on Facebook is contingent on one's network size and network heterogeneity. The researchers surveyed approximately 7000 Facebook users and found users with both larger network size and larger network heterogeneity (i.e. more Facebook friends from different groups) tend to have more status updates but vary in whether posts are positive or negative. Increased network size is associated with more positive status updates, while increased heterogeneity is associated with more negative status updates. The authors reason this latter finding by asserting that those with a more diverse audience share more negative emotions to garner social support. Alternatively, people do not want to share too much positive news online if the audience is diverse to avoid the perception of bragging.

不需要同步。不同的社交媒體帳號可以讓人們重點呈現他們不同的面向（例如 LinkedIn vs. Facebook）。因此，橫跨各種社交媒體平台的觀眾通常被概念化為「假想的」，這是因為用戶當下無法確定自己是被監視，及被多少人監視。任何人都可以用匿名身份去查看社交媒體的公開帳戶（例如公開的推特和 Instagram 帳戶），即潛在地容許人們在網上的印象會不斷地被審查。由於人們無法進行即時的反響並迎合觀眾，他們可能會在不斷地被監視的情況下匯報自己的感受。
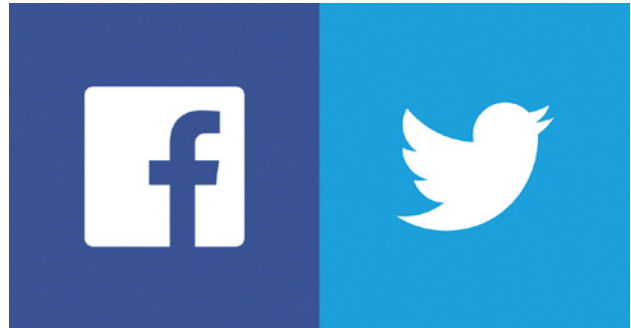
一個人要向「假想的」觀眾管理印象是有難度的，因為互聯網的連繫，使用戶能夠同時與來自各種社交環境的人建立連繫（例如同事、家庭成員、朋友和認識的人），從而使不同規範和背景出現崩解，導致不同的社交群組變成為單一廣泛的受眾。這種稱之為「社交情境崩解」（context collapse）的概念，迫使人們的自我展示策略同時滿足不同群組的需求。以前在現實世界中脫離的群組，現在於網絡世界重新聚集在一起（Gil-Lopez 等，2008 年）。當一個人向特定對象發布貼文，這表示他們亦需考慮其他接收者同樣可以查看同一貼文。由於在網上發布的貼文能潛在地被任何人在特定的社交網絡上查看，故此，隨著更多重疊的社交領域出現抵觸，網上印象管理越趨憂慮。

由於社交情境崩解的緣故，人們在網上發布的內容會同時在不同的群組裡傳播。因此，人們希望在網絡世界創造一個良好的印象，於是人們有時會公開發表連自己也不相信會贏得他人認可的言論，政見和分歧等。這些情況導致人們在網上發布一些他們私下並不相信的內容，這稱之為「偏好偽裝」（Kuran，1987 年）。換句話說，大眾對這些意見的公開認可度很高，反之私人認可度則很小。

「偏好偽裝」會影響人們如何構建他們在網上的角色。為了同時迎合各個群組，人們在表達具有潛在爭議的意見時會變得猶豫，以避免遭到反對。而為了迎合更多的群組，人們傾向增加他們的語言變化，並只在適當的情況下才會披露有關自己的個人訊息。Marwick 和 Boyd（2010 年）對擁有數十萬關注者的推特用戶進行了調查，詢問他們向誰發文、何時進行自我審查、他們會想像誰在閱讀他們的貼文，以及是什麼使他們是真實的。結果顯示，公開的貼文會將個人和專業混合，並且適合一般大眾。那些推特用戶亦會在不披露太多個人訊息的情況下盡力表現得最真實。同樣，Gil-Lopez 等（2008 年）發現，一個人在臉書的自我呈現取決於其網絡規模和網絡異質性。研究人員對大約七千名臉書用戶進行調查，發現網絡規模和網絡異質性較大的用戶，（即較多臉書朋友來自不同群組），往往具有更多的狀態更新，但貼文屬正面或負面則有所不同。網絡規模的增加與更多正面的狀態更新有關，而增加的異質性則與負面的狀態更新有關。作者們認為這是後來的推論發現，認為那些擁有較多不同層面的觀眾的用戶，

Cover Story ● 封面故事

Overview of 4G (2009 – 2019)

By 2009, there was an intense need to keep up with the data tsunami that resulted from smartphones. Consequently, many initiatives within the Hong Kong telecommunications industry led to enhanced speed and bandwidth to consume and disseminate data. A significant event in 2014 was 4G Voice over Long Term Evolution (LTE). The difference is twofold: firstly, the high density voice makes the sound quality better than circuit-switched voice (2G & 3G). Second, the efficiency of the voice calls only takes 6 seconds to 8 seconds to connect the call. We highlight milestones of some organizations:

- HKT was aware that the phone was not used primarily for calls anymore and from 2012 onwards phone calls became free. Later, HKT had its own Public Cloud launch. HKT has fibers in Cheung Chau and Peng Chau. HKT also provided exclusive Wi-Fi service in MTR line and MTR station. PCCW also had more than 3,000 Wi-Fi hotspots.

- China Mobile launched its 4G services with converged LTE network in 2012 based on both FDD (Frequency Division Duplex) and TDD (Time Division Duplex) standards. Based on the statistics published by Quest Mobile in 2019, more than 80% of China's population is active mobile internet users now.

- Hutchison noted that social media plays a huge role as a transformation agent to facilitate information flow and reshape social interaction between company and customers. Facebook and Instagram continue to be two popular tools for companies to market new products and services, and interact with customers. The emergence of social media tools has also helped the company attract more young customers to subscribe to the company's services.

- SmarTone noted that each network had to increase its data capacity to meet customer demand which led to 4G. Since more and more people use their phones beyond voice, SmarTone was driven by a voice-driven to data-driven environment. It claimed as the first network in HK that supported 4G.

會分享更多負面情緒的貼文來獲得社交支持。或者是，若觀眾層面較多樣化，人們也不願意分享太多正面的新聞，以避免給人自誇瞎吹的感覺。

4G 概覽（2009 年至 2019 年）

2009 年，智能手機導致的數據海嘯引發迫切的數據處理需求。因此，香港電訊業採取了許多舉措，從而提高了數據使用和傳播的速度和帶寬。 2014 年的重要發展是 4G 語音長期演進（LTE），而其帶來的區別是雙重的：首先，高密度語音的音質優於電路交換語音（2G 和 3G）。其次，語音通話的效率僅需 6 到 8 秒即可連接。我們在此重點介紹一些機構的里程碑：

- 香港電訊（HKT）意識到電話不再主要用於通話，電話通話並且從 2012 年開始免費。後來，香港電訊推出了自己的公共雲，並且在長洲和坪洲鋪設光纖，更在港鐵線及港鐵站提供獨家 Wi-Fi 服務。電訊盈科當時還擁有三千多個 Wi-Fi 熱點。

- 中國移動於 2012 年推出了以 FDD（頻分雙工）和 TDD（時分雙工）為基準融合的 LTE 網絡 4G 服務。根據 Quest Mobile 在 2019 年發布的統計數據，目前中國 80% 以上的人口是活躍的流動互聯網用戶。

- 和記（Hutchison）指出，社交媒體在促進資訊流和重塑公司與客戶之間的社交互動方面，扮演著巨大的角色。臉書和 Instagram 仍然是該公司銷售新產品和服務，以及與客戶互動的兩種普及工具。社交媒體工具的出現對吸引更多年輕客戶訂購該公司的服務有所幫助。

- SmarTone 指出，每個網絡都必須增加其數據容量，以滿足客戶的需求，亦從而催生了 4G。由於越來越多人使用電話不僅為語音通話，SmarTone 因而在語音驅動以至數據驅動的環境下付出努力。SmarTone 聲稱是香港第一家支持 4G 的網絡公司。

4G Launch

HKT announcement on 4G LTE 450Mbps launch in 2015. Mr. Peter Lam, Managing Director of HKT's Engineering (third right) and Mr. David Wang, President of Wireless Network Product Line of Huawei (third left) demonstrate the world's first LTE-A 450Mbps solution in Hong Kong at a press conference. They are accompanied by Dr. Henry Wong, Head of Strategic Wireless Technology and Core Networks of HKT (second right); Mr. SM Shuen, Head of Radio Networks Engineering and Operation of HKT (far right); Mr. Bob Cai, President of LTE FDD Network of Huawei (second left) and Mr. Xiao Yu, Deputy President, Product Solution and Marketing, Southeast Asia Region, Huawei (far left).

香港電訊於 2015 年宣布推出 4G LTE 450Mbps。香港電訊工程部董事總經理林榮執先生（右三）與華為無線網絡產品線總裁汪濤先生（左三）在香港的新聞發佈會上，共同展示全球首個 LTE-A 450Mbps 解決方案。同時出席的代表包括香港電訊無線業務策略及核心網絡主管黃錦恆博士（右二）、香港電訊無線網絡工程及營運主管孫兆文先生（右一）、華為 LTE FDD 領域總裁蔡孟波先生（左二）及華為東南亞地區部產品解決方案與營銷副總裁虞曉先生（左一）。

4G Launch

Mr. Sean Lee, Director & Chief Executive Officer of China Mobile Hong Kong.
中國移動香港董事兼行政總裁李帆風先生

3 Hong Kong launches 4G LTE network under the "One Love. One World" banner in a large-scale promotional campaign in 2012.
3 香港於 2012 年開展大型品牌推廣項目「One Love. One World」，並推出 4G LTE 流動通訊服務。

SmarTone has launched a territory-wide 4G LTE network in 2012, and was the only mobile operator in Hong Kong support iPhone 5 with 4G LTE network.
SmarTone 於 2012 年推出覆蓋遍及全港的 4G LTE 網絡服務，並且是香港唯一支持 4G LTE 網絡的 iPhone 5 的流動電訊商。

- Huawei capitalized on the potential for 4G and have since employed over 80 thousand employees engaged in Research & Development in scientific research to ensure high-tech. Today, they automated customer service and upgraded their cloud service to allow for massive data storage.

- 華為充分利用了 4G 的潛力，自此僱用了八萬多名從事科學研發的員工，以確保高科技的發展。如今，他們已把客戶服務自動化並且升級了雲服務，以應付海量的數據存儲。

- Towngas - a company which originally specialized in the natural gas arena but later incorporated telecommunications business – built optic fiber telecommunication tubes alongside their gas tubes. Doing so provides uninterrupted optic fiber and communication to data centers that provide cloud computing. These data centers ensure confidentiality and safety from cyberattacks and physical hazards (e.g. fire).

- 香港中華煤氣有限公司 — 一家最初專注於天然氣領域，但後來又合併了電信業務的公司。該公司在其燃氣管旁邊建造了光纖電信管，藉以為其提供雲計算的數據中心提供不受干擾的光纖和通信。這些數據中心可確保機密性和安全性，免受網絡攻擊和人身傷害（例如火災）。

TGT uses sophisticated Glass-In-Gas (GIG) technology to lay optical fibres within submarine gas pipeline, protected by polyethylene pipe, completing an 1,800-meter cross harbor fiber-optic path from Quarry Bay to Cha Kwo Ling in February 2018.
名氣通電訊（TGT）使用先進的沼氣玻璃（GIG）技術在海底天然氣管道中鋪設光纖，並採用聚乙烯管保護，及後於 2018 年 2 月完成了一條從鰂魚涌到茶果嶺的 1,800 米跨海港光纖路徑。

- To facilitate any potential disputes between providers and customers, CAHK established the Customer Complaint Settlement Scheme (CCSS) in 2012 to serve as a mediation service. The CCSS is a mediation scheme set up by the telecommunications industry resolves billing disputes in deadlock between telecommunications service providers and their customers. The mediation service is provided by an independent service center (CCSS Centre) set up under the Communications Association of Hong Kong (CAHK), an industry association representing the communications sector in Hong Kong. Customers who choose to use the mediation service under the CCSS may first contact the Office of the Communications Authority (OFCA) which will assess the applications against prescribed criteria. OFCA will refer accepted cases to the CCSS Centre for follow-up actions.

- 為解決電訊服務供應商與客戶之間可能發生的任何糾紛，香港通訊業聯會於 2012 年建立了解決顧客投訴計劃（CCSS）作為調解服務。CCSS 是電訊業建立的調解方案，旨在協助電訊商與其客戶解決一些已陷入僵局的計帳爭議。 調解服務是由代表香港通訊業界的組織香港通訊業聯會成立的代理機構（CCSS 中心）提供。選擇使用 CCSS 調解服務的客戶可以先聯繫通訊事務管理局（通訊局），該局將根據規定的標準評估申請，並會將已受理的案例移交給 CCSS 中心採取後續行動。

CAHK – [Customer Complaint Settlement Scheme] Grand Opening 2013
香港通訊業聯會 —[解決顧客投訴計劃（CCSS）] 於 2013 年隆重開幕

Meeting the increased data use has heavy social psychological implications. We document six overarching trends:

1) Massive Increase in Data Use Contributes to Information Overload and Fragmented Realities

2) Influx of Novel Social Media Platforms Altered Business-Customer Communication and Led to the Rise of Key Opinion Leaders

3) Over-reliance on Phones Fuels Addiction, Polarization, and Mental Health Concerns

4) Big Data is Capable of Constructing Online Personality Profiles and Processing Natural Language

5) Online Deception Provides a Safe Haven for Malicious Self-Disclosure and Mass Misinformation

6) Ongoing Battle Between Cybercrimes and Cybersecurity

在滿足日益增長的數據使用量的同時，沉重的社會心理影響從而產生。我們特此記錄了六個總體趨勢：

1) 數據使用的大量增加導致資訊超載和零碎的實況

2) 新興交媒體平台的蜂擁改變了企業與客戶之間的溝通，並導致關鍵意見領袖（KOL）的崛起

3) 過度依賴手機助長成癮，並導致兩極分化和心理健康問題

4) 大數據能夠構建網絡個性形象和處理自然語言

5) 網上欺騙為惡意自我披露和大量錯誤資訊提供了避風港

6) 網絡罪案與網絡安全之間的持續對戰

Massive Increase in Data Use Contributes to Information Overload, Crowdsourced Mobile Apps, and Fragmented Realities

The massive increase in data use allows vast and rapid information exchange that led to decentralized modes of creating and sharing information, knowledge, and culture. With 4G, people can download dozens of apps they could not previously because those apps require high bandwidth that 3G did not provide. 4G also allows people to document memories and events with photos and videos, and people can choose to share these files with anyone within minutes. Everyone can be an amateur reporter because they can easily create and share content.

Everyone to some extent can choose who to share their online content with (e.g. a video shared privately among friends vs. a video posted on a public YouTube account) and due to context collapse, public content tends to spread extremely rapidly. The potential downside is that what is placed online potentially stays online permanently, which hinders people's control of online impression management. An embarrassing video can remain online for years to come. Any video, tweet, or comment can be taken out of context and used against someone to libel, shame, or ridicule. Worse, someone in possession of sensitive information about someone else can use that information as leverage for potential blackmail.

The spike of online content contributed to information overload (Lee et al., 2017). To provide some order to information in the cyberspace, interest groups are created for a particular niche. For example, there are groups dedicated for people interested in a particular hobby (e.g. sports, music), groups for certain types of people (e.g. expats, international teachers, people looking for places to rent), and groups dedicated to discuss certain ideas (e.g. politics, psychology, dating advice). Crowdsource apps were created to facilitate discussion and communication for these interest groups. Quora, for example, is a question-and-answer platform founded by two former Facebook employees in 2010. A user creates an account, asks questions under a topic, and wait for other users to respond (Ovadia, 2011). Users can start a discussion by commenting, ranking, or debating other users via their posts.

Crowdsource mobile apps go beyond the virtual world and seep into the physical world to the point it alters people's lifestyles. Rideshare apps such as Uber and Lyft altered the transportation industry by crowdsourcing available drivers. Drivers for rideshare apps are not professional drivers but rather citizens who can drive. Lodging apps such as AirBnB altered the hotel industry by crowdsourcing available accommodations. Hosts for lodging apps do not run a professional hotel but are rather ordinary citizens who have a place for others to stay temporarily. Dating apps crowdsource singles looking to make new friends or potential new partners. Other apps that crowdsource replace the need for in-person interaction. Before 4G, it was common practice for people in some countries to play chess with strangers in a public place. With apps, people can play chess with strangers all over the world. In a broader sense, crowdsource mobile apps allow people to interact with similar others.

Despite the resources crowdsource apps offer, people still have to selectively consume what websites to watch and what to ignore due to information overload. Various Internet sites give users control to customize their media consumption (e.g. which news outlets to follow, which Twitter accounts to follow), where most people choose ones that conform to their views (Riles et al., 2018). This process of choosing what online content to consume is not random, as people prefer to go after content that they

數據使用的大量增加導致資訊超載，眾包移動應用程式和零碎的實況

數據使用的大量增加造成廣泛而快速的資訊交換，從而導致以分散模式建立和共享資訊、知識和文化。有了 4G，人們可以下載許多以前無法使用的應用程式，因為這些應用程式需要的是 3G 無法提供的高帶寬。4G 還允許人們使用照片和視頻記錄記憶和事件，人們可以選擇在幾分鐘之內與任何人共享這些文件。每個人都可以成為業餘記者，因為他們可以輕鬆創造和共享內容。

每個人在某種程度上都可以選擇與誰共享網上內容（例如，在朋友之間私下共享的視頻，對比在公共 YouTube 帳戶上發布的視頻），並且由於在社交媒體上出現「社交情境崩解」的情況時，公共內容往往會迅速傳播。潛在的負面影響是，放置在網上的內容可能會永久保持在線狀態，這阻礙了人們的網上印象管理的控制，令人尷尬的視頻可以在網上保留很多年。任何視頻，推文或評論都可以從社交情境中抽離，並用於誹謗、羞辱或嘲笑他人。更糟糕的是，擁有他人敏感資訊的人可以利用這些資訊來進行潛在的勒索。

網上內容的激增導致資訊超載（Lee 等，2017 年）。為了向網絡空間中的資訊提供某種順序，針對特定的利基市場因而產生了興趣團體。例如，一些團體專門針對特定愛好（例如體育、音樂）感興趣的人，針對某些類型的人（例如外國人、國際教師、尋找租房的人）的團體，以及專門討論某些想法的團體（例如政治、心理學、約會建議）。眾包應用程式的創建，促進了這些興趣團體的討論和交流。例如，Quora 是一個由兩位前臉書員工在 2010 年建立的問答平台。由用戶設立一個帳戶，在一個主題下提出問題，然後等待其他用戶做出反應（Ovadia，2011 年）。用戶可以通過其帖子拋磚引玉，向其他用戶進行評論、排行或辯論來開始討論。

眾包移動應用式超越了虛擬世界，滲入了現實世界，以至改變了人們的生活方式。 諸如 Uber 和 Lyft 之類的共乘應用通過眾包可用的司機來改變交通行業。乘車共享應用程式的司機並不是專業司機，而是會開車的公民。諸如 AirBnB 之類的住宿應用通過眾包可用的住宿改變了酒店行業。住宿應用程式的託管人不是經營酒店的專才，而是擁有可讓他人暫時居住的地方的普通公民。約會應用程式將尋求結識新朋友或潛在新合作夥伴的單身人士眾包。其他應用程式的眾包取代了面對面互動的需求。在 4G 之前，某些國家 / 地區的人們在公共場所與陌生人下棋是很普遍的做法。借助應用程式，人們可以與世界各地的陌生人下棋。從廣義來說，眾包移動應用程式允許人們與類似的其他人交流。

儘管眾包應用程式提供了很多資源，但是由於資訊超載，人們仍然必須選擇要觀看的網站和要忽略的內容。各種互聯網網站均給予用戶定制媒體消費的控制（例如，要關注哪些新聞媒體，要關注哪個推特帳戶），大多數人可以在其中選擇符合其觀點的媒體（Riles 等，2018 年）。選擇要消費哪些網上內容的過程並不是隨機的，因為人們傾向於追求他們同意的內容。即使人們被動地上網，亞馬遜、Netflix 和 Instagram 也會根據用戶的網上活動向用戶建議他們可以購買、觀看和關注的對象。有系統地選擇要消費的資訊（無論是主動產生的資訊還是通過算法產生的資訊）皆有助於選擇性曝光。

agree with. Even when people passively surf the web, Amazon, Netflix, and Instagram would suggest users what they could buy, watch, and whom to follow based on the user's online activities. Systematic ways of selecting what information to consume – whether it be active through one's volition, or passive through algorithms – contributes to selective exposure.

Selective exposure is nothing new in terms of information consumption. Even before the rise of telecommunications of the Internet, people are bound to consume different information due to various circumstances. That being said, selective exposure is an issue in the 4G era as it creates a norm of fragmented reality (Riles et al., 2018; Susskind, 2018). When people obtain information about an event that they did not personally attend, they turn to other sources of information such as viral photos/videos, mainstream news media, blogs, or discussion boards. While small-scale events such as conference talks or a viral dance video can be captured accurately via online content (where we define accuracy as consistent information across various outlets and assume the information provided is true and not manipulated), large scale events such as political movements tend to provide lots of coverage that hold inconsistent information across outlets. Some outlets report a certain political slant, while another outlets contradicts that slant. People's opinions of large scale events are thus driven by selective exposure.

Information overload thus presents a puzzling paradox. While more information gives people more access to various perspectives, more information also means people consume different perspectives, thereby causing people's sense of reality to be different than others when looking at the same event. People's reality is further fragmented with the influx of novel social media platforms.

Influx of Novel Social Media Platforms Altered Business-Customer Communication and Led to the Rise of Key Opinion Leaders

Beyond fragmented realities, the 4G era coincided with the promulgation of even more social media platforms that further reshapes communication in the online world. Instagram and Pinterest were launched in 2010, while WeChat and Snapchat were launched in 2011. The emergence of these platforms enhances connectivity in various ways. Generally speaking, Instagram and Pinterest focus on broadcasting aesthetic pictures to a wide range of people or organizations. WeChat and Snapchat primarily serve as platforms to exchange photos and videos in a more private manner.

These social media platforms influenced how some operators communicated with their customers. They understood that social media plays a huge role as a transformation agent to facilitate information flow and reshape social interaction between company and customers. As such, Facebook and Instagram continue to be two popular tools for companies to market new products and services, and to interact with customers. The emergence of social media tools has also helped in attracting younger customers to subscribe to the company's services. Call centers took advantage of social media to streamline their operations. Now, customers no longer have to call to contact their customer service center. Instead, customers can use WeChat, Whatsapp, and Facebook to communicate. Doing so opens wide lines of communication that were not previously possible.

These new social media platforms allowed everyone to be connected around the world, with some emphasizing a public form of connection. Instagram and Twitter users can "follow"

就資訊消費而言，選擇性曝光並不是什麼新鮮事物。甚至在互聯網的電信興起之前，基於各種情況，人們必然會消費不同的資訊。話雖如此，選擇性曝光是 4G 時代的一個問題，因為它創造了零散的現實規範（Riles 等，2018 年；Susskind，2018 年）。當人們獲得他們自己沒有參加的活動的有關資訊時，他們會轉向其他資訊來源，例如網上瘋傳的照片 / 視頻、主流新聞媒體、博客或討論區。雖然可以通過網上內容準確捕獲會議演講或瘋傳的舞蹈視頻等小規模事件（在這裡，我們將準確性定義為跨渠道的一致資訊，並假設所提供的資訊是真實的且未被操縱），但大型事件如政治運動趨向於提供大量報導，從而使各個網站的資訊不一致。一些網站點報導某種政治傾向，而另一些網站則與此相反。因此，人們對大規模事件的看法是受到選擇性曝光的驅使。

因此，資訊超載帶來了令人困惑的悖論。儘管更多的資訊讓人們有更多機會探討各種觀點，但是更多的資訊也意味著人們會採納不同的觀點，從而導致人們在觀看同一事件時的真實感與其他人不同。隨著新興社交媒體平台的湧入，人們的現實便進一步支離破碎。

新興社交媒體平台的蜂擁改變了企業與客戶之間的溝通，並導致主要意見領袖（KOL）的崛起

除了零散的現實之外，4G 時代恰逢更多社交媒體平台的發表，從而進一步重塑了網絡世界中的通信。Instagram 和 Pinterest 於 2010 年推出，而微信和 Snapchat 則於 2011 年推出。這些平台的出現以各種方式增強了連接性。一般來說，Instagram 和 Pinterest 專注於向廣泛的人或組織傳播美學圖片。微信和 Snapchat 主要用作以更私密的方式交換照片和視頻的平台。

這些社交媒體平台影響了一些電訊商與客戶的溝通方式。他們了解到，社交媒體在促進資訊流和重塑公司與客戶之間的社交互動方面扮演著巨大的角色。因此，臉書和 Instagram 仍然是公司銷售新產品和服務，以及與客戶互動的兩種流行工具。社交媒體工具的出現也有助於吸引年輕的客戶訂購該公司的服務。客服中心利用社交媒體簡化了操作。如今，客戶不再需要致電聯繫其客戶服務中心。取而代之，客戶可以使用微信，WhatsApp 和臉書進行交流。這樣做開通了以前無法實現的廣泛溝通渠道。

這些新的社交媒體平台使每個人都可以與處於世界各地的人建立聯繫，其中有些人強調公開的聯繫形式。如果關注的帳戶是公開帳戶，則 Instagram 和推特用戶可以「關注」他們想要的任何人。粉絲人數是受歡迎程度的指標，更多的粉絲暗示更多人關注該特定賬戶的擁有者（Ferrara 等，2014 年），並且由於網絡效應，人們可能傾向於信任更多粉絲的帳戶，因為這表示有更多人信任該帳戶（就如人們信任一家顧客多的餐館勝於沒有顧客的餐館的同一原理）。當然，關於粉

whomever they please, provided that the followed account is a public one. One's follower count serves as a marker for popularity. More followers implicitly indicates that more people pay attention to the owner of that particular account (Ferrara et al. 2014). And because of the network effect, people may tend to trust an account with more followers since it denotes more people trust it (the same principle where people trust a restaurant that has more customers than one that is empty). Of course, this assertion that followers equate popularity is contingent on the assumption that each follower represents a distinct person/organization that is real. It's possible that some accounts are fake as some accounts are fake or bots.

As people obtain more followers on their social media account, their online posts (e.g. photos, videos, comments, blogs) are broadcasted to more people. A post shared on an account with a thousand followers would, on average, be seen more than a post shared on an account with a hundred followers. Hence, an account with more followers is more effective in communicating with more people. When an account gets thousands of followers/subscribers, the owner of the account is assumed to assert some influence on the followers. Consequently, these people become influencers or key opinion leaders (KOLs).

KOLs rise in popularity in the online world due to an attractive appearance, talent in a specific domain (e.g. singing, dancing), their connection to a famous celebrity, or some aspect of their personality. Because of the 'Halo Effect' – a term in psychology where people equate good-looking individuals with positive traits – attractive KOLs are usually assumed to possess positive personality traits (Harris & Bardney, 2019). KOLs attract and retain their followers by frequently posting engaging content that engages their viewers. Sometimes this requires preference falsification, but nonetheless KOLs' opinions influences their followers. With enough popularity, it becomes common practice for organizations ask KOLs to serve as the intermediary between a brand and customers. KOLs utilize the word-of-mouth advertising technique but applied in a powerful online context due to context collapse. The KOL economy is a rising trend in mainland China and many businesses have turned to KOLs for advertising instead of using conventional marketing channels.

Being a KOL and following KOLs stimulates heavy Internet Use. As more people want to keep up with the latest trends, the latest news, share their content with their fan base, and stay active in communicating with businesses and customers, they end up spending more time on their smartphones. Indeed, some research found that people who thought about their smartphones were more able to think of words that related to social networks, thereby suggesting a connection between phones and social relationships (Kardos et al., 2018). Smartphones provide opportunities for social connections, but there comes a point where people over-rely on their phones.

Over-Reliance on Phones Fuels Addiction, Polarization, and Mental Health Concerns

A high-end smartphone in the 4G era enabled a plethora of new affordances. Perhaps ironically, the smartphone is no longer used much to make phone calls but instead used for other purposes in a portable manner. People can store personal information, access social networking accounts, travel, and store other personal files all on their electronic devices. Users can access and "look-up" all sorts of information virtually anytime and anywhere because time and geographical location are no longer constraints. People can communicate with family, friends, associates, and colleagues anytime regardless of where they are. Nowadays, the phone can

絲等同於受歡迎程度的斷言取決於每個粉絲是代表一個真實獨特的人／組織的假設。然而，某些帳戶有可能是假的，因為某些帳戶是偽造的或殭屍程式。

隨著人們在社交媒體帳戶上獲得更多關注者，他們的網上帖子（例如照片、視頻、評論、博客）將被廣播給更多人。一個擁有一千個關注者的帳戶分享的帖子，與一個擁有一百個關注者的帳戶分享的帖子相比，平均而言前者將被更多人看到。因此，擁有更多關注者的帳戶在與更多人交流時會更有效益。當一個帳戶有成千上萬的粉絲／訂戶時，可以假定該帳戶的擁有者對粉絲產生一定的影響。因此，這些人將成為具影響力的人或關鍵意見領袖（KOL）。

KOL 由於具有吸引的外貌，特定領域的才能（例如唱歌，跳舞），與知名人士的聯繫，或其個性的某些特質，KOL 在網絡世界中的知名度因此得以提升。由於「光暈效應」（Halo Effect）- 這一心理學術語，人們將長相好的人等同於具有積極特質的人，因此通常認為有吸引力的 KOL 具有積極的人格特質（Harris 和 Bardney，2019 年）。KOL 通過頻繁發布引人入勝的內容來吸引並留住他們的粉絲。有時，這需要偽造偏好，但 KOL 的意見仍然會影響其粉絲。隨著 KOL 擁有足夠的人氣，機構要求 KOL 充當品牌和客戶之間的中介已成為一種慣例。由於社交媒體情境崩解，KOL 利用口碑廣告技巧，應用在強大的網上情境中。KOL 經濟在中國大陸呈上升趨勢，許多企業已轉向 KOL 締造廣告宣傳，以取代傳統的營銷渠道。

成為 KOL 和關注 KOL 會刺激互聯網的大量使用。隨著越來越多的人希望跟上最新趨勢，最新消息，與粉絲群分享他們的內容，保持與企業和客戶的溝通交流，他們最終將更多時間花在智能手機上。確實，一些研究發現，想起智能手機的人更容易想到與社交網絡相關的單詞，從而暗示了手機與社交關係之間的聯繫（Kardos 等，2018 年）。雖然智能手機為建立社交聯繫提供了機會，但有時人們會過度依賴手機。

過度依賴手機助長成癮，並導致兩極分化和心理健康問題

4G 時代的高端智能手機帶來了大量新功能。也許諷刺的是，智能手機不再用於打電話，而是以便攜式方式用於其他目的。人們可以在其電子設備上儲存個人資訊，存取社交網絡帳戶，旅行以及儲存其他個人文件。用戶幾乎可以隨時隨地存取和「查找」各種資訊，因為時間和地理位置不再受限制。無論身在何處，人們可以隨時與家人、朋友和同事進行交流。如今，手機還可以用作付款方式，在很大程度上代替了錢包的用途。例如，八達通卡已被集結到手機中，因此大家可以少帶一張卡，使用手機如同八達通卡一般。

also serve as a means for payment which largely substitutes the wallet's purpose. For instance, Octopus card is integrated into one's phone, so people can bring one less card and utilize the phone as if it were an octopus card.

The drastic increase in data use is explained by many reasons, one of which was the launch of several highly successful social media platforms in a narrow window of time. Another reason is the prevalence of smartphones. During the 4G era, the smartphone market became saturated, which made everyone hyper-connected all the time. While there are obvious benefits such as communicating with loved ones without time or geographical constraints, hyper-connectivity have plenty of drawbacks to the point some high-end restaurants do not want the disruption from mobile phone activity and would forbid customers about phones in the restaurants. As noted by one interviewee, hyper-connection blurs the boundary between home and work, which makes it difficult to ignore Email and texts during non-working hours. Indeed, some experimental evidence found that checking Email more increases stress (Kushlev & Dunn, 2015).

A sizable amount of research in psychology found that heavy social media (and by extension Internet use) led to the rise of Internet addiction disorder (Rosen, 2012; Weinstein et al., 2014). Similar lines of research also found the habitual use of mobile apps contribute to compulsive smartphone use (Clements & Boyle, 2018). Even the clinical psychology Diagnostic and Statistical Manual, which classifies all known mental and health disorders, included Internet gaming disorder in its current edition last updated in 2013. Urges and behaviors regarding Internet use is correlated with a whole host of psychological distress symptoms, including insomnia, stress, compulsive need to check in with technology, separation anxiety, and depression (Rosen, 2012; Wang et al., 2018). Actively paying attention to one's smartphone while having face-to-face conversations is shown to be correlated with relationship problems, negative workplace outcomes, and conversation quality (Al-Saggaf & O'Donnell, 2019).

Additionally, heavy social media use contributes to polarization as explained by three steps by a renowned social psychologist Jonathan Haidt (Haidt & Rose-Stockwell, 2019). First, the introduction of the Facebook "like" and the Twitter "retweet" allowed content to be graded and ranked. Second, online posts that contain humor or outrage are more likely to be shared than mundane posts. Third, Facebook and Twitter present one's newsfeed for optimal engagement, such that posts with the most likes, comments, and shares are presented instead of chronological order. Taken together, social media platforms facilitate the spread of outrage and this is exacerbated by mainstream media. To increase news engagement, journalists on social media platforms notice what is most popular and increase viewership of their mainstream media by sharing the same popular stories, which later gets shared back on social media. As a result, stories that involve outrage receive more attention and have a higher likelihood of going viral.

Sharing outrage could be both benevolent and malevolent. On one hand, more transparency on the Internet shedding light on unacceptable behavior (Farrow, 2019). On the other hand, sharing outrage contributes to a "call-out" culture where any post can be manipulated, taken out of context, or even fabricated to shame and ridicule. As such, sensitive issues that benefit from debate are rarely communicated across parties publicly. Even acknowledging a valid argument from someone in the opposing political/religious party can easily get people in trouble from their own party, thereby leaving little room for compromise (Murray, 2019). Instead, posts about outrage are often rewarded and shared. Unfortunately, posts that contain outrage tend to be uncivil, and sharing outrage on

數據使用量急劇增加的原因很多,其中之一就是在很短的時間內就推出了多個非常成功的社交媒體平台。另一個原因是智能手機的普及。在 4G 時代,智能手機市場變得飽和,這使每個人都時刻保持超連接。這樣雖然有明顯的好處,例如與親人溝通不受時間或地域限制,但超連接性有很多缺點,以至於某些高級餐廳不希望受到手機活動打擾,並禁止顧客在餐廳內使用手機。正如一位受訪者所指出的那樣,超連接模糊了家庭和工作之間的界限,這導致在非工作時間難以忽視電子郵件和短信。事實上,一些實驗證據發現,檢查電子郵件會增加壓力 (Kushlev 和 Dunn,2015 年)。

相當數量的心理學研究發現,大量使用社交媒體(以及通過互聯網擴展使用)導致了網絡成癮的上升 (Rosen,2012 年;Weinstein 等,2014 年)。類似的研究也發現,習慣性地使用流動應用程式會導致強迫性使用智能手機 (Clements 和 Boyle,2018 年),甚至對所有已知精神和健康疾病進行分類的臨床心理學《診斷和統計手冊》,在其 2013 年更新的最新版本中也包括互聯網游戲障礙。與互聯網使用有關的衝動和行為與許多心理困擾症狀相關,包括失眠、壓力、迫切需要技術檢查,分離焦慮和抑鬱症 (Rosen,2012 年;Wang 等,2018 年)。面對面交談時積極注意自己的智能手機,與人際關係問題、負面工作場所結果和談話質量均有相關性 (Al-Saggaf 和 O'Donnell,2019 年)。

此外,社交媒體的大量使用導致兩極分化,著名的社會心理學家喬納森●海特 (Jonathan Haidt) 通過三個步驟進行了解釋 (Haidt 和 Rose-Stockwell,2019 年)。首先,臉書的「贊」和推特的「轉推」的引入允許對內容進行分級和排名;其次,與平凡的帖子相比,包含幽默或暴行的網上帖子更容易被分享;第三,臉書和推特展示某人的新聞是為了實現最佳互動,這樣一來,就可以根據最多「贊」,評論次數和分享次數顯示帖子,而不是按時間順序排列;社交媒體平台共同促進了憤怒的蔓延,而主流媒體則加劇了這種憤怒。社交媒體平台注意到最流行的內容,並通過共享相同的流行故事來增加其主流媒體的觀看率,這些故事隨後又在社交媒體上重新分享,因此,涉及憤怒的故事將受到更多關注,並更有可能散播開去。

分享憤怒既是和睦又充滿惡意。一方面,互聯網上的更高透明度揭露人們無法接受的行為 (Farrow,2019 年)。另一方面,共享憤怒會助長「召喚」文化,在這種文化中,任何帖子都可以被操縱,斷章取義,甚至被製造成可恥和可笑的。因此,從辯論中受益的敏感問題很少在各方之間公開交流。即使承認反對的政黨 / 宗教黨派中某人的有效論點,也很容易使人們從自己的政黨中遇到麻煩,以致幾乎沒有妥協的餘地 (Murray,2019 年)。相反,有關憤怒的帖子通常會得到獎勵和分享。不幸的是,包含憤怒的帖子往往是不文明的,並且在互聯網上共享憤怒會加劇政治兩極化。互聯網政治討論中的頑固態度使人們認為強有力的論點是不合理和厭惡的。一些研究人員發現,無論論點是強還是弱,在網上遇到不文明帖子的人都認為評論的理性程度較低 (Popan 等,2019 年)。該研究表示,如果一方在網上表現出不文明的行為,就無法說服他人。

the Internet exacerbates political polarization. Incivility on Internet political discussions makes people perceive strong arguments as irrational and aversive. Some researchers found that people who encountered uncivil posts online rated the comments as less rational regardless of argument is strong or weak (Popan et al., 2019). This line of research implies that convincing others will not work if one's party behaves uncivil online.

Addiction and polarization to smartphones have been attributed to mental health issues because of people's over-reliance on them. Although mobile communication can allow closer contact with family members and reduce the psychological distance between those living in different countries, people have less in-person communication because we rely too much on social media tools for communication by text. Also, people may be very anxious when they lose their phone because it stores a lot of private information. Losing one's phone removes people's access to online activities such as escaping their real-life problems like loneliness.

On an affective (i.e. emotional based) level, the concerns behind losing one's phone seems to be widespread, such that the expressions of 'no mobile phone' and 'phobia' has been combined to form the psychological construct 'nomophobia', which refers to separation anxiety for phones (Nie, Wang, & Lei, 2020). People reported feeling anxious when thinking about their phone powering off suddenly when engaging in online activities, such as messaging, obtaining information, or recreation. Similar lines of research found that those who score higher in smartphone separation anxiety tend to have higher state anxiety, which in turn decreases their working memory (i.e. the amount of information one can hold at a given time; Hartano &Yang, 2016).

Additionally, people's emotional states may plunge due to social comparison. Smartphones allows people to connect with those they would not otherwise meet in real-life. These include celebrities and talented individuals all over the world. As such, people can follow online profiles of people who are superior or inferior to them in a certain domain (e.g. singing, dancing, cooking, and acting) for social comparison. When one compares to someone better, they are conducting upward social comparison. But when one compares to someone worse, they are conducting downward social comparison. While upward social comparison can serve as inspiration and gives people a goal to aim for (e.g. "I want to be as good as Aaron Kwok at dancing"), more often it leads to envy and decreases to subjective well-being and mental health (Jang et al., 2017). In some cases, people want to self-enhance their skills to compensate, and these cases of self-enhancement are picked up by others (who then experience a fall in emotional states), which in turn creates an envy circle (Verduyn et al., 2020). Interestingly, some research found that social comparison leads to a weaker decrease in depressive symptoms if people followed fewer strangers on social media and instead followed more people they knew (Lup et al., 2015).

But, this is not always the case if people experience the fear of missing out. As people can see their friends broadcast their lives on Facebook, Twitter, Instagram – some even on a daily basis – it broadcasts many options that they themselves cannot be pursue and thus induce a sense of exclusion. The form of exclusion leads to the fear of missing out, which is the desire to continually be part of what other people are doing (Przybylski et al., 2013). Some research found that those scoring high in fear of missing out are associated with more depressive symptoms, less mindful attention, and tend to check social media right after waking, during meals, and even while operating motor vehicles (Baker et al., 2016).

由於人們過度依賴智能手機，因此智能手機上癮和兩極分化歸因於心理健康問題。儘管流動通信可以令與家人的聯繫更加緊密，並縮短了居住在不同國家／地區的人們之間的心理距離，但人們的面對面交流則較少，因為我們過度地依賴社交媒體工具以文字短信交流。同樣，人們在丟失手機時可能非常擔心，因為它會儲存很多私人資訊。遺失電話可以使人們無法進行網上活動，例如逃避他們的現實生活問題，如孤獨感。

基於情感的層面上，丟失手機背後的擔憂似乎很普遍，因此，「沒有手機」和「恐懼症」的表達方式已經組合在一起，形成了心理結構「恐懼症」，即手機的分離焦慮（Nie，Wang 和 Lei，2020 年）。人們反映說，當想到自己的手機在進行網上活動（例如訊息收發、獲取資訊或娛樂）時突然關機會感到焦慮。相似的研究發現，在智能手機分離焦慮中得分較高的人往往具有更高的狀態焦慮感，這反過來卻降低了他們的工作記憶力（即人們在特定的時間內可以保存的資訊量；Hartano 和 Yang，2016 年）。

此外，由於社交比較，人們的情緒狀態可能會大幅下挫。智能手機可以使人們與現實生活中無法遇到的事物建立聯繫。其中包括世界各地的名人和才華橫溢的人。這樣，人們可以在某個領域（例如唱歌、跳舞、烹飪和表演）中關注在網上比他們優劣的人進行社交比較。當一個人與一個更好的人進行比較時，他們將進行向上的社交比較。反之，當一個人與一個更糟的人進行比較時，他們正在進行向下的社交比較。向上的社會比較可以激發靈感，並為人們提供一個追求的目標（例如「我想和郭富城一起跳舞」），但更多時候它會引起嫉妒，並降低主觀幸福感和心理健康（Jang 等，2017 年）。在某些情況下，人們想通過自我提升來彌補自己的能力，而這些自我提升的案例會被其他人（後來情緒下降的案例）所接受，這反過來又形成了一個羨慕圈子（Verduyn 等，2020 年）。有趣的是，一些研究發現，如果人們在社交媒體上關注較少的陌生人，而關注更多認識的人，則由於社交比較而導致的抑鬱症狀會減弱（Lup 等，2015 年）。

On a behavioral level, some experimental evidence found that the presence of smartphones decreases enjoyment on face-to-face interactions (Dwyer et al., 2018). In their studies that sampled hundreds of participants, people who were asked to keep their phone on the dining table during a family meal felt more distracted and enjoyed the meal less, relative to people who were asked to put the phone away. Another study had participants maximize their phone interruptions by turning phone alerts on for one week, then minimizing their interruptions by turning notifications off another week. Participants reported higher inattention and hyperactivity during the week notifications were turned on, which in turn led to lower productivity (Kushlev et al., 2016). Additionally, experimental evidence found that smartphone use decreases smiles between strangers (Kushlev et al., 2019a). This line of research points to the general finding that constant connectivity negates one's full attention and emotional benefits of social interaction in subtle ways (Kushlev et al., 2019b).

Furthermore, social media promotes ever-present relational aggression, which is defined as aggression based on manipulating the victim's relationships (Crick et al., 2002). Examples of relational aggression online include threatening to unfriend/exclude, posting embarrassing content to shame someone or to damage one's reputation by spreading rumors. Because people are hyper connected, there is no escape from relational aggression. Even when one blocks content from being posted on their profiles, damaging content can still be posted online for everyone else to see. Prolonged relational aggression has been associated with increases in anxiety and depression, especially for young adults (Twenge, 2017; Twenge & Martin, 2020).

On a cognitive (i.e. mental processes) level, the smartphone serves as a source of transactive memory when one distributes the task of encoding and remembering information from their own working memory to their phone. That is, when people reduce the cognitive demand of remember information (e.g. schedule, appointments, addresses, passwords) by storing it in their phone, they no longer have to remember it because the phone stores that information (Risko & Gilbert, 2016). As a result, the phone serves as an external memory source that people can consult with at any time. While beneficial in many ways, the downside is that the degree of organization of one's smartphone as a digital repository affects people's confidence of recalling important information, such that more organized digital repositories are associated with greater confidence in the knowledge stored within those systems (Hamilton et al., 2016).

Constant connection to the Internet can backfire as people tend to mistake the Internet's knowledge as their own (Ward et al., 2017). Having instantaneously access to the Internet and the ability to 'look up' anything makes people believe they know more than what they truly do, as evidenced by research that found people believe answers they find online are originally stored in their own mind (Fisher et al., 2015). Instantaneous access to the Internet via one's smartphone can also lead to digital amnesia, which occurs when people forget information that can easily be located on the Internet (Wegner & Ward, 2013).

But letting go of one's phone is not easy as the smartphone is often a requirement whenever one leaves their home. This is because the smartphone is capable of serving as one's wallet (e.g. digital payments such as Huawei pay, WeChat pay), one's GPS, and in some cases, one's identification. In mainland China, WeChat has evolved such that its 800+ million users can use it to "hail a taxi, order food delivery, buy movie tickets, play casual games, check in for a flight, send money to friends, access fitness tracker data, book a doctor appointment, get banking statements, pay the water bill, find geo-targeted coupons, recognize music,

但是，如果人們經歷了錯過了的恐懼，情況就並非總是如此。人們可以看到他們的朋友在臉書、推特、Instagram 上廣播他們的生活，甚至是每天都在播報許多他們自己無法追求的選擇，從而引起排斥感。排斥的形式導致人們害怕錯過，亦即是渴望不斷成為其他人正在做的事情的一部分（Przybylski 等，2013 年）。一些研究發現，那些害怕錯過得較高的人會伴有抑鬱症狀，注意力不集中，並傾向於在起床後，進餐時甚至在駕駛車輛時檢查社交媒體（Baker 等，2016 年）。

在行為層面上，一些實驗證據發現，智能手機的存在會降低面對面互動的樂趣（Dwyer 等，2018 年）。在對數百名參與者進行抽樣調查的研究中，被要求在家庭聚餐時將手機放在餐桌上的人相對於被要求將電話擺開的人而言，注意力更分散，享受用餐程度較低。另一項研究讓參與者通過打開一個星期的電話通知來使他們的電話中斷增至最大限度，然後通過在另一周關閉通知來使他們的電話中斷降到最低。參與者匯報稱，在打開通知的一周內注意力不集中和活動過度，導致生產力降低（Kushlev 等，2016 年）。此外，實驗證據表明，使用智能手機可減少陌生人之間的笑容（Kushlev 等，2019a）。這研究指出了一個普遍的發現，即持續的連通性以微妙的方式抵消了人們對社交互動的全神貫注和情感收益（Kushlev 等，2019b）。

此外，社交媒體促進了無休止的關係攻擊，這被定義為基於操縱受害者關係的攻擊（Crick 等，2002 年）。網上關係攻擊的例子包括威脅要取消交友 / 排斥，發布令人尷尬的內容以羞辱某人或通過散佈謠言來破壞某人的聲譽。由於人們之間的聯繫非常緊密，因此無法擺脫關係攻擊。即使有人阻止將內容發布到其個人資料中，破壞性的內容仍可以在網上發布，以供其他人查看。長期的人際關係攻擊與焦慮和抑鬱感的增加有關，特別是對於年輕人（Twenge，2017 年；Twenge 和 Martin，2020 年）。

在認知（即心理過程）層面上，當智能手機將編碼和記憶資訊從人們自己的工作記憶分配到手機時，它充當了交互記憶的來源。也就是說，當人們通過將記住的資訊（例如日程安排、約會、地址、密碼）儲存在手機中來減少對需要記住的資訊的認知需求時，他們不再需要記住它，因為電話會儲存該資訊（Risko 和 Gilbert，2016 年）。因此，手機可以用作外部儲存源，以供隨時查閱。儘管智能手機在很多方面都有好處，但不利之處在於其作為數碼儲存庫的組織程度會影響人們回憶重要資訊的信心，因此，更有組織的數碼儲存庫讓人們對這些系統中儲存的知識更有信心（Hamilton 等 ，2016 年）。

由於人們傾向於將互聯網的知識誤認為自己的知識，因此與互聯網的持續連接會適得其反（Ward 等，2017 年）。擁有立即存取互聯網並具有「查找」任何內容的能力使人們相信自己比真正了解的事情多，研究顯示，人們認為自己在網上找到的答案最初是儲存在他們自己的腦海中（Fisher 等，2015 年）。互聯網存取也會導致數碼失憶，當人們忘記了可以輕鬆在互聯網上找到資訊時，就會發生數碼失憶（Wegner 和 Ward，2013 年）。

然而，放開手機並不容易，因為每當離家外出時，攜帶智能手機通常是必需的。 這是因為智能手機可以用作錢包（例如華為支付、微信支付等數碼付款），全球定位系統（GPS），以及某些情況下的身份證明。在中國大陸，微信已經發展成為擁有八億以上用戶的平台，可

search for a book at the local library, meet strangers . . . follow celebrity news, read magazine articles, and even donate to charity all on one platform" (Susskind, 2018).

4G has propelled an integration of people's lives with smartphones where people stay connected with others all the time. This is made possible with data centers that ensure transmissions are quick and safe. But, heavy use in smartphones contribute to Big Data that is capable of predicting various human traits.

以用來「叫出租車、訂購食品、購買電影票、玩休閒遊戲、辦理登機手續、向朋友匯款、存取健身追踪數據、預約醫生、獲取銀行結單、支付水費單、查找地理位置定向優惠券、識別音樂、在圖書館搜索一本書、結識陌生人 ... 關注名人新聞、閱讀雜誌文章，甚至捐贈給慈善機構，全都在一個平台上」（Susskind，2018 年）。

當人們處於一直與他人保持聯繫時，4G 便推動了生活與智能手機的融合。確保傳輸快速和安全的數據中心可以實現這一目標。然而，大量使用智能手機促成了能夠預測各種人類特徵的大數據。

TGT Hong Kong Data Centre 2
名氣通香港 2 號數據中心

Big Data is Capable of Constructing Online Personality Profiles and Processing Natural Language

Most social media platforms prompt users to upload some identifiable information, such as a profile picture. Because the profile picture often serves as the first impression, people carefully choose what to upload. But, the presence of profile pictures, while useful to serve as the first impression, can backfire as those pictures can be used to predict the user's personality. Personality research in the online world is conceptualized by the Five-Factor Model, which claims to capture people's personality on how they vary on five overarching traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Qiu et al. (2015) recruited over five hundred Chinese participants to complete personality scales, demographic information, and to submit profile pictures voluntarily. Pictures were coded based on various dimensions (e.g., camera position, face visibility, public or private location) and these scores were correlated with the self-reported personality traits. Results show that those picture dimensions can predict basic demographic information (age, gender) and some personality traits. Namely, the "duckface selfie" predicted neuroticism (i.e. sensitivity to negative emotions) and youth, increased camera height predicted agreeableness (i.e. compassion, politeness) and female, and private location predicted conscientiousness (i.e. industriousness, orderliness) and male.

Internet users who learn about the predictive nature of profile pictures may refrain from posting them, but people's personalities can still be predicted without pictures. Matz et al. (2017) aimed to predict the personality traits of 3.7 million people to see how they react to Facebook ads (measured by clicks and download rates). They obtained people's levels of extraversion from myPersonality. org, where participants voluntarily completed personality scales (again based on the Personality Five-Factor Model), and people's Facebook likes. After building a data-driven model that predicts levels of extraversion from Facebook likes, Matz et al. (2017) used

大數據能夠構建網絡個性形象和處理自然語言

大多數社交媒體平台會提示用戶上傳一些可識別的資訊，例如用戶照片。由於用戶照片通常是第一印象，因此人們謹慎選擇要上傳的內容。用戶照片的存在雖然可以用作第一印象，但卻適得其反，因為這些圖片可用於預測用戶的個性。網絡世界中的人格研究是由五因素模型概念化的，該模型聲稱可以捕捉人們的人格特徵，了解他們在五個總體特徵上的變化方式：開放的經驗，認真的態度，性格外向，隨和及神經質。Qiu 等（2015 年）招募了五百多名中國參與者，以完成人格量表，人口統計資訊並自願提交用戶照片。照片是根據各種維數（例如相機位置、面部可見度、公共或私人位置）進行編碼的，這些得分與自我報告的人格特徵相關。結果表明，這些照片的維數可以預測基本的人口統計學資訊（年齡、性別）和某些人格特徵。即「嘟嘴自拍」是預測神經質（即對負面情緒的敏感性）和青年，相機高度增加是預測隨和（即同情、禮貌）和女性，而在私人場所是預測盡責性（即勤奮、有序）和男性。

當互聯網用戶了解到用戶照片的可預測性，他們可能會避免發布這些圖片，可是即使沒有照片，人物的個性仍然可以預測。Matz 等（2017 年）的目的是預測 370 萬人的個性特徵，以了解他們對臉書廣告的反應（通過點擊和下載率衡量）。他們從 myPersonality.org 獲得了人們的外向性水平，參與者在其中自願完成了人格量表（再次基於人格五因素模型），並獲得了他們的臉書贊。Matz 等（2017 年）建立了一個數據驅動模型，該模型可以預測來自臉書的外向性水平。使用了一種實驗範式，將人的外向性（高與低）和廣告外向性（高與低）一分為二。研究人員隨後為這些臉書用戶投放了七天的廣告，發現如果廣告與臉書用戶的外向性相匹配，則廣告參與度會更高；人們更有可能點擊並下載廣告（即填字遊戲）1.3 倍。

an experimental paradigm that dichotomously classified person extraversion (high vs. low) and ad extraversion (high vs. low). The researchers then ran ads over seven days for those Facebook users and found that ad engagement was higher if the ad matched the extraversion of the Facebook users; people were more likely to click and download the ad (i.e. a crossword puzzle game) 1.3 times.

This form of psychological targeting does not stop there. Even without personality self-reports or profile pictures, people's digital footprints inadvertently reveal their personality traits and demographic information. Since the advent of Facebook, the Facebook 'like' became the most generic digital footprint that reveals positive associations with products, sports, musicians, books, brands, and other personal preferences. Kosinski et al. (2013) obtained Facebook Likes (on photos, status updates, Facebook pages) from 58,000 volunteers to predict their age, gender, sexual orientation, ethnicity, religious and political views, personality traits, happiness, and use of addictive substances. These outcome variables were categorized dichotomously, and the predictions were highly accurate. Computers were able to predict demographic information with data-driven models with success rates of over 80% in some categories. These findings imply that people may choose not to reveal certain aspects of oneself such as their age or use of addictive substances, and yet this information can be predicted from what they 'like' on Facebook. Given the ever-increasing amounts of digital footprints people leave behind (and some of which are placed by other people in one's social network), it becomes increasingly difficult for individuals to fully control what attributes they reveal in the online world.

In fact, there is some evidence that computers are now better at predicting one's personality traits than one's own Facebook friends. Wu et al. (2015) recruited over 80,000 participants to complete a 100-item personality questionnaire (i.e. International personality item pool), and computers were tasked to predict the personality of these participants by using only the participants' Facebook 'likes'. Results show that the computer's predictions of personality via Facebook Likes were more predictive than the user's Facebook friends' rating of the user's personality. Subsequent analyses found that more likes from a user increase prediction accuracy substantially, such that computers need approximately 100 'likes' to outperform a friend and 300 'likes' to outperform a spouse.

With abundant data about people's online activities, computers can conduct advanced correlational and Bayesian analyses to predict its users' behaviors. Indeed, one interviewee noted that there are intelligent searches when one buys something from TaoBao or Amazon. These intelligent searches work by analyzing what people tend to buy. If many people who purchase item X tend to also purchase item Y (thereby indicating a positive correlation between item X and item Y), then people who buy item X are notified about item Y. As more data is obtained, more complex algorithms are able to predict what cluster of items people will likely buy.

As it stands now, Big Data is capable of predicting demographic information and behavioral patterns. But it does not stop there; computers are able to process people's language. Psycholinguists and psychologists have long found that people's choice of words inadvertently reveals demographic information, personality traits, and thought processes (Pinker, 2007). As such, psychologists are interested in studying people's language online, which gave rise to computerized textual analysis. In the past, studying how language reveals one's emotionality, social relationships, deception, thinking styles, and demographic information has been cumbersome and limited because researchers have to code responses by hand and much of the research participants were college students (Tausczik

這種形式的心理定位並不僅限於此。即使沒有個性自我報告或用戶照片，人們的數碼足跡也會無意間透露出他們的個性特徵和人口統計資訊。自從臉書出現以來，臉書的「贊」成為最通用的數碼足跡，它揭示了與產品、體育、音樂家、書籍、品牌和其他個人喜好的積極聯繫。Kosinski 等（2013 年）從 58,000 名志願者那裡獲得了臉書贊（通過照片、狀態更新、臉書頁面），以預測他們的年齡、性別、性取向、種族、宗教和政見、人格特質、幸福和成癮性物品的使用。將這些結果變量二分法分類，而預測是非常準確。電腦能夠使用數據驅動的模型預測某些類別的人口統計資訊，成功率超過 80%。這些發現暗示人們可能選擇不透露自己的某些方面，例如年齡或上癮物品的使用，但是這些資訊可以通過他們在臉書上的「贊」來預測。鑑於人們日益留下數碼足跡（其中一些足跡被其他人放置在某人的社交網絡中），人們越來越難以完全控制自己在網絡世界中所展現的屬性。

事實上有證據指出，電腦現時比個人的臉書朋友更能預測個人的性格特徵。 Wu 等（2015 年）招募了 80,000 多名參與者，以完成一項 100 個項目的個性問卷（即國際個性項目庫），並要求電腦僅使用參與者的臉書「贊」來預測這些參與者的個性。 結果顯示，電腦通過臉書贊對個性的預測比用戶的臉書朋友對用戶個性的評價更具預測性。隨後的分析發現，來自用戶的更多「贊」大大提高了預測準確性，因此電腦需要大約 100 個「贊」來勝過朋友，和需要 300 個「贊」來勝過配偶。

電腦可以利用有關人們網上活動的大量數據，進行先進的關聯和貝葉斯分析，以預測用戶的行為。一位受訪者確實指出，當人們從淘寶或亞馬遜購買商品時，就會進行明智的搜索。這些智能搜索通過分析人們購買東西的傾向來操作。如果許多購買商品 X 的人也傾向於購買商品 Y（從而表明商品 X 和商品 Y 之間存在正相關關係），那麼就會向購買商品 X 的人通知有關商品 Y。隨著獲得越來越多的數據，便能夠使用更複雜的算法預測人們可能會購買哪些商品。

就目前而言，大數據能夠預測人口統計資訊和行為模式。但是它並不止於此； 電腦能夠處理人類的語言。心理語言學家和心理學家早就發現，人們對單詞的選擇會無意間透露出人口統計學資訊，人格特質和思維過程（Pinker，2007 年）。因此，心理學家對網上學習人們的語言很感興趣，這引起了電腦文本分析的興起。過去，研究語言如何揭示自己的情感，社會關係，欺騙，思維方式和人口統計資訊一直很繁瑣且有限，因為研究人員必須手動編寫回響代碼，而且許多研究參與者都是大學生（Tausczik 和 Pennebaker，2010 年 ）。如今，自然語言處理背後的研究方法已經發生了巨大變化，方法是快速收集和分析各種領域中的大量文本樣本。

目前，探索與字詞計算（Linguistic Inquiry Word Count）是用於研究用什麼字眼可揭示人的心理的最廣泛使用的程式之一（Pennebaker，Mehl 和 Niederhoffer，2003 年）。由於其原有概念是研究負面情緒寫作的有益效果，探索與字詞計算現在可以根據 70 多種文本形音義（例如代詞、認知過程、感知過程、道德行為）來跟蹤個人敘事、對話、小説和其他體裁基礎。雖然對字詞進行計算聽起來很初級，但僅對字詞進行計算就已經可以預測人們的年齡、狀態、欺騙、健康狀況和相關結果（Pennebaker，2013 年）。例如，在整個生命週期中，人們使用更多積極詞，更少單數第一人稱，增加過去式，複雜化詞語。使用第一人稱代詞表示狀態低落，抑鬱症狀以及誠實。

& Pennebaker, 2010). Today, research methodology behind natural language processing has changed drastically by collecting and analyzing big samples of text across a variety of domains in a rapid fashion.

Currently, one of the most widely used programs to study what words reveal about people psychologically is the Linguistic Inquiry Word Count (Pennebaker, Mehl, & Niederhoffer, 2003). Since its original conception that studies the beneficial effects of writing about negative emotions, the Linguistic Inquiry Word Count now tracks personal narratives, conversations, novels, and other genres based on over 70 textual dimensions (e.g., pronouns, cognitive processes, perceptual processes, moral foundations). While counting words may sound rudimentary, counting words alone is already capable of predicting people's age, status, deception, health, and related outcomes (Pennebaker, 2013). For instance, people use more positive words and fewer first-person singular, more past tense, and more complex words over the lifespan. Using first-person pronouns is indicative of low status, depressive symptoms, and also honesty.

Apart from the Linguistic Inquiry Word Count, there are other programs that process people's language to analyze their psyche. One recently-created computer program analyses the complexity of texts (Conway et al., 2014). This computer program called the Automated Integrative Complexity (or Auto IC) scores the overall complexity of a passage of text based on differentiation (number of separate concepts evoked about a particular topic) and integration (connections made between the topics evoked). Simple texts indicate a relatively unidimensional structure of an idea, while more complex texts represent multi-faceted thoughts about an idea. Further, the Auto Integrative Complexity system scores elaborative complexity (the extent to which the text is one-sided) and dialectical complexity (the extent to which the text considers alternative perspectives).

The complexity of ideas has shown to predict a plethora of significant outcomes. For example, complexity predicts war outbreaks, maintaining political power, lying, health, and terrorism (Repke et al., 2018; Conway & Woodard, 2020). Leaders are capable of manipulating how complex (or how simple) they communicate as a means of influence (Chan et al. 2020). Clearly, computers can use digital footprints to understand people based on linguistic content and complexity, and these programs to analyze data are much quicker than human coders.

Every time someone uses the Internet for impression management strategies to convey a specific persona or to search something on a search engine, they leave digital footprints that let computers learn more about them. Even what we listen to on Spotify, watch on Netflix, or order on Amazon becomes data for computers to learn about us (Mitnick, 2017). In other words, our digital footprints reveal more than what we want others to know. Given this revelation, are people motivated to hide their true selves online? In the next section, we argue why online deception cultivates both malicious self-disclosure and mass misinformation.

Online Deception Provides a Safe Haven for Malicious Self-Disclosure and Mass Misinformation

There are psychological mechanisms that facilitate deception in the online world. We discuss the most prominent one: the online disinhibition effect. People often behave differently in the online world because psychological restraints that regulate behavior are weakened, which in turn disinhibits people's behavior. In one of the most widely cited cyberpsychology articles, Suler (2004)

除了探索與字詞計算外，還有其他程式可以處理人們的語言以分析其心理。最近創建的一種電腦程式可以分析文本的複雜性（Conway 等，2014 年）。該電腦程式稱為自動化綜合複雜性（或「自動 IC」），它根據差異對一段文字的整體複雜性區分（關於特定主題的單獨概念的數量）和綜合（引起話題之間的聯繫）進行評分。簡單的文本表示一個想法的相對「單一」結構，而更複雜的文本表示一個想法的多方面思考。此外，自動化綜合複雜性系統對詳盡的複雜性（文本為單面的程度）和辯證複雜性（文本考慮替代觀點的程度）評分。

想法的複雜性已顯示可以預測大量重大結果。例如，複雜性預測戰爭爆發，維持政治權力，撒謊，健康和恐怖主義（Repke 等，2018 年；Conway 和 Woodard，2020 年）。領導者有能力操縱他們溝通的複雜程度（或簡單程度），作為一種影響力的手段（Chan 等，2020 年）。顯然，電腦可以根據語言內容和複雜程度來利用數碼足跡理解人們，並且這些程式分析數據的速度比人類編碼員快得多。

每當有人使用互聯網進行印像管理策略來傳達特定角色，或在搜索引擎上進行搜索時，他們都會留下數碼足跡，從而讓電腦了解更多有關他們的資訊。甚至我們在 Spotify 上聆聽，在 Netflix 上觀看或在亞馬遜上訂購的內容都變成了電腦了解我們的數據（Mitnick，2017 年）。換句話說，我們的數碼足跡揭示了比我們希望別人知道的更多。鑑於這一啟示，人們是否有動機在網上隱藏自己的真實自我？在下一節中，我們討論為什麼網絡欺騙會同時培養惡意的自我披露和大量的錯誤資訊。

網絡欺騙為惡意自我披露和大量錯誤資訊提供了避風港

有一些心理機制可以造成網絡世界中的欺騙。我們現討論最突出的一個：網絡解禁作用。人們在網絡世界中的行為通常會有所不同，因為調節行為的心理約束被削弱了，從而解禁了人們的行為。在被廣泛引用的網絡心理學文章之一中，Suler（2004 年）解釋了這種現象背後的六種機制，即網絡解禁作用。第一種機制是分離匿名，它認為網上自我是分離的，因為匿名將一個人的網上自我與現實自我分離。第

explains the six mechanisms behind the phenomenon known as the online disinhibition effect. The first mechanism is dissociative anonymity, which argues that the online self is compartmentalized since anonymity detaches one's online self from one's offline self. The second mechanism is invisibility, which argues that since people cannot see one another online (even when they know the other's identity), they are less concerned about how they sound or look when they communicate. The third mechanism is asynchrony, which means people do not interact in real-time. Delays in response time could lead to people coming back to the conversation whenever one feels it is convenient to do so, occasionally to the point of what Suler calls 'emotional hit-and-run.' The fourth mechanism is solipsistic introjection, which occurs when people subvocalize as they read their texts as if they are talking to themselves. Disinhibition strengthens when this introjected character feels subjectively real. The fifth mechanism is dissociative imagination, which occurs when people feel that their online personas are characters they created in the online realm is in an entirely separate space. The last mechanism is the minimization of status and authority, which argues that norms in the online world are less strict and less enforced. Taken together, these six factors explain why people tend to behave more disinhibited online, and recent research supports its relevance to the online world today (Schlosser, 2020).

Malicious Self-Disclosure

Online disinhibition has implications for developing and maintaining interpersonal relationships in the online world. Namely, the degree to which people reveal personal information about oneself – known as self-disclosure - signals trust, liking, and increased commitment to the relationship (Reis & Shaver, 1988; Sprecher, et al. 2013). Recipients can interpret disclosure as desire to form a more intimate relationship, which in turn causes people to disclose to those whom they like and trust since self-disclosure is simultaneously vulnerable and rewarding (Tamir & Mitchell, 2012).

Individuals who disclose intimate topics report increased closeness relative to non-intimate/non-emotional 'small-talk' topics. Notably, disclosure can be categorized as factual (e.g. descriptive statements) or emotional (e.g. private feelings and judgments), with the latter being a stronger predictor of intimacy than self-disclosure of facts.

Although self-disclosure has various benefits, it can be risky as revealing personal information can be used against oneself if there is a record of what is said in the online world. To this end, some people might fake self-disclosure to get others to self-disclose to obtain sensitive information that can be used for future blackmail.

Mass Misinformation

Online deception is 1) intended to mislead and 2) communicated in a technologically mediated message (Hancock, 2007). In the online world, deception is broadly classified as either message-based or identity-based. As the name implies, message-based deception refers to creating or sharing fictitious messages. To qualify as a deceptive message, the sender must be aware that the message is fabricated while the receiver is not aware (Finneman & Thomas, 2018). There are many forms of message-based deception, including full fabrication, fact fabrication, date-time fabrication, source fabrication, quote fabrication, and plagiarism.

But is message-based deception a unique issue in the online world? Some research found that there is more message deception when people communicate online. For instance, Naquin et al. (2010) argued that Email communication is subject to more negative language, more inhibited behavior, and is more

二種機制是隱身性，該機制認為由於人們無法在網上看到對方（即使他們知道對方的身份），因此他們不必擔心自己在交流時的聲音或表情。第三種機制是異步性，這意味著人們不會實時交互。延遲的回應時間可能導致人們在覺得方便的時候會回到對話中，有時甚至達到Suler 所說的「情緒奔跑」(emotional hit-and-run) 的地步。第四種機制是單語插入，當人們在閱讀文本時就好像在自言自語一樣發聲。當這個內向型人物主觀感覺真實時，禁忌感就會增加。第五種機制是分離性想像，當人們認為他們的網上角色是他們在網絡領域中創造時，就會發生這種分離。最後一種機制是地位和權威的最小化，該機制認為網絡世界中的規範不那麼嚴格，執行也不那麼嚴格。綜上所述，這六個因素可以解釋為什麼人們傾向於在網上表現得更加放蕩，最近的研究支持這些機制與當今網絡世界的相關性（Schlosser，2020年）。

惡意自我披露

網上解禁對於發展和維持網絡世界中的人際關係具影響力。即是人們在多大程度上透露自己的個人資訊（稱為自我披露）表示信任，喜歡和增強對關係的承諾（Reis 和 Shaver，1988 年；Sprecher 等，2013 年）。接受者可以將披露解釋為渴望建立更親密的關係，這又使人們向他們喜歡和信任的人披露資訊，因為自我披露既脆弱又得益（Tamir 和 Mitchell，2012 年）。

與非親密 / 非情感化的「閒聊」主題相比，披露親密主題的人表示親密感是有增長的。值得注意的是，披露可以分為事實性（例如描述性陳述）或情感性（例如私人感覺和判斷），與事實的自我披露相比，後者更能預示親密關係。

儘管自我披露有多種好處，如果曾說的話在網絡世界中留有記錄，洩露個人資訊會帶來風險和危害自己。為此，某些人可能會偽造自我披露，而讓其他人進行自我披露，以獲取將來可用於勒索的敏感資訊。

大量錯誤信息

網絡欺騙是 1) 意圖誤導和 2) 以技術為媒介的訊息交流（Hancock，2007 年）。 在網絡世界中，欺騙大致分為基於訊息的或基於身份的。顧名思義，基於訊息的欺騙是指創造或分享虛擬訊息。要獲得欺騙性訊息的資格，發送者必須知道訊息是捏造的，而接收者卻不知道（Finneman 和 Thomas，2018 年）。基於訊息的欺騙有很多形式，包括完整的偽造，事實的偽造，日期時間的偽造，來源的偽造，報價的偽造和抄襲。

但是基於訊息的欺騙在網絡世界中是否是一個獨特的問題？一些研究發現，當人們網上交流時，會有更多的訊息欺騙。例如，Naquin 等（2010 年）認為，電子郵件交流更容易受到負面語言的影響，行為受到更多的抑制，並且在心理上更加疏遠。研究參與者被隨機分配參加

psychologically distant. Participants in their study were randomly assigned to play the ultimatum game (i.e. a game about distributing resources between two people) where players communicated via Email or pen-and-paper. Results show that those in the Email condition deceived more, and this effect was explained by the permissiveness of misrepresenting their answers online.

In contrast, identity-based deception pertains to creating a false identity. In the online world, anyone can lie about personal information (e.g., age, gender, ethnicity, occupation, life experiences) and can join or leave virtually any online context whenever they please. Because the majority of social networking sites do not require identity verification or pose a restriction on how many accounts one can possess, little regulation stops identity deception. Without regulation, instances of malicious identity deception are rather prevalent in the cyberspace. For instance, there are established groups that specialize in online romance scams. Whitty and Buchanan (2015) examined the psychological impacts of online romance scams by interviewing victims. In most cases, the scammers gain the victim's trust by self-disclosing and declaring one's love and the intention of starting an exclusive relationship with the victim, followed by frequent and intense communications. The scammer will then ask for gifts that increase in monetary value over time. When the victim finds out the online romance is a scam, some reported that the emotional loss was more damaging than the financial loss, some had issues coping, and many had negative views of online relationships afterward.

Instances like these where scammers manipulate victims to disclose sensitive information is known as social engineering. Social engineering methods often capitalize on both message and identity deception to achieve their goals of embarrassment, blackmail, and manipulation (Hancock, 2007; Whitty & Young, 2017; Mitnick, 2017). A lucid example would be phishing scams, where scammers successfully tricked victims into disclosing their Email passwords because scammers pretended to be authority figures to get victims to disclose personal information.

Yet despite the potentially detrimental effects of online deception, there are arguments for concealing one's identity. People conceal some facets of their identity because the online world is a safe haven to avoid perceived stigma behind marginalized identities that are biologically based (e.g., ethnic or sexual minorities) or choice-based (e.g., drug users). Alternatively, some may choose to conceal their identity because they treat the online world as a form of escape that provides anonymity they cannot attain in the offline world. However, the outcomes of concealment are not always clear. Some research found that endorsement to conceal one's marginalized identity was positively associated with self-esteem (Plante et al., 2013), but other research finds that long-term concealment of marginalized identities is associated with anxiety and depression (Pachankis, 2007). Regardless of the outcome, there are clear motivations for online deception.

Social engineers have clear motivations behind online deception, and advances in digital technology continue to expand their arsenal. Technology today that manipulates fake photos and videos to sound or look like someone else is known as "Deepfakes." Deepfake technology arose from computers learning to replicate patterns from Big Data, and applications of this technology are beginning to proliferate. Although this sort of technology can be beneficial in some ways such as recreating the voice of a historical figure to educate children, or to restore speech to people who lost their voice, social engineers can employ Deepfakes to put people's faces on unsettling avenues (e.g., adult videos) to be used to blackmail, to intimidate, or to plant fake evidence (Chesney & Citron, 2019). Implications of Deepfakes are huge, as fact and fiction become harder to discern. As audio and video content cannot always be

最後通牒遊戲（即在兩個人之間分配資源的遊戲），玩家通過電子郵件或筆和紙進行交流。結果表明，處於電子郵件條件下的那些人受騙的可能性更大，這種影響是由於在網上錯誤地陳述了他們的答案而造成的。

相反，基於身份的欺騙與創造虛假身份有關。在網絡世界中，任何人都可以將個人資訊撒謊（例如年齡、性別、種族、職業、生活經歷），並且可以隨時隨地虛擬加入或離開任何網上環境。由於大多數社交網站不需要身份驗證或限制每人可以擁有多少帳戶，因此幾乎沒有法規可以阻止身份欺騙。如果沒有監管，惡意身份欺騙的實例在網絡空間中相當普遍，例如，有一些專門從事網上戀愛騙局的組織。Whitty 和 Buchanan（2015 年）通過採訪受害者，考察了網絡浪漫騙局的心理影響。在大多數情況下，詐騙者會通過自我披露並宣告自己的愛，以及與受害者建立排他關係的意圖，然後通過頻繁而激烈的溝通來贏得受害者的信任。騙子然後會要求禮物，這些禮物會隨著時間的推進而增加金錢價值。當受害者發現網絡戀情是一個騙局時，一些人表示情感損失比經濟損失更具破壞性，一些人有困難應對損失，許多人事後對網上關係持負面看法。

這類騙子操縱受害者使其披露敏感資訊的情況被稱為社交工程。社交工程方法通常利用訊息和身份欺騙來實現其尷尬、勒索和操縱的目的（Hancock，2007 年；Whitty 和 Young，2017 年；Mitnick，2017 年）。一個清晰的例子是網絡釣魚詐騙，詐騙者成功地誘騙受害者公開其電子郵件密碼，因為詐騙者假裝是權威人物以誘使受害者披露個人資訊。

然而，儘管網絡欺騙潛在有害影響，但仍有隱瞞自己身份的爭論。人們隱藏自己身份的某些方面，是因為網絡世界是避開基於生物學（例如種族或性少數群體）或基於選擇（例如吸毒者）的邊緣化身份背後恥辱感的避風港。另外，有些人可能選擇隱藏自己的身份，是因為他們將網絡世界視為逃脫形式，提供了現實世界無法獲得的匿名性。但是，隱藏的結果並不總是很清楚。一些研究發現，認可隱瞞自己的邊緣化身份與自尊成正相關（Plante 等，2013 年），但其他研究發現，長期隱瞞邊緣化身份與焦慮和抑鬱相關（Pachankis，2007 年）。無論結果如何，網絡欺騙都是有明確的動機的。

社交工程師在網上欺騙背後有著明顯的動機，而數碼技術的進步繼續擴大他們的武器庫。如今，處理偽造的照片和視頻以致聽起來或看起來像其他人的這種技術被稱為「深偽」（Deepfakes）。Deepfake 技術源於電腦從學習大數據中復制模式的技術，該技術的應用並正開始激增。儘管這種技術在某些方面可能是有益的，例如重新創建歷史人物的聲音作為教學用途，或者讓失去聲音的人恢復講話，但社會工程師可以利用 Deepfakes 將人們的臉龐放在令人不安的途徑（例如，成人視頻）用於勒索、恐嚇或植入虛假證據（Chesney 和 Citron，2019 年）。Deepfakes 的含義是巨大的，因為事實與虛構變得更難辨別。由於音頻和視頻內容不能總是信以為真，因此欺詐性視頻變得更難抹黑，而真實的視頻反過來可能更容易被抹黑。結果是錯誤資訊的劇增。

taken at face value, fraudulent videos become harder to discredit, and authentic videos might, in turn, become more easily discredited. Consequently, misinformation is exacerbated.

The prevalence of online deception cultivates mass misinformation. While the exact rate of misinformation online is challenging to determine, people do not know what to trust or not trust. As a result, there have been calls for governments and tech companies to work together to increase cybersecurity and reduce misinformation (Smith & Browne, 2019). However, increasing cybersecurity is no easy task due the increased proficiency of cybercrimes.

Ongoing Battle Between Cybercrimes and Cybersecurity

Advances in smartphone technology inevitably come with it the risk of cybercrimes. In today's digital age, countless individuals use the Internet for work and leisure on a daily basis, but the downside is that increased information technology use predicts increased susceptibility to cybercrime victimization (Cheng, Chan, & Chau, 2020). Unfortunately, implementing effective cybersecurity is strenuous because it has to defend against the unique characteristics of cybercrime (Chan & Chan, 2018b). Namely, cybercrimes can 1) attack regardless of physical location, 2) attack at any time, 3) be anonymous and untraceable in some cases, 4) succeed with only one attempt. In some ways, cybercrimes, which are continually evolving alongside technological advances, are more dangerous than conventional crimes.

Some of the most common types of cybercrime according to the Cyber Security and Technology Crime Bureau of the Hong Kong Police Force are: online game-related crime, Internet/e-mail account abuse, e-mail scams, hacking, online shopping fraud, other online fraud (e.g., e-auction fraud), credit card misuse, and social media deception. Further, technological-based cybercrimes include viruses, spyware, ransomware, and distributed denial of service (DDoS). As cybersecurity measures increase, so too do cybercrime methodologies, thereby creating a mutual battle between cybercrime and cybersecurity. Given the prevalence of cybercrime in Hong Kong – where the total number of reported cybercrime cases in Hong Kong has soared more than fivefold from 2009 to 2018 - we can be reassured that the operators have implemented measures for their customer's data security. China Mobile encrypts its customer data which makes individual information to be impossibly interpreted by intruders. Huawei has implemented fingerprint and face ID lock that secures customers' data.

Our interviewees noted that the ICT sector are working arduously to enhance cybersecurity. Different organizations in the world such as European Union and international standard bodies continue to study the 5G Cybersecurity concern, and mitigation measures will be deployed to minimize the security risk. Another way to keep your mobile data safe is to store them in cloud servers instead of storing them in your phone. But no matter how secure one's data is, there is still a non-zero chance that people fall to cybercrime. In fact, cybercrimes tend to target new applications that might yield the most valuable data to exploit, whether it be a new social media app or a video conferencing platform.

What happens after cybercrime occurs? Some research found that falling prey to cybercrimes – specifically the most common cybercrimes listed by the Hong Kong police force mentioned above - is associated with decreased perceived fairness, control, trust in the online world, life satisfaction, and happiness (Cheng et al., 2020). With ever-present social engineering ploys, people have to remain vigilant in all online activities to prevent those detrimental outcomes from occurring. Given that what is posted

網絡欺騙的盛行會滋生大量錯誤資訊。儘管很難確定網上錯誤資訊的確切發生率，但人們不知道什麼該信任或不信任。於是，人們呼籲政府和科技公司共同努力以提高網絡安全性並減少錯誤資訊（Smith 和 Browne，2019 年）。可是，由於網絡罪案的熟練程度不斷增進，提高網絡安全並非易事。

網絡罪案與網絡安全之間的持續對戰

智能手機科技發展中不可避免的是隨之而來的網絡罪案風險。在當今的數碼時代，無數人每天都在互聯網進行工作和休閒活動，但不利的一面是，資訊科技使用的不斷增加，正預示著因網絡罪案受害的可能性會越來越大（Cheng，Chan 和 Chau，2020 年）。不幸的是，實施有效的網絡安全非常費力，因為它必須防禦網絡罪案的獨特特徵（Chan 和 Chan，2018b）。即網絡罪案可以：1）不受物理位置的攻擊；2）隨時攻擊；3）在某些情況下是匿名且不可追蹤的；4）僅一次嘗試即可成功。在某些方面來看，網絡罪案隨著科技發展一起不斷演進，實在是比常規罪案更加危險。

根據香港警務處網絡安全及科技罪案調查科，最常見的網絡罪案類型包括：與網絡遊戲有關的罪案、互聯網 / 電子郵件帳戶濫用、電子郵件詐騙、黑客攻擊、網上購物欺詐、其他網上詐騙（例如，電子拍賣欺詐）、信用卡盜用和社交媒體欺騙。此外，基於技術的網絡罪案包括病毒、間諜軟件、勒索軟件和分佈式拒絕服務（DDoS）。隨著網絡安全措施的增加，網絡罪案方法也隨之上升，從而在網絡罪案和網絡安全之間引發了一場相互對戰。鑑於香港的網絡罪案盛行（從 2009 年到 2018 年），香港網絡罪案舉報案例總數激增逾五倍。但我們可以放心，電訊商已採取措施保護其客戶的數據安全。中國移動將其客戶數據加密，從而使入侵者無法闡釋個人資訊。華為已經實施了指紋和人臉身分識別鎖來保護客戶的數據。

我們的受訪者指出，ICT 業界正在努力提高網絡安全性。世界各地的不同組織，例如歐盟和國際標準組織，都在持續研究 5G 網絡安全問題，並將採取緩解措施以最大程度地降低安全風險。另一保證流動數據安全的方法是將其儲存在雲服務器中，而不是儲存在手機中。但是，無論數據的安全性如何，人們陷入網絡罪案的可能性仍然為非零。事實上，無論是新的社交媒體應用程式還是視頻會議平台，網絡罪案都傾向於針對可能產生最有價值數據的新應用程式進行攻擊。

網絡罪案發生後會怎樣？一些研究發現，淪為網絡罪案（尤其是上述香港警務處列出的最常見的網絡罪案）的獵物與下降的公平感，控制力，對網絡世界的信任，生活滿意度和幸福感有關（Cheng 等，2020 年）。隨著社會工程手段的不斷發展，人們必須在所有網上活動中保持警惕，以防止發生不利的後果。鑑於網上發布的內容可以永久保存，任何由本人或他人在社交媒體平台或相關領域發布的令人尷尬的照片都可能被用於勒索和操縱（Mitnick，2017 年）。如果其他用

online can remain permanent, any embarrassing photo posted on social media platforms or related arenas by oneself or others could potentially be used for blackmail and manipulation (Mitnick, 2017). Even Facebook posts or Tweets that are deleted can still be exploited if other users saved the post before deletion. In sum, the new affordances provided by smartphones in the 4G era opens doors for cybercrimes, which in turn call for increases in cybersecurity.

The era of 4G prompted many changes in the human psyche; some for the better and some for the worse. We next move onto the social psychological impact of 5G.

Social Psychological Impact of 5G (2020 onwards)

The year 2020 marks the launch of the new 5G era that will transform industries and societies to fully integrate automated immersive technology. 5G would increase data transmission (including upload and download speeds), connect millions of smart devices, and reduce latency. Soon, applications behind augmented reality, artificial intelligence, virtual reality, and the Internet of Things would make Hong Kong to become a smart city. But, getting there would require initiatives from the Hong Kong telecom operators and related research institutions and manufacturers.

Achieving proper handover to 5G mobile networks would result in uninterrupted service while developing new applications. These include developing Cloud computing, AI, cloud games, AR, and VR. 5G can boost the operational efficiency, new service offerings, and enhance customer experience of the enterprises. The telecommunication industry facilitates the flow of people, goods, capital and information which can drive economic development of a society. In time, 5G would support fast financial transactions and bring more innovation to the financial industry such as smart banking, smart finance and asset management.

戶在刪除前保存了帖子,那麼即使是被刪除的臉書帖子或推文也仍然可以被利用。總而言之,智能手機在 4G 時代提供的新能力為網絡罪案打開了大門,而反過來又需要呼籲提高網絡安全性。

4G 時代引發了人類心理的許多變化。有些變得更好,有些變得更糟。接下來,我們將探討 5G 的社會心理影響。

5G 帶來的社會心理影響（2020 年以後）

2020 年標誌著嶄新的 5G 時代的來臨,它將改變各行各業及社會,將之全面融入自動化的科技年代。5G 將增加數據傳輸（包括上載及下載速度）,連接數百萬個智能終端裝置及減低時延。不久將來,在擴增實境（AR）、人工智能（AI）、虛擬實境（VR）、物聯網（IoT）背後的應用,將會引領香港成為一個智慧城市。不過,要成功實現這個目標,仍需要香港電訊營運商,相關的研究機構和製造商通力合作,共同推進才得以達成。

在開發新應用程式時,需要正確切換至 5G 流動網絡,才不會令服務出現中斷,這些包括雲計算、AI、雲遊戲、AR 和 VR。5G 能夠提高營運效率,提供新服務和加強企業的客戶體驗。電訊業協助促進人流、貨物流,資本流和資訊流,從而帶動社會的經濟發展。與此同時,5G 亦支援快速金融交易,為金融業帶來更多創新的應用,如智慧銀行,智慧金融和資產管理等。

Ms. Susanna Hui, Group Managing Director of HKT (center), together with (from left) Mr. Peter Lam, Managing Director of HKT Engineering; Mr. Tom Chan, Managing Director of HKT's Commercial Group; Mr. Bruce Lam, Managing Director of CSL Consumer Mobile, announce 5G service to be launched on April 1.
香港電訊集團董事總經理許漢卿女士（中）聯同（左起）工程部董事總經理林榮執先生、商業客戶業務董事總經理陳紀新先生及無線業務市場營銷總裁林國誠先生,宣布於 4 月 1 日推出 5G 服務。

Guest-of-Honour Miss Eliza Lee Man-ching, Permanent Secretary for Commerce and Economic Development (Communications and Creative Industries) (2nd from left), Dr. Li Feng, Chairman of CMHK (2nd from right), Mr. Sean Lee, Director & Chief Executive Officer of CMHK (1st from left), and Dr. Max Ma, Director and Executive Vice President of CMHK (1st from right), jointly officiated at the Grand Opening of the China Mobile 5G Innovation Centre Hong Kong Open Lab.
主禮嘉賓商務及經濟發展局常任秘書長（通訊及創意產業）利敏貞女士（左二）,聯同中國移動香港董事長李鋒博士（右二）、中國移動香港董事兼行政總裁李帆風先生（左一）、以及中國移動香港董事兼副總裁馬子斌博士（右一）共同主持「中國移動 5G 聯合創新中心」香港開放實驗室開幕儀式。

SmarTone launched its world-class 5G service in May 2020, with the city's widest network coverage through Dynamic Spectrum Sharing (DSS) to spearhead smart city development in Hong Kong .
SmarTone 於 2020 年 5 月正式推出世界級的 5G 服務，並採用愛立信的動態頻譜共享技術 (Dynamic Spectrum Sharing) 為全港提供至廣的覆蓋，引領香港邁向智慧城市。

HTHKH Executive Director and CEO Kenny Koo (third from left) and his management team announce 3 Hong Kong's launch of 5G service.
和記電訊香港控股有限公司執行董事兼行政總裁古星輝先生聯同其管理團隊，宣布 3 香港正式推出 5G 服務。

Upcoming Trends in 5G and its Psychological Impact

The upcoming years will be met with upcoming trends that capitalize 5G technology. These include 1) increased use of public and private data networks to maximize efficiency, 2) new ways of interacting with the world through augmented reality and virtual reality, 3) connecting millions of devices through the Internet of Things with ultra-low latency, and 4) computers complete human tasks via artificial intelligence. Taken together, these trends will make Hong Kong into a smart city, which will radically enhance various institutions.

5G 的未來趨勢及其帶來的心理影響

未來數年，5G 科技的發展趨勢將會帶來好處，其中包括：1）增加使用公共和私有數據網絡以發揮最高效率；2）透過擴增實境和虛擬實境的新方式與世界互動；3）通過物聯網以低時延連接數百萬個終端裝置；4）電腦透過人工智能完成人類的任務。這些趨勢匯集一起將引領香港成為智慧城市，並會從根本上加強不同機構的實力。

Increased Use of Public Data to Maximize Efficiency

The pros and cons of using public data have long revolved around the conflict between security and privacy. While some trust the government or other tech organizations to monitor the public's activities (e.g. surveillance, facial identification, traffic data) for purposes of safety, accountability, and efficiency, others feel that any monitoring of them and their movements is an invasion of privacy. Indeed, public data may sometimes be anonymous in principle but Big Data is already capable of predicting one's personality and behaviors based on their digital footprints. Identifying people in security footage naturally means that some level of information about an individual or a group is somewhere in cyberspace. While surveillance and facial recognition has positive benefits such as deterring crime and preventing identity theft, facial recognition could still be problematic for a few reasons. For one, security breaches are an ever-present danger in our increasingly digital world (Marr, 2019). Surveillance and facial identification software places the security of an individual's

增加使用公共數據以發揮最高效率

使用公共數據的利與弊一直圍繞在安全性和私隱之間的衝突。儘管有些人信任政府或其他技術機構，他們監察公眾活動（如：監視、臉部識別、數據流動）的目的是保障安全，問責和促進效率，然而，有些人則認為，對他們自身和他們的流動性進行監察都屬於侵犯私隱。誠然，公共數據原則上有時可能是匿名的，但大數據經已能夠基於個人的數碼足跡而預測其個性和行為。當利用保安鏡頭對人進行識別，自然地意味著可以在網絡空間，取得關於個人或團體一定程度的訊息。即使監視和臉部識別有正面的好處，如可以防止罪案和預防身分被盜用，但由於一些原因，使用臉部識別仍存在問題，諸如安全漏洞在現今日趨數碼化的世界裡，仍持續造成威脅便是其（Marr，2019 年）。監視及臉部識別軟件把個人資料的安全性，放置在任何能取得有關資料的實體中，而不是由個人掌握，從而剔除了許多人賴以依附的個人控制水平。另一方面，人們若不知道某企業或實體透過臉部識別而取得的資訊的目的，他們便會擔心這些公司在取得他們的資訊

personal information in the hands of whatever entity collected that information, rather than with the individual, thereby taking away a level of personal control that many people are attached to. For another, if people do not know the intent of a particular corporation or entity that collects information via facial recognition, they might worry that the corporation will use that information for purposes they may not agree with, such as targeted marketing. A third reason is that public data compromises one's capacity for impression management in the online world. As discussed in a previous section, people are motivated to craft a favorable image (especially KOLs) by choosing what they want others to see (and what to conceal). Facial recognition and surveillance potentially bring information to light that influencers never intended to share. For example, a renowned vegan health blogger would not want to be seen indulging in a Big Mac. This debate between privacy and security is echoed by our interviewees. For instance, lamp posts that monitors traffic and road conditions have been met with concerns on both privacy and security. While these lampposts can accurately report any collisions/road accidents, it can also capture what people are doing in vehicles. As a result, PCCW decreased the resolution of their cameras to protect people's privacy while maintaining a much-needed record of traffic conditions.

New Ways of Interacting with the World through Augmented Reality and Virtual Reality

Another trend in the 5G era is seeing the world mediated by technological advances. One way technology alters our perception is through augmented reality, which places computer-generated stimuli that appear on one's smartphone. Today, augmented reality is already used in real-time translation (e.g. Google Translate app), shopping and marketing (McLean & Wilson, 2019), education (Akçayır & Akçayır, 2017), and video games (Morschheuser et al., 2017). As more apps that feature augmented reality increase, people will be able to see a different reality through their smartphones. The possibilities are endless are computer-generated images on reality will be available for smartphone users.

後，可能會進行一些未經他們同意的用途，例如進行目標市場推廣。第三個原因是公共數據會影響人們在網絡世界的印象管理。正如在之前一節的論述，人們被激勵去建構一個良好的形象（尤其是 KOL），來向他們的對象呈現一個他們所選擇的形象（及所隱藏的形象），從臉部識別及監視所得的資訊，有可能是這些具影響力人士不打算分享的訊息；例如，一位著名的健康素食博客，不會想被人看到他沉迷於漢堡包。我們的受訪者對私隱與安全之間的爭論進行了回應。舉例來説，負責監視交通和路面情況的街燈，早已在私隱和安全性方面備受關注。即使這些街燈可以準確地匯報任何碰撞／路面意外，但同時亦可捕捉人們在車上的一舉一動。最後，電訊盈科降低了攝影機的解像度，冀在保護大眾的私隱的同時，亦維持必需的交通情況紀錄。

透過擴增實境和虛擬實境的新方式與世界互動

5G 時代的另一個趨勢，是藉由先進科技作為媒介去了解這個世界，其中一項改變我們感知的科技，便是透過擴增實境經由電腦產生的刺激物，在人們的智能手機上出現。今時今日，擴增實境已應用在即時翻譯（如：Google 翻譯程式）、購物、市場推廣（McLean 和 Wilson，2019 年），教育（Akçayır 和 Akçayır，2017 年）和視頻遊戲（Morschheuser 等，2017 年）。隨著具有擴增實境功能的應用程式越來越多，人們可以透過其智能手機觀看不一樣的現實，並且由電腦產生的現實影像，將給予智能手機用戶無限可能性。

SmarTone pushes the frontier to 5G, pioneers Hong Kong's first 5G live field trial in 3.5 GHz and 28 GHz bands simultaneously, also showcased the future Mixed Reality for town planning.
SmarTone 一直部署 5G 發展，並率先進行全港首個同步使用 3.5 GHz 及 28 GHz 頻段的 5G 實時測試，並展示未來城市規劃的混合實境。

Another way technology alters our perception is through virtual reality, which takes over what we see and hear. Current applications of VR involve video games, education, and art. For instance, the PlayStation 4 has games that allow players to immerse themselves in a haunted house or a battlefield. Medical students can use VR applications such as "Share care" to visualizes various human organs. These organs can be viewed in 3D space that no traditional textbook can provide. Artists can use apps such as "Tiltbrush" to paint in a variety of colors, brush styles, and in a 3D setting without using physical canvases (Chan & Chan, 2018a). As one interviewee pointed out, VR allows anyone to 'see' popular sights around the world. People can sightsee world wonders (e.g. Eiffel Tower, the Pyramids) without being physically present. Hutchison anticipates that VR and AR technologies will provide consumers with a seamless experience with hotel check-ins and services, as well as virtual room experience and customization.

Connecting Millions of Devices through the Internet of Things

These technologies alter how we see the world are made possible with scalability and network management 5G provides by making these devices more powerful when devices are connected via the Internet of Things (Li et al., 2018). 5G-IoT allows collaboration between smart devices to mutually interact and share data without human input. In time, people could communicate in a highly interactive and immersive virtual world with low latency to simulate reality. Conferences, classrooms, and meetings can be done entirely virtually.

However, the inherent diverse nature of networks and devices in 5G-IoT renders a lack of consistency across IOT systems and applications. Hence, there needs to be technology standards (i.e. data aggregation, network protocols) and regulatory standards (i.e. security solutions). For instance, HKT completed successful outdoor 5G trials in both the 3.5 GHz and 28GHz spectrum bands and first in Hong Kong to do a live outdoor broadcast on 5G network in 2018. China Mobile collaborated with their partners to provide more services like transmission, broadband, IoT and Information and Communications Technology (ICT) solutions.

虛擬實境是另一種改變我們感知的科技，它取替了我們所見所聽的方式，現時 VR 的應用範圍有視頻遊戲，教育和藝術層面等；例如：PlayStation 4 備有利用 VR 的遊戲讓玩家恍如置身在鬼屋或戰場中；醫科學生可以利用「Share care」等 VR 應用程式，來將人體不同的器官視覺化，他們可以在傳統教科書中無法提供的三維空間去查看這些器官；藝術家可以運用「Tilt Brush」等應用程式，在 3D 設置的空間上繪出各種色彩和筆觸風格，而無需在一幅實在的畫布上創作（Chan 和 Chan, 2018a）。正如其中一位受訪者所述，VR 讓任何人都可以「觀看」世界各地的熱門景點，亦不必親身去到現場，便可欣賞世界奇觀（如：艾菲爾鐵塔和金字塔）。和記電訊預期，VR 和 AR 科技將會為消費者帶來無縫的酒店入住登記和服務，以及虛擬住房體驗和客制化服務等。

通過物聯網連接數百萬個終端裝置

5G 提供的可擴展性和網絡管理，令終端裝置通過物聯網連接後的性能變得更強大，使我們通過這些技術來改變我們認識這個世界成為可能（Li 等，2018 年）。5G-IoT 容許智能終端裝置之間進行互動，並且無需人手輸入便可共享數據。屆時，人們可以在高度互動和身臨其境的虛擬世界裡溝通，並配合低時延的優勢模擬現實；會議、課室教學和面談都可以虛擬進行。

不過，5G-IoT 中的網絡固有多樣化特性和終端裝置，致使 IoT 系統和應用之間缺乏一致性，因此，有需要定下技術標準（即數據聚合和網絡通訊協定）與及規管標準（即安全解決方案）。舉例來說，HKT 於 2018 年使用 3.5 吉赫頻帶和 28 吉赫頻帶成功進行 5G 室外場地測試，並率先在香港使用 5G 網絡進行實時室外廣播。中國移動香港亦與合作夥伴提供更多服務，如傳輸、寬頻服務、IoT 和資訊通訊科技（ICT）解決方案等。

China Mobile NB-IOT Launch
中國移動香港推出 NB-IoT

Computers Complete Human Tasks via Artificial Intelligence

As technology continues to advance, computers will be able to outperform many humans in various tasks. Nowadays, computers can possess similar cognitive functions as humans to learn and achieve their goals, albeit in specific domains (Tegmark, 2018). Computers learn via machine learning to build schemas/models by sifting through large datasets. For instance, computers learn to recognize objects and faces by going through heaps of pictures. Computers learn to compose music by sifting through heaps of music. Computers learn how to read emotions (i.e., affective computing, sentiment analysis) by linking various stimuli with typical human reactions.

Applications of AI would significantly alter finance, manufacturing, education, transportation, energy, healthcare, legal systems, and other industries (Tegmark, 2018). Because AI is still in its relative infancy and the long-term outcomes of implementing AI in various industries are still largely unknown, questions as to whether AI is an overall benefit or an overall danger to humanity is controversial. While AI is capable of advancing many industries, integrating computers into human lives has large-scale implications that can potentially backfire. For instance, while computers can help humans make better decisions with data-driven models derived from Big Data (Denis & Young, 2017), computers can also collect data on humans that can be used to predict them. Additionally, those who grow up with AI technology may anthropomorphize life-like technology and attribute them with human-like psyches and thereby influence children's social and cognitive development (Severson & Carlson, 2010). Some evidence suggests that children attribute digital assistants with psychological properties but no biological properties as a new ontological category of living things. This line of research found that children would talk to digital assistants like a friend and confidant for social and moral deliberations (Severson & Woodard, 2018).

Even the best researchers in Artificial Intelligence do not have a consensus on whether AI will surpass human competence or gain digital consciousness to think on its own. What AI researchers do agree on is that computers surpass humans on specific tasks (e.g., playing chess), but not all tasks in general (Tegmark, 2018). Since AI technology utilizes machine learning and big data to automate tasks that are typically done by humans (with the unfortunate outcome of putting many people out of jobs), MIT professor Max Tegmark recommends today's youth to aim for careers where machines are bad at. These jobs include heavy interpersonal communication, unpredictability, and creativity.

However, communication tasks do not necessarily give humans an advantage. Computers are learning to outperform humans on tasks such as writing. Using data mining to extract how people write in various genres, programs such as Grammarly not only understand spelling and grammar, but can also improve writing based on criteria such as audience, formality, domain (e.g. academic, general, technical), tone, and intent (e.g. describe, convince, inform). Grammarly can check for plagiarism across millions of written texts online and even provide automated feedback that is now implemented in businesses and universities (O'Neill & Russell, 2019). However, it does not stop there. With machine learning, computers can already learn to write journalistic pieces (e.g., stock prices, business report) like humans in arenas that rapidly converts data into narrative news entirely without human input. This practice of automated journalism publishes articles at a much faster pace than most journalists with the added ability to create multiple customized versions for different audiences (based on their digital footprints). Articles that are primarily fact-based such

電腦透過人工智能完成人類的任務

隨著科技日益進步，電腦在處理許多任務上都遠勝人類。現今，在某些特定領域，電腦擁有類似人類的認知功能，可以學習和達到他們的目標（Tegmark，2018 年）。電腦藉著機器學習，通過篩選大型數據集來建立模式/模型，例如：電腦藉助大量的圖片去學習識別物體和臉部、透過大量音樂篩選學習作曲、透過連繫至不同刺激與典型的人類反應去學習閱讀情緒（即情感計算和情感分析）。

AI 應用將會為金融、製造、教育、交通運輸、能源、醫療保健，法律系統及其他行業帶來顯著改變（Tegmark，2018 年）。由於 AI 仍處於起步階段，並且在各個行業中運用 AI 的長期結果仍是未知之數，因此有關 AI 對人類是有整體利益還是有害仍然受到爭議。雖然 AI 能夠推動許多行業的發展，但結集大量電腦到人類生活中，可能會適得其反。譬如說，電腦能運用大數據的數據驅動模型來協助人類作出更好的決定（Denis 和 Young，2017 年），但電腦同樣可以從人類身上收集得來的數據對其作出預測。此外，那些與 AI 科技一起成長的人，可能會把栩栩如生的技術人格化，並賦予它們類似人類的心理，從而影響孩子的社交和認知發展（Severson 和 Carlson，2010 年）。有證據顯示，兒童倚賴數碼助理歸因於心理屬性，而沒有生物學屬性，這是一種新的生物本體論的説法；這一系列研究發現，兒童會與數碼助理像朋友和知己般傾談，以進行社會和道德思考（Severson 和 Woodard，2018 年）。

即使是人工智能領域裡最優秀的研究人員，也無法就 AI 是否能超越人類的能力，或是能夠取得數碼意識而進行獨立思考方面達成共識。AI 的研究人員同意在特定任務上（如下棋），電腦能超越人類，卻非所有任務（Tegmark，2018 年）。由於 AI 技術是通過機器學習和大數據，去將平時由人類完成的任務進行自動化工序（遺憾地這令到很多人因此而失去工作），故此，麻省理工學院（MIT）教授 Max Tegmark 建議現今的年青人，要找一些機器不擅長的職業，包括一些需要大量人際溝通，不可預測和具創造力的工種。

不過，需要溝通的任務不一定給人類帶來好處。電腦正在學習能勝過人類的任務，例如學習編寫，它們通過數據挖掘來抽取學習人們在各種體裁中的寫作方式，例如 Grammarly 之類的程式，不單能夠理解拼字和文法，還可以基於對象、形式、範疇（如：學術性，普及性和技術性）、語氣和用意（如：描述、説服和告知）等去改善寫作。Grammarly 亦能在網上過百萬的文章裡檢查有否出現抄襲，亦提供自動反饋，目前該程式已在一些企業和大學中應用（O'Neill 和 Russell，2019 年）。但是，它並不止於此，電腦通過機器學習，已可像人類一樣編寫一些需要快速地將數據資訊轉換成敘述體裁的新聞文案（如：股票價格和業務報告），而無需經人手操作輸入。這種自動化的新聞發布比大多數新聞工作者多了一種附加能力，這種模式可以就不同對象製作多個自定版本（根據他們的數碼足跡）。這種以事實為本，如體育、財經和市場推廣的內容，在過去數年已開始由電腦負責編寫，並預計這種新聞形式將會激增（Carlson，2015 年）。

as sports, finance, and marketing have been written by computers (without human input) for several years now, and this form of journalism is expected to proliferate (Carlson, 2015).

Artificial intelligence analyzes heaps of data to learn how to write as competently or, in some cases, better than humans. Computers will continue to improve as more data is fed into the online world. As computers become more capable, it will learn to perform and enhance various industries. As more and more industries becoming 'smart', Hong Kong will become a smart city.

Hutchison 5G Base Station
和記電訊 5G 基站

人工智能通過分析大量數據來學習如何勝任寫作任務，甚至在某程度上，表現比人類更優秀。當越來越多的數據進入網絡世界，電腦的運算和分析將會不斷改善和提升，它們的能力越高，便能學習為不同行業執行和強化任務。隨著更多的行業變得「智能化」，香港將會成為一個智慧城市。

Making Hong Kong a Smart City: Enhancing Transportation, Healthcare, Education, Shopping, and Entertainment

When there is lots of data that is fed into millions of connected devices that lets people see the world in a technologically mediated way, then over time Hong Kong would become a smart city. Smart cities as a concept include ICT infrastructures that are increasingly digitized, inter-connected, and sustainable, such that there is smart transportation, smart healthcare, smart education, smart shopping, smart entertainment, and smart industries all around. Admittedly, we are still at the beginning of 5G so some applications below are theoretical.

使香港成為智慧城市：加強交通運輸、醫療保健、教育、購物和娛樂

當大量數據流經數百萬個相互連接的終端裝置時，人們便會在科技作為媒介的導引方式下了解這個世界，假以時日，香港亦將成為一個智慧城市。智慧城市的概念包括日漸數碼化、互相連接和具持續性的資訊及通訊科技（ICT）基礎設施，令智能交通、智能醫療、智能教育、智能購物、智能娛樂和智能工業隨處可見。誠然，我們仍處於 5G 的起步階段，因此，以下一些應用屬於理論上的論述。

The 3Innocity programme supports start-ups, industry leaders and scientific research talent to build a digital economy ecosystem.
「3 智城」計劃支持初創企業、業界領導者和科研專才建立一個數碼經濟生態系統

Smart Transportation

Currently, there are apps (e.g. rideshare apps, Google maps) that inform people how to get from location to destination based on the transportation available. These apps inform people where certain vehicles are at and approximately when it will reach a destination. However, these apps focus on getting people from point A to point B and overlook other factors that might affect large-scale transportation. To enhance transportation, there needs to be lots of data transmitted among vehicles in real-time with ultra-low latency to maximize efficiency and reduce collisions. Doing so includes real-time location tracking, sensors to reduce collision between vehicles, maximizing on-demand transport, instant notifications of delays and collisions, and to fully utilize parking spaces.

Traffic data can be gathered in real-time via GPS devices, road cameras, vehicle identification, and even crowdsourced traffic reports (Amin-Naseri et al., 2018). Information collected involves location and speed of vehicles and traffic conditions, with the hopes of creating predictive algorithms to inform the public when travelling is most efficient. Traffic data would be disseminated via radio, texts, digitized traffic signs, or apps to inform citizens about optimal routes.

智能交通

現時，有些應用程式（如：共乘應用程式，Google 地圖）會提供如何從一個位置到達另一個目的地的交通選擇，這些應用程式會顯示附近有什麼可行的車輛，和預計抵達時間。可是，這些應用程式只集中指示人們如何從 A 點到達 B 點，而忽略了其他可能引致大型交通影響的因素。要加強交通暢順，車輛之間便需要大量以超低時延實時傳輸的數據，以發揮最高效率和減低出現碰撞事故，然而，要落實這些措施需要實時位置追蹤、減少車輛碰撞的傳感器、按需運輸的最大化、延遲和碰撞即時通報和充分利用停泊位置。

實時交通數據可以通過 GPS 終端裝置、道路攝影機、車輛識別，甚至群眾外包的交通報告來獲取（Amin-Naseri 等，2018 年）。收集的訊息包括位置、行車速度和交通狀況，冀建立預測演算法去通知大眾最有效率的出行情況；交通數據可以透過電台、短信、數碼交通標記，或應用程式發布，以便通知市民最佳的出行路線。

Optimizing travel time can be further streamlined with ridesharing apps and smart parking. Ridesharing apps could reduce the number of cars (and costs per passenger) travelling, while parking sensors can notify drivers about how many parking spots are available in a given carpark. Drivers could then, through their smartphone, reserve a designated parking spot for a given length of time.

Collisions would automatically be reported to the nearest transport authority and police to solve the matter. Traffic cameras would accurately recall what truly occurred on traffic incidents for evidence. Within the next decade, the rise of self-driving cars would drastically reduce car accidents via robust machine learning and optimize driving routes based on the available data. Self-driving cars could have built-in smart parking to allow passengers to get from Point A to Point B without human input.

As driverless cars become more accepted in society, there would be potential for driver-less cars as a service. These would be similar to rideshare apps but the car would be driverless and people are able to monitor the car, the route, estimated time of arrival, and who can unlock the car from one's smartphones. Parents would be able to send their kids to school this way and designate someone (e.g. a trusted teacher) to unlock the car when it reaches its destination.

While self-driving cars would drastically reduce accidents, there nonetheless would still be cases of collisions/accidents beyond the car's control. Consequently, formidable moral questions on how self-driving cars should behave inevitably arise. Consider using the classic trolley problem applied to self-driving cars: If a self-driving car encounters a scenario where it would run over pedestrians and the only way to avoid that is to sacrifice the passengers in the car, what would be the proper algorithm that determines the outcome? Some research examined this exact question and found that participants prefer autonomous vehicles that abide by utilitarian protocols (i.e. the option that minimizes the damage overall), but participants also like to ride in autonomous vehicles that protect them as the passenger no matter what (Bonnefon et al., 2016). This creates a paradox as to how self-driving cars should be programmed.

共乘應用程式及智能停車可以進一步優化出行和簡化流程。共乘程式可協助減低路面行駛車輛的數量（和每位乘客的成本），而停車場的傳感器則可通知駕駛人士在特定的停車場內可供停泊的車位數量，駕駛人士可以透過他們的智能手機，預留指定的停泊車位及時間。

當發生碰撞事故時，有關情況會自動通報至最近的運輸當局和警察，以便提供支援和協助處理，交通攝影機亦會提交事故發生時的準確畫面作為證據。在未來數十年內，自動駕駛汽車將會興起，並通過強勁的機械學習大幅度減低交通意外的發生，和根據現有數據來優化駕駛路線。自動駕駛汽車已內置智能停泊功能，使乘客無需人手輸入便可從 A 點到達 B 點。

隨著社會日漸接受無人駕駛汽車，使之有機會提升成為一種服務，這和共乘程式類似只是沒有駕駛者在內，而乘客可以監察車輛、路線和預計抵達時間，以及由誰可以在其智能手機打開車門。家長可利用無人車送子女上學，當到達指定目的地時，更可指定授權人士（如：可信賴的老師）打開車門讓子女下車。

即使自動駕駛汽車可以幫助大幅度減低事故發生，但仍然存在車輛無法控制的碰撞／意外情況，因此，無可避免地出現了自動駕駛汽車應如何操作等道德問題。讓我們嘗試引用經典手推車的問題於自動駕駛汽車：若自動駕駛汽車遇到要在行人道路上行駛的情況，而避免這種情況的唯一方法是犧牲車內的乘客，那麼，正確的演算法結果是什麼？一些確切地檢視這個問題的研究，發現參加者傾向採取遵守功利主義的自動駕駛汽車（即是將整體損害最小化的選擇），但參加者同時喜歡乘坐自動駕駛汽車，並認為它們能為乘客提供保護（Bonnefon 等，2016 年）。這就自動駕駛汽車的編寫程式產生了悖論。
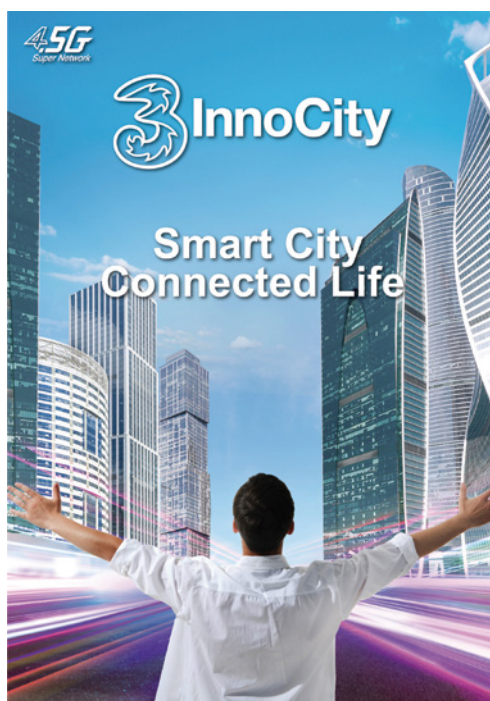
Smart Healthcare/eHealth

Providing quality healthcare to lots of patients simultaneously is a highly complex task. Healthcare infrastructure (e.g. labs, ICU, operation units), logistics, specialized services, and reaction to emergencies all need to be optimized for hospitals and clinics to be efficient. With AI and Big Data, hospitals can be optimized by analyzing heaps of hospital and doctor data (Ellahham & Ellahham, 2016).

Medical doctors spend years familiarizing themselves with the fundamental medical literature as well as research from their specialization. While years of training provides hospitals with the necessary expertise for diagnosis and treatment, laypeople and potential patients struggle to grasp medical literature without proper consultation with a medical personnel. In the 5G era, laypeople would soon be able to consult a chatbot (via an app) that synthesizes the latest medical literature for symptom, diagnosis, and care. By using a dichotomous key approach that asks participants a series of yes/no questions, the chatbot would be able to advise patients on what their patients could have and if they should consult a medical professional (Fischer & Lam, 2016).

Medical administrators have the tough task of scheduling patients and treatment, storing sensitive patient data, optimizing hospital facilities, and keeping an inventory of the hospital's resources. Valuable datasets would synthesize the expertise of administrators and medical personnel that would, in turn, provide better diagnosis and patient flow, better treatment, lower medical error, and implement novel medical solutions.

Our interviewees noted that there is a rising demand for healthcare given the aging population in Hong Kong. 5G allows monitoring an elderly's health in real-time to greatly reduce the medical system's costs and to stabilize people from exacerbating health conditions. Healthcare solutions such as advanced emergency communication systems, environmental monitoring systems and other personal healthcare products will be made possible with 5G technology.

Collaboration with start-ups put forth the SmarTone 5G Innovation Hub with a new wave of 5G live demo to support the live demo and live broadcast.
SmarTone 與初創企業携手透過 5G Innovation Hub 在 5G 網絡上進行實時展示及現場直播

智能醫療保健 / 電子健康

要同一時間為大量病人提供具質素的醫療服務是一項高難度任務，要提升效率便需要為醫院及診所的醫療基建（如：實驗室、深切治療病房和手術室等）、物流、特別服務和緊急情況的反應等進行優化。醫院可利用 AI 和大數據，協助分析大量醫院及醫生的數據，以便優化醫院的運作（Ellahham 和 Ellahham，2016 年）。

醫生們都花了數年時間來熟習基本的醫學文獻，以及他們的專業研究。他們多年來的培訓為醫院提供了診斷和治療所需的專業知識，但一般普通人和潛在病人在沒有醫護人員適當的諮詢下，很難掌握和理解這些醫學文獻。然而，在 5G 時代裡，一般人將會很快便可以透過應用程式向聊天機器人（ChatBot）進行諮詢，這些 ChatBot 綜合有關症狀，診斷和護理的最新醫學文獻，透過二分法來詢問參加者一連串是 / 否的問題，ChatBot 便能夠對病者進行建議或請他們找醫生進行深入諮詢。（Fischer 和 Lam, 2016 年）

醫療行政人員需處理多項艱鉅的任務，包括：安排病人行程和治療時間、保存敏感的病人資料、優化醫院的設施，並對醫院的資源進行庫存。醫療行政人員可以利用有價值的數據集，協助整合行政人員和醫護人員的專業智識，從而提供更好的診斷和病人照護流程、更好的治療，減低醫療失誤和推行新興的醫療方案。

我們的受訪者指出，隨著香港人口逐漸老齡化，對醫療保健的需求亦不斷增加。5G 可以實時監測長者的健康情況，大大減少醫療系統的成本和穩定惡化的健康狀況。5G 技術將一些諸如先進緊急通訊系統、環境監察系統，與及其他個人醫療護理產品等的醫療保健方案將變成可能。

Smart Education

The proliferation of 5G would allow students to learn anything from virtually anywhere, and teachers to teach anything from virtually anywhere. Currently, students can learn languages, instruments, life skills (e.g. cooking, public speaking), and college courses online. Teachers can share their lectures, notes, publications, and communicate with students entirely online. Top universities in the world already have full online courses (with certificates to indicate completion) from top academics. Other initiatives such as Master Class recruits experts in various industries to teach their expertise.

智能教育

5G 的普及將使學生可以在任何地方虛擬地學習各種事物，而老師亦可以虛擬地教授任何東西。目前，學生可以在網上學習語言、樂器、生活技能（如：烹飪和公開演説）和大學網上課程。教師可以在網上分享他們的講座、筆記、出版物，和與學生在網上溝通。一些世界頂尖的大學亦已開辦全日制網上課程，由頂尖學者教授，學生在完成課程後亦會獲發證書；其他大師級的課堂亦會從不同行業邀請專家來教授他們的專業知識。

Smart education is more than moving classes to the online realm; smart learning involves utilizing Big Data to enhance learning that cannot be provided in traditional classes that are moved online. Currently, the online world has crowdsourced textbooks that combines the expertise of various scholars with easy opportunities for rapid updates. For instance, WikiBooks provide academic textbooks written by faculty and students (Ravid et al., 2008). Professors in psychology recruited other top academics from various subdisciplines of psychology to each write a chapter of a textbook that corresponds to their expertise, then made the textbook entirely free to students. But, these textbooks are still, in a larger sense, combining human expertise around the world.

With 5G, online content does not have to be entirely assembled by humans. With initiatives such as Google Talk to Books that utilizes AI, users can simply input natural language (e.g. "what makes a moral person?") and is led to a series of passages from various books related to the topic. However, due to algorithms of selective exposure, what one person sees is different from another even if the search term is the same, leading to fragmented realities (Chalmers & Edwards, 2017). Other programs such as EssayBot utilizes AI writes by suggesting relevant content on millions of webpages, paraphrases content to avoid plagiarism, and automatically cites those works. Fortunately, students cannot get away with these programs as there are counter-plagiarism programs that detects semantic and syntactic similarity (i.e. the meaning and order of words) across millions of texts (Sahi & Gupta, 2017).

The only courses that cannot be moved online are hands-on topics/courses that require the traditional classroom or laboratory. These include medical, engineering, and scientific practicum that needs requires physical presence (although some aspects of these practicums may be substituted via VR). Another drawback of current online education is the lack of social interaction and interactivity in online courses. Indeed, many courses are asynchronous, meaning the learners and teachers are not online at the same time. Lectures are not given real-time but instead are pre-recorded and uploaded online (Kim et al., 2016). But, these obstacles can override (to some extent) with VR and AR. With VR, students can gather in a virtual classroom that resembles a traditional face-to-face classroom for remote participation. Social interaction can occur as students will see and speak to their peers in the form of avatars. With AR, students will be able to use their smartphones for interaction in the real world.

On top of enhancing learning, 5G can also track students' progress to inform teachers how to teach most effectively. China Mobile provides an online learning platform known as the Sync Class service. China Mobile cooperates with different publishers to run this platform so as to make the platform rich in content and useful to the students. The online platform provides learning materials, exercises and mock exam papers, and online tutorial services for primary school students so that they can learn everywhere and anytime through their mobile. This online platform also helps to monitor the learning progress of the students.

Students would be able to learn by amassing online content posted by various academics or compiled by AI. Teachers would be able to monitor their students' learning, and use AR and VR to teach like never before.

Smart Shopping/E-commerce

Currently, smartphones allow shoppers to browse any product from their phone. They can browse various models of the same product for the best deal. People can even purchase all their groceries and food online. Some apps already allow shoppers to browse furniture

智能教育不單是將實體教學轉移到網上，智能學習更包含利用大數據來加強轉移到網上學習後，一些傳統教學裡無法提供的學習。目前，網絡世界已提供群眾外包的教科書，集各家學者之大成，並提供一個便捷機會來進行快速更新。舉例來說，維基教科書（WikiBooks）提供由學院及學生編纂的教科書（Ravid 等，2008 年）；心理學教授們亦曾招募其他不同心理學科的頂級學者，就其專業範疇撰寫教科書的其中一章，並把集成的教科書免費讓學生閱讀。只是，這些教科書在更大程度上，匯聚世界各地的人類專業知識。

有了 5G，網上內容不一定再由人來匯集，例如 Google 推出的 Talk to Books 便利用 AI 讓用家簡單地輸入語句（如：如何成為一個有道德的人？），該應用便會羅列來自不同書本與這個主題有關的一系列文章供參考。但是，由於採用選擇性曝露演算法的原故，即使搜尋同一個主題，每個人所看到的內容都會不同，從而導致現實分散（Chalmers 和 Edwards，2017 年）。其他如 EssayBot 的程式亦借助 AI 進行寫作，而編寫內容的建議是來自過百萬網頁上的相關內容和釋義，改寫內容為避免抄襲，更會自動加上附註。幸而，學生不能擺脫這些程式，因為同時有反抄襲程式可以檢測過百萬篇文章中的語義和句法的相似性（即字詞的含義和順序）（Sahi 和 Gupta，2017 年）。

唯一不能轉移至網上教學的課程，是那些需要在傳統課室或實驗室裡進行實驗學習的課程，包括：需要親身出席課堂的醫科、工程科和科學實習科類別（即使部分實習內容可以由 VR 替代）。網上教學的另一個缺點是網上課程缺乏社交互動和互動性。實際上，許多課程不是同步進行，即學習人士和教師不一定同時在線，課堂並非實時授課，而是預先錄影，然後再上傳至網上（Kim 等，2016 年）。不過，VR 和 AR 可以在某程度上幫助克服這些障礙，學生們可以利用 VR 聚集在一個虛擬課室，如同傳統面對面授課模式般進行遙距學習，學生們亦可以化身形式看到同伴，彼此交談，從而促進社交互動；學生亦可在他們的智能手機上通過 AR 與現實世界互動。

除了增強學習功能外，5G 還可以追蹤學生的學習進度，以通知教師如何最有效地教學。中國移動香港推出一個名為「同步課堂」的網上學習平台，並與不同出版商一起運作這個平台，冀為平台增加豐富的教學內容和資訊，對學生大有裨益。此網上平台為小學生提供學習材料、補充練習、模擬考試試題和網上功課輔導服務，讓他們隨時隨地透過手機學習，並同時監察他們的學習進度。

學生將可以通過積累不同學者發布的或 AI 編寫的網上內容來學習；教師則可以監察學生的學習情況，並利用 AR 和 VR 來進行前所未有的教學模式。

智能購物 / 電子商貿

目前，消費者可以在他們的智能手機上瀏覽各式產品，甚至瀏覽同一產品的各種型號來取得最佳價格；人們甚至可以在網上購買所有雜貨和食物。有些應用程式更開始使用 AR，讓買家瀏覽傢具產品，以

via AR to see how it fits in their room. TaoBao already allows any user to snap a picture as the search term to look for similar products.

With 5G, shopping can potentially browse for products via VR which allows shoppers to examine the product from any angle. Retailers could learn about their clientele through Big Data analyses to predict what products appeal most to what demographic groups.

Smart shopping ads for can be posted on social networking platforms such as Instagram to attract potential customers. Some franchise stores that sell bubble tea, for instance, already have promotions that give customers discount if they follow the store's Instagram page. With enough followers (especially with KOLs as followers), the franchise can analyze their customer base and, in turn, follow Instagram accounts of similar demographics as a marketing tactic to inform others about their store.

Smart Entertainment

Past research on smartphone behavior has shown that while females often spend their time on social media, males often spend their time on gaming (Lukianoff & Haidt, 2018; Su et al., 2020). 5G would enhance gaming by eliminating the need for players to download games because games can be stored in cloud services. People would be able to connect their devices to bigger screens and still experience no delay because 5G latency are within milliseconds. People will be able to use their smartphones as a controller and potentially substitute gaming consoles.

Beyond gaming, VR technology would allow people to attend concerts virtually, play instruments with their friends virtually (by appearing in the same virtual room), and immerse themselves in simulated environments. Currently, there are games that simulate cooking, driving, constructing, and dancing. Future VR headsets will be even more smooth such that players can complete those tasks in virtual rooms alongside friends.

Smart entertainment is especially beneficial for the elderly who have more time on their hands. The elderly can use of VR technology to virtually attend concerts or other places they would not go physically. They can continue learning via some real-time live stream platforms without connection issues.

了解這些產品如何配合他們的房間擺設。另外,淘寶經已讓用家隨時把拍攝到的照片用作搜尋類似的產品。

5G 讓消費者有機會利用 VR 瀏覽產品,讓他們多角度檢視產品;而零售商則藉著大數據分析來了解他們的客戶群,方便他們預測哪些類型的產品最適合哪些人群。

智能購物廣告可投放在 Instagram 等社交平台,以吸引更多潛在客戶。舉例來説,有銷售珍珠奶茶的特許經營店會給予追蹤他們 Instagram 帳號的顧客享有折扣優惠,藉此進行促銷宣傳。有了足夠的粉絲(尤其有 KOL 關注的帳號)數量,這些特許經營者便可對其客戶群進行分析,進而追蹤類似 Instagram 帳號的人口群組來進行市場推廣,讓更多人認識他們的店舖。

智能娛樂

曾經有關智能手機應用行為的研究指出,女性使用智能手機的時間,多花在社交媒體上,而男性則花時間在手遊上(Lukianoff 和 Haidt,2018 年;Su 等,2020 年)。由於遊戲已可儲存在雲服務,5G 讓玩家無需下載遊戲,更添玩遊戲的趣味。玩家更可將終端連接至更大的屏幕而不受時延影響,因為 5G 的時延仍能保持在幾毫秒之內;人們亦可用其智能手機作為控制器,並有可能替代現有的遊戲機。

除了遊戲,VR 技術還可以讓人們虛擬地參加音樂會,與朋友一起玩樂器(透過在同一間虛擬房間內出現),以及將自己沉浸在模擬環境中。目前,已有一些模擬烹飪、駕駛、建設和跳舞的遊戲;預期未來的 VR 眼鏡將會令用家在玩遊戲時更加順暢,讓玩家與其他朋友一起在虛擬房間中完成任務時,更添樂趣。

另外,智能娛樂對有更多空閒時間的長者同樣帶來更多好處,他們可以使用 VR 技術虛擬地出席音樂會或去一些他們實際上不會去的地方,亦可透過實時直播平台持續學習,而不受連接影響。

HTHKH Executive Director and CEO Kenny Koo plays 5G mobile battle games on a 100-plus inches huge screen with super low latency at the 3Supreme flagship store in Causeway Bay.
和記電訊香港控股有限公司執行董事兼行政總裁古星輝先生在銅鑼灣 3Supreme 旗艦店的 100 多吋的大屏幕上,以超低時延玩 5G 手機戰鬥遊戲

Social Impact of Smart City

Changes in transport, healthcare, education, shopping, entertainment, and more industries would inevitably influence the daily lives of citizens in a smart city. Even those who actively not partake in technological advances would be impacted as well. Therefore, it is necessary to consider the social psychological impacts of a smart city.

As more technology is integrated to people's daily lives, there need to be some universal level of technological competence. While this will not be an issue for the youngest generation, as the youngest generation grew up with the Internet and is named after the Internet (iGen stands for Internet generation for those born on 1995 or after; Twenge, 2017), older generations would have to stay up to date with advances of 5G. Even those who prefer the traditional ways of shopping, learning, security, and payment (via cash instead of online transactions) will be affected by newer trends. As such, the government and technology companies should provide ways to educate the public about newer technology.

As the 5G era progresses, people will be living in an increasingly quantified society, meaning data would intertwine every aspect of people's lives. This is not necessarily a bad thing, as it allows people to understand human behavior within their own society. To understand more about a society, government and academia have long produced national censuses that recruit a representative sample to answer various questions (Kitchin, 2014). But, this approach is limited by the social desirability bias (where people lie on their answers to appear socially desirable) and temporality (where survey data might be out of date). Big Data generates data continuously as people's digital footprints grow for every comment, follower, tweet, Facebook like, online purchase, and Google search. Data scientists and AI would turn this raw data into information. Consequently, decisions made in various institutions will be based on data rather than intuition and anecdotal experience, even on simple decisions like travel time.

智慧城市帶來的社會影響

交通運輸、醫療保健、教育、購物,娛樂和更多行業的變化,將不可避免地影響智慧城市裡大眾市民的日常生活,即使那些不積極參與技術演進的人也會受到影響。 因此,有必要考慮智慧城市帶來的社會心理影響。

當越來越多科技融入人們的日常生活,人們便需要具備普遍水平的科技能力。這情況對最年輕的一代來說不是問題,因為他們正是與互聯網一起成長的一代,亦以互聯網而命名(iGen 被稱為「我」一代,是指於 1995 年或以後出生的年輕人;Twenge,2017 年);年長的幾代人則需要學習與 5G 並進。即使那些偏向採用傳統方式進行購物、學習、保安和付款(使用現金而非網上交易)的人,亦受到新趨勢影響。因此,政府和科技公司應該提供渠道,教育公眾有關最新科技的方法。

隨著 5G 時代的演進,人們將在一個日益量化的社會裡生活,意味著人們日常生活的各個層面將會被數據圍繞。這未必是一件壞事,反而促使人們多了解其身處的社會裡的人類行為。為了更了解一個社會,政府和學術界長期進行全國性人口普查,並收集具代表性的樣本來回答不同的問題(Kitchin,2014 年),可是,這個方法受到人們對社會期望的偏見(人們在回答時會說謊話來表現出對社會的滿意程度)和時間性(調查結果可能會過時)的限制。然而,當人們對每個評論、關注者、貼文、臉書讚、網上購物和 Google 搜尋的數碼足跡不斷增長,大數據亦持續衍生數據,數據科學家和 AI 便會將這些原始數據轉化成為訊息,因此,在不同機構裡進行的決定,即使是簡單如出行時間,都是基於數據分析,而非靠直覺及根據軼事經驗。

SmarTone 5G Robot
SmarTone 的 5G 機械人

More complex matters such as recruitment, loans, insurance, and housing will likely be impacted by algorithms of distribution. Big Data analysis could predict who the best applicants are within a pool of applicants for a given job, what type of people are most likely to pay back their loans and insurance, who deserves housing the most with remarkable accuracy, among other important decisions. These analyses help recruiters, companies, and various stakeholders in aligning the service with the people who deserve the service the most. However, algorithms are not perfect since samples are used to infer something about a larger population and 'false-positives' to still occur (O'Neil, 2016). For example, suppose a certain demographic is less likely to pay back their loans, so a policy was enacted to place additional constraints on this group to motivate them to pay loans on time. This policy may be justified, but nonetheless the policy punishes some people in that group who may very well pay back their loans on time.

Any prediction that targets a group can be prone to false positives that unjustly punish individuals who vary from the predicted behavior. This is because predictions derived from Big Data analysis are contingent on data accuracy. Predictions become invalid when the samples collected does not accurately reflect the population of interest. Of course, it is impossible to entirely eliminate error in behavioral data because some variations in the behavioral data are sometimes impossible to attribute to a cause. Hence, there needs to be initiatives that constantly vet the veracity of the data, as well as vigilant protection against cybercrimes.

Because advances in technology also bring about sophisticated cybercrime methods, there needs to be constant cybersecurity practices to prevent from occurring. While the telecom operators are aware of cybercrimes and implement various cybersecurity measures (all detailed in the previous edition of this ICT guide), HK citizens should be cautious about giving any of their personal information away in the online world (e.g. phishing scams). Citizens could also implement free two-factor authentication to prevent people from logging into their online accounts even if their password is compromised. Protecting oneself from falling prey to cybercrimes would indirectly prevent decreases in life satisfaction and happiness (Cheng et al., 2020).

When people become aware that data is collected about the public, people may feel under more scrutiny than before. People may realize that their digital footprints are permanent and are used to predict them. Even seemingly innocuous Facebook 'likes' and who one follows on Instagram reveal something about the person. As such, efforts of impression management may be compromised. Perhaps a Key Opinion Leader is adamant on creating a certain personality and associates oneself with a designated group of people, but the KOL's digital footprints suggests otherwise. There are benefits to various institutions by analyzing public data, but citizens may be ambivalent because of impression management reasons.

In sum, 5G alters the lifestyle of HK citizens. 5G is complex and requires collaborations among various parties. We next turn to the collaborations our telecom operators are involved in.

更多諸如招募、借貸、保險和住屋等複雜性問題，很可能會受到分配演算法的影響。大數據分析以精湛的準確度，可以預測在一眾應徵者中，誰最合適；那類人最有機會還清他們的貸款和保險；誰更值得獲得房屋分配，以及其他重要決定。這些分析協助招聘人員、公司和不同持份者，使服務與最值得接受相關服務的人取得一致性。但是，演算法並非完美，由於樣本是用來推算更大的人口，所以仍有機會出現「假陽性」結果。(O'Neil，2016 年)。例如，假設某特定人群是不太可能償還他們的貸款，因此而制定一些政策來對該群體附加約束，從而推動他們準時還款；雖然這政策可能是合理的，但同時亦會懲罰那些在該群體裡可能會準時還款的人。

任何以針對一個群體來作出的預測容易出現「假陽性」結果，導致不公正地懲罰有別於預測行為的個體，這是因為由大數據分析得出的預測取決於數據的準確性。若收集的數據未能準確反映人口的興趣及偏好，所得的預測結果亦會無效。當然，要去除在行為數據中的錯誤是不可能的，因為有些在行為數據中出現的變數，有時候未必能歸納出原因。故此，有需要採取一些措施來持續驗證數據的真偽，以及對網絡罪案提高警惕。

科技進步亦衍生複雜的網絡犯案方式，因此需要持續不斷地實施網絡安全來預防網絡罪案發生。電訊商一直關注網絡罪案並實施不同的網絡安全措施（詳情可參閱香港通訊業聯會上一期的香港通訊業概覽），香港市民亦應在網絡世界謹慎地披露個人訊息（如：網絡釣魚詐騙）；市民亦可以啟動免費的雙重認證，即使密碼被盜取，仍可以預防其他人登入他們的網上帳號。保護自己避免陷入網絡罪案，可簡接地預防生活滿足度和愉快度的下降（Cheng 等，2020 年）。

當人們注意到收集的數據是關於公眾時，人們可能會感覺比以前受到更多的審查。人們可能會意識到他們的數碼足跡是永久性的，並會用來對他們進行預測。即使看似無傷大雅的臉書「贊」，和關注那些 Instagram 帳號，都可以透露個人的一些訊息，為此，印象管理的努力亦可能受到影響。KOL 或者會堅持建立一個特定的形象，和與一些特定的群組連繫，可是他們的數碼足跡卻顯露了不一樣的實情。不同的機構透過公共數據分析可以得到好處，但是由於印象管理的原因，對市民來說可能會產生矛盾。

總括而言，5G 改變了香港市民的生活方式；5G 是複雜的，並需要各方通力合作才得以完善。接下來，我們轉去了解電訊商參與 5G 的合作。

5G Collaborations

Hutchison notes that 5G development paves the way for facilitation of the "3InnoCity" project, which aims to expedite Hong Kong's development into a smart city, support startups and collaborate with other industries (especially scientific and research development companies), and to develop advanced applications for public use and consequently enhance efficiency of managing resources and services. Multibyte and China Mobile joined the The Greater Bay Area 5G Industry Alliance, which provides a technology platform for operators and lines up industries. A primary purpose of this alliance is to serve as a connection for 5G finance, education, entertainment, and more.

5G 合作

和記電訊指出，5G 發展帶動了「3 智城」計劃的推進，此計劃旨在加快香港發展成為智慧城市、支持初創公司、與其他行業共同合作（尤其是科學研發的公司）、研發先進應用予公眾使用，並提高資源管理和服務效率。博元訊息和中國移動香港加入大灣區 5G 產業聯盟，為營運商提供一個科技平台和進行產業合作，此聯盟的主要目的是成為 5G 金融、教育、娛樂和其他的橋接連繫。

Launch event for The Greater Bay Area 5G Industry Alliance on October 16, 2019.
大灣區 5G 產業聯盟於 2019 年 10 月 16 日舉行啟動典禮

In 2017, HKT, ASTRI, Qualcomm, and Huawei formed the Smart Mobility Consortium. They will contribute to smart transportation via assisted driving and autonomous driving in the future. In 2018, China Mobile set up a Hong Kong Open Laboratory of CMCC 5G Innovation Center in March 2018, which proactively initiated collaborations with telecommunication and vertical industry partners to promote development of 5G technologies and applications in various industries. They also obtained the trial permit of 5G frequencies from OFCA to perform different kinds of 5G network tests in the past 12 to 18 months. Furthermore, CMHK, along with China Mobile Guangdong, Companhia de Telecomunicações de Macau, and Guangdong Communication Industry Association, have established "The Greater Bay Area 5G Industry Alliance". The alliance aims to enhance and promote the development of 5G industries, especially for stakeholders and operators in the Greater Bay Area.

2017 年，香港電訊、應科院、高通及華為共同成立智能交通聯盟，透過輔助駕駛和自動駕駛，他們將在未來為智能交通作出貢獻。2018 年，中國移動香港在 2018 年 3 月成立中國移動 5G 聯合創新中心，促進電訊及垂直行業的合作，在不同行業推動 5G 技術及應用；並同時獲通訊事務管理局（通訊局）發出的 5G 技術測試許可證，並在過去 12 到 18 個月進行各種 5G 網絡測試。另外，中國移動香港與中國移動廣東、澳門電訊及廣東省通信行業協會共同成立「大灣區 5G 產業聯盟」，該聯盟旨在加強和促進 5G 產業發展，特別是大灣區的持份者和營運商。

Cover Story ● 封面故事

In June 2020, Together with Hong Kong Cyberport and HKT, Microsoft Hong Kong announced the opening of Microsoft 5G IoT Makerspace, which integrates an Internet of Things (IoT) experience zone with makers workspace to inspire and enable Hong Kong start-ups to explore and experiment their IoT solutions through utilizing HKT's 5G network and Microsoft's technologies. Leveraging Hong Kong Cyberport's start-up community and HKT's true 5G services, Microsoft 5G IoT Makerspace will also offer workshops and expert advice to upskill start-ups, test their solutions and provide go-to-market support to commercialize their solutions.

2020 年 6 月，Microsoft 香港聯同香港數碼港及香港電訊為 Microsoft 5G IoT Makerspace 揭幕，Microsoft 5G IoT Makerspace 結合物聯網（IoT）體驗區與 makers 工作空間，旨在激發和推動香港初創團隊運用香港電訊的 5G 網絡和 Microsoft 技術探索和試驗其 IoT 解決方案。憑藉香港數碼港的初創社群和香港電訊的真正 5G 服務，Microsoft 5G IoT Makerspace 將提供一系列工作坊和專家建議，協助初創提 升技能、測試其解決方案並支援他們將其解決方案推出市場及作商業用途。

Mr. Tom Chan, Managing Director of Commercial Group of HKT (3rd from right), Mr. Fred Sheu, National Technology Officer of Microsoft Hong Kong (2nd from left) and Mr. Peter Yan, Chief Executive Officer of Hong Kong Cyberport (4th from left), kick off the Microsoft 5G IoT Makerspace
HKT 商業客戶業務董事總經理陳紀新先生（右三）、Microsoft 香港區域科技長許遂發先生（左二）及香港數碼港行政總裁任景信先生（左四）一起為 Microsoft 5G IoT Makerspace 揭幕

5G in Reality: Insights from Exceptional Leaders

Due to the numerous large-scale social impacts enabled by 5G, CAHK conducted a series of interviews with leading practitioners in July 2020 to better comprehend how 5G applications will impact Hong Kong. The interviewees include telecom operators, manufacturers, government-funded research centers, and more. We highlight key points from the interviews below in alphabetical order of the leader's surname listed below. The full interview reports are included in this Guide.

活出 5G 真體驗：卓越領導者的真知灼見

鑑於 5G 為社會帶來大規模的社會影響，香港通訊業聯在 2020 年 7 月，邀請了業界領先的從業者進行一系列的訪問，以深入了解 5G 應用將如何影響香港。受訪者包括電訊營運商、製造商，政府資助的研究中心及其他。我們撮要了一些訪談重點，並按照受訪者的姓氏的字母順序作為下表內容的排列，完整的訪問內容亦包含在本概覽內。

Chief Technology Officer of SmarTone - Mr. Stephen Chau
SmarTone 科技總裁─鄒金根先生

SmarTone is committed to bringing the best 5G experiences to consumers and enterprises with the ultimate goal of forging a path to smart city development in Hong Kong. SmarTone offers a vast 5G network coverage, both indoor and outdoor, with Ericsson's Dynamic Spectrum Sharing technology.

SmarTone has been working closely with enterprises from construction, healthcare, hospitality, property management, retail, and transportation for 5G digital transformation. SmarTone's 5G Innovation Hub established in early 2017 encourages cross-industry collaboration with start-ups and business partners to co-create 5G cases and trial them on its precommercial 5G network. In January 2020, SmarTone has collaborated with a local start-up to showcase a live demo of 5G high-speed and low-latency connectivity that comprised of 3.3GHz and 28GHz.

The showcase included three highlights. 1) SmarT Health – a 5G-connected ambulance embracing healthcare innovations that allows doctors to provide remote assistance to treat patients in movable vehicles. Additional features include remote assessment of a patient and ultrasound procedures that can be conducted inside an ambulance using a special haptic glove controlled by a doctor remotely through a specially designed joystick. 2) SmarT 5G Café – A 5G-connected barista can take orders and serve customers with robot-made coffee. The robot arm can then transfer the coffee to a coffee-printing machine where a photo or graphic can be printed on the foam of the coffee. 3) eMotorSports – model cars connected to 5G can respond immediately to an obstacle to avoid collision thanks to low latency and high speed of 5G.

SmarTone 一直致力為消費者及企業帶來最佳的 5G 網絡體驗，並以帶動香港智慧城市發展作為終極目標。SmarTone 採用愛立信（Ericsson）的尖端動態頻譜共享技術（Dynamic Spectrum Sharing、DSS），於室內室外提供全港至廣的 5G 網絡覆蓋。

SmarTone 一直與來自建築業、醫療保健、酒店業、物業管理、零售業和運輸業等企業緊密合作，為 5G 數碼轉型共同努力。SmarTone 5G Innovation Hub 於 2017 年初成立，致力推動跨行業合作，鼓勵初創企業和業務夥伴共同開創 5G 應用實例，並在 SmarTone 5G 商用前網絡上進行測試。於 2020 年 1 月，SmarTone 與本地初創企業携手合作，以高速及低時延的 5G 網絡，包括 3.3 GHz 及 28 GHz 頻段，作實時展示及現場直播。

該次展示包括 3 個重點：1）SmarT Health ── 一架連接 5G 的救護車，以創新技術容許醫生進行遙距支援，在救護車行駛時為傷者提供協助；醫生透過 5G 網絡配合特別設計的醫療遙控設備使用的觸感手套，亦可以為傷者進行急救評估及超聲波檢查。2）SmarT 5G Café ── 5G 調配咖啡機械臂可按照客人要求調配咖啡，配合咖啡打印機，更可將圖案或照片打印在咖啡泡沫上。3）eMotorSports ── 5G 網絡的低時延及高速特性讓連接 5G 網絡的模型車在遇上障礙物時，能即時作出反應，避免發生碰撞。

CEO of Hong Kong Applied Science and Technology Research Institute (ASTRI) – Mr. Hugh Chow
香港應用科技研究院行政總裁─周憲本先生

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'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 a 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 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.

ASTRI serves as three bridges. 1) Bridge of Collaboration – provide the bridge between basic research and commercialization and to turn upstream research from academia into applicable solutions for the market. 2) Bridge of Communication - to raise awareness of their support and capabilities to address pain points and make socio-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.

香港應用科技研究院有限公司（應科院）由香港特別行政區政府於 2000 年成立，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 實時數據吞吐量。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無人駕駛技術，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。

應科院擔負三個橋接的重任：1）合作的橋樑 ── 提供基礎研究及商業化之間的橋樑，將學術領域裡的上游研究轉變為適用於市場的解決方案；2）通訊的橋樑 ── 針對應科院解決痛點的能力以惠澤本地社會經濟發展，藉以提高人們對應科院的支援及認知；3）人才培育的橋樑 ── 與大學和業界夥伴共同開展人才發展計劃及實習計劃，為創科領域培養科研人才。

Group Managing Director of HKT – Ms. Susanna Hui
香港電訊集團董事總經理—許漢卿女士

Hong Kong Telecom (HKT) is a telecommunications company in Hong Kong with extensive fixed and mobile communication networks and technologies. It has decades of experience and talents in system integration. The evolution of 2G, 3G, and 4G has shifted the demand for communication from voice to data to mobile broadband. As a telecom operator, HKT has witnessed the rapid growth of communication traffic in the past 30 years.

As the era of 5G progresses, HKT would make use of their practical experience and understanding of the operations of various industries to promote the Internet of Things (IoT), augmented reality (AR), and cloud computing. Hong Kong Telecom will continue to work closely with global start-ups and technology partners to develop 5G smart technology solutions suitable for various industry applications, including medical, transportation, logistics, construction and other innovative application solutions, such as artificial intelligence (AI) and robotics, retail, and more to assist companies in accelerating the pace of digital transformation and business development. HKT is committed to cooperating with this policy and the development of the 5G ecosystem in Hong Kong and the Greater Bay Area.

The Greater Bay Area is the road to the "One Belt One Road" initiative, which is expected to transform coastal areas into high-tech metropolises. To that end, Hong Kong businesses and companies have been actively exploring opportunities in this area. For example, as a leading telecommunications and ICT provider in Hong Kong, Hong Kong Telecom has established telecommunications infrastructure and ICT platforms, including a cloud data center (Sky Exchange), and established a Security Operation Centre (SOC) in Guangzhou at the end of last year.

香港電訊（HKT）擁有廣泛的固網和流動通訊網絡和科技的香港電訊服務供應商，並擁有數十年系統融入的豐富經驗和人才。2G，3G 和 4G 將流動通訊需求由話音轉移到數據，再轉移至流動寬頻。作為一家電訊營運商，HKT 見證了過去 30 年通訊業務的急劇增長。

隨著 5G 時代的演進，HKT 亦利用他們的實踐經驗和對各行各業的認識來促進物聯網（IoT）、擴增實境（AR）和雲計算的發展。HKT 亦會繼續與全球初創公司和技術夥伴合作，共同開發適合不同行業的 5G 智能科技方案，包括醫療、交通運輸、物流、建築業和其他創新應用方案，如人工智能（AI）和機械人、零售，以協助支持企業加快在數碼轉型及業務發展的步伐。HKT 致力於推動有關政策和促進香港和大灣區 5G 生態系統發展。大灣區是邁向「一帶一路」倡議的重要支撐，冀藉此將沿岸地區發展成高科技大都市。有見及此，許多香港企業和公司一直積極在這區域探索發展機會。例如：作為香港首屈一指的電訊及通訊科技（ICT）供應商，HKT 在去年年底已在廣州建設電訊基建及 ICT 平台，當中包括雲數據中心（Sky Exchange）和安全管理中心（SOC）。

Executive Director and CEO of Hutchison Telecommunications Hong Kong Holdings Limited – Mr. Kenny Koo
和記電訊香港控股有限公司執行董事兼行政總裁—古星輝先生

For many decades, Hong Kong has a vigorous telecom infrastructure that provides stable coverage across the city. Since the 3G era, data coverage spans both indoors and outdoors and even in underground areas such as MTR. This form of widespread connection in the city is quite unparalleled worldwide. The expansion of 5G would help various industries in terms of healthy competition.

Competition is present in every industry. Koo notes that competition among telecom operators was rather tense during the 4G era. However, this trend will alter during the 5G era because 5G transforms the market nature. As 5G unfolds, the market size will increase and in turn, provide more potential for vertical marketing and specialized applications. Companies can use 5G to focus on their niche, and competition will be healthier. In other words, different companies can focus on how to adopt 5G to give them a competitive advantage to target a more specialized market. Doing so would result in a decreased clash for the same customers.

However, adopting new technology is not easy for many professions. As more people are required to work from home and avoid public gatherings, there need to be ways to help professions that generally meet face-to-face. Hutchison plans to be an intermediary to enable content producers (e.g. Key Opinion Leaders, artists, performers, private tutors) who struggle in the current pandemic situation. This includes collaborating with various professionals to create VR content for the public that will be accessible at the comfort of one's home.

數十年以來，香港一直擁有全面的電訊基建，為本地提供穩定而覆蓋廣泛的電訊服務。自 3G 時代起，數據覆蓋範圍已遍及室內外，甚至延伸至港鐵沿線等地下區域。香港的廣泛連接性可謂全球無與倫比，對香港來説更是一個強大優勢。5G 的發展將會協助不同行業帶來健康的競爭環境。

古先生指出，每個行業都存在著競爭，而電訊營運商之間在 4G 時代的競爭亦相當激烈。不過，這種形勢將在 5G 時代改變，因為 5G 將會改變市場上的競爭格局。5G 的啟動擴大了市場規模，並為垂直市場和專業應用提供更多的潛在機會。企業可以利用 5G 專注於自己的強項，這樣將使市場競爭更加健康。換句話説，不同企業要專注如何運用 5G 來加強他們的競爭優勢，並針對更專業的垂直市場，這樣可減少出現相同客戶群的衝突。

然而，並非每個行業都可輕易採用新技術，隨著越來越多人在家工作及避免聚會，有需要為經常作面對面交流的行業找出路。為此，3 香港計劃成為在新冠肺炎期間苦苦掙扎的內容製作人（如：KOL、藝人、表演者和私人導師）的中介。 3 香港計劃與這些專業人士合作創作 VR 內容，讓大眾可以安在家中舒適地存取。

Director and CEO of China Mobile Hong Kong Company Limited – Mr. Sean Lee
中國移動香港有限公司董事兼行政總裁—李帆風先生

China Mobile Hong Kong (CMHK) is a leading telecom operator that specializes in a whole host of services to enrich the end-user experience. CMHK not only provides mobile services, but also offers home broadband services, cloud services and internet data center. CMHK collaborates with Hong Kong Applied Science and Technology Research Institute (ASTRI) and Hong Kong Science and Technology Parks Corporation (HKSTP) on 5G technology and projects such as AR / VR in entertainment and education, high-security authentication systems in payment services, etc and has worked with airport authority to build their private 5G network.

The launch of 5G represents a shift of focus in the telecom industry. Generally speaking, 3G revolves around people, 4G revolves around people and information, and 5G revolves around machine to machine communication. 5G will bring upon many new enhancements, namely CMHK's dedication to A.I.C.D.E (AI, IOT, Cloud, Big Data, Edge computing). Data would be stored in the cloud & be processed in the edge, devices would be connected through 5G network, and machines will be able to operate on their own. In the near future, people would be able to use augmented reality that has facial/pattern recognition capabilities. Laypeople would be able to use AR to identify famous paintings (and quickly learn of the painting's history), identify products in supermarkets for the best prices, see real-time translations, play board games such as mahjong, and other uses that enhance one's lifestyle. There are many more applications that can be powered by the advent of 5G and A.I. technology to address complex problems and improve customer experience.

中國移動香港（CMHK）是一家提供廣泛及多元服務的領先電訊營運商，服務範圍不僅提供流動通訊服務，還包括家居寬頻、雲服務及數據中心服務等，藉此豐富用戶的體驗，為人們帶來更優質的日常生活。CMHK 一直與香港應用科技研究院和香港科技園（HKSTP）緊密合作，進行 5G 技術及項目研發，例如運用 AR/VR 在娛樂和教育上的應用，以及高安全性認證的支付服務等，並與香港機場管理局合作，協助建設其專有的 5G 網絡。

5G 的推出標誌著電訊業的一個徹底轉變。過往，3G 以人為導向，4G 以人和訊息為導向，如今，5G 則是以機器對機器的通訊為導向。5G 將帶來許多新的增強功能，CMHK 致力發展 A.I.C.D.E（AI 人工智能、IoT 物聯網、Cloud 雲計算、Big Data 大數據、Edge Computing 邊緣計算）。數據將會在雲端儲存，並運用邊緣計算進行處理；終端裝置通過 5G 網絡進行連接，機器亦可以自行運作。人們很快便可使用配備臉部 / 模式識別的擴增實境（AR），享受多元化的生活，諸如利用 AR 識別名畫，並即時了解該幅畫的歷史；又可在超級市場裡識別產品和最優惠價格；查看實時翻譯，玩麻將等桌上遊戲以及其他能夠豐富日常生活的用法。5G 和 AI 技術的出現能針對複雜的問題和改善客戶的體驗。

General Manager of Hong Kong Productivity Council and APAS R&D Centre – Dr. Lawrence Poon
香港生產力促進局及汽車科技研發中心總經理—潘志健博士

The Hong Kong Productivity Council (HKPC) facilitates the government's technology initiative. Namely, HKPC's projects are in line with the government's Smart City blueprint released in 2018, which outlines six smart categories. These are smart mobility, government, people, living, economy and environment.

HKPC stimulates the commercial adoption of 5G in various ways. In the realm of smart transport, HKPC has its own automobile parts and systems (APAS) Research and Development Center. In recent years, technological advances have garnered much thought about driverless cars, but Dr. Poon stresses that driverless cars need to use 5G to be practical. Achieving this noble task is made possible via HKPC's virtual platform that simulates various forms of environments by manipulating a wide range of variables (e.g. number of people, bicycles, animals, cars, speed of cars). These simulations aim to recreate HK transport patterns to make cars entirely autonomous.

HKPC's facilities are capable of assisting tech adoptions by the commercial community. HKPC's SME ONE serves as a one-stop application support and consultation for government funding schemes. SME ONE provides seminars and workshops to solve potential technical problems. Within HKPC, there are test back labs that provide controlled environments that stabilizes external noise (and by extension allows variables to be manipulated or controlled) for reliable quality. Outside of HKPC facilities, there are mobile teams that use HKPC technology and equipment to survey the data quality in outdoor areas. Initiatives that support SMEs will in turn allow 5G to become an ecosystem.

香港生產力促進局（生產力局）致力協助香港特區政府推行科技措施，更全力支持於 2018 年推出的「香港智慧城市藍圖」，該藍圖勾劃出六大智慧範疇，包括：智慧出行、智慧政府、智慧市民、智慧生活、智慧經濟及智慧環境。

生產力局積極鼓勵 5G 商用多樣化，在智能交通研究方面，生產力局設有專注研發智能交通項目的部門，汽車科技研發中心（APAS）。近年，科技的進步刺激了大量無人駕駛車的研究，潘博士強調，自動駕駛車必須要 5G 技術的配合方可落實運作。生產力局的虛擬平台通過模擬多種環境場景設置並加入廣泛的變數，（如：人數、單車、動物、汽車和車速），務求完善自動駕駛汽車的成效。這些模擬應用旨在重塑城市的交通模式，以實踐完全自動駕駛車的目標。

生產力局致力促進商界採用技術，轄下的「中小企一站通」（SME One）旨在提供一站式全面的營商資訊服務，包括香港政府的各類型資助及支援計劃的諮詢，透過定期舉辦不同的研討會及工作坊，為中小企解決一些潛在技術性問題。生產力大樓內設有一個測試區域，提供可控的環境進行測試實驗，以穩定外來噪音，並通過延伸，容許處理不同變數以達到可靠的質量。另外，生產力局亦有專家，負責利用生產力局研發的技術與設施在室外環境進行數據質量測量。這些支援中小企的 5G 應用將有助構建一個健全的 5G 生態系統。

General Manager of Huawei Hong Kong Representative Office – Mr. Wilson Wang
華為香港代表處總經理─王青先生

HUAWEI was founded in 1987 and is currently a leading provider for smart devices and ICT infrastructure that operates in over 170 countries. HUAWEI serves to bring the digital world to everyone and is a valuable manufacturer for various HK telecom operators. There are plenty of applications that help consumers, but the process of implementing and executing these applications is driven by applications' business case. That is, Hong Kong's unique capitalist mindset makes it so investors prioritize the return of investment before taking action. While this pragmatic approach is sensible, the onus of implementing 5G applications becomes dependent on the projects' business case. In the Mainland, the government will fund ground-breaking ideas and still invest in projects even if not all projects yield significant results.

Mr. Wang notes that 2020 saw has several meaningful applications in 5G, but HK cannot rely on talent and ideas alone. Despite Hong Kong's rapid development start-ups, Hong Kong's development of 5G lags behind Mainland; the Mainland already has over three thousand companies planning/currently implementing 5G projects. The Greater Bay Area already uses sophisticated AI, cloud platforms, and a rapidly developing 5G network. As such, HK's start-ups can use the GBA's AI and cloud platform to reach GBA's markets and to create applications modeled after the GBA framework.

To invest wisely in a business case, one must consider network requirements and application ability. To that end, Huawei has collaborated with various Universities in Hong Kong, Science Park, organizations, and associations. Huawei also has free hardware module and software training start-ups aimed at 5G development to enable Hong Kong's tech ecosystem kick-off 5G. While the Mainland's push for 5G is a nation-wide initiative with funding supported by the centralized government, HK is based on free trade, which impacts the speed of 5G development.

華為於創立於 1987 年，是全球領先的資訊及通訊科技基礎建設與智能裝備供應商，業務遍及 170 多個國家。華為致力把數碼世界帶給每個人，同時亦是香港多間電訊營運商的重要供應商及合作夥伴。5G 將提供許多幫助消費者的應用，然而，要推行這些應用需要由應用的商業案例去帶動。香港獨特的資本主義心態，讓投資者在採取行動之前，會優先考慮投資回報。雖然這種務實的方法是明智的，但是要推行 5G 應用則取決於項目的商業案例。在中國內地，政府會資助原創意念，即使未必所有項目都有顯著回報，但仍會進行投資。

王先生指出，5G 在 2020 年裡有幾個別具意義的應用，但香港不能單靠人才和想法；即使香港的初創企業發展迅速，但香港 5G 的發展仍落後於大陸。內地已有三千多家公司計劃 / 經已實施 5G 項目。大灣區已運用尖端的 AI 和雲平台迅速發展 5G 網絡，因此，香港的初創公司以利用大灣區的 AI 和雲平台來進運大灣區市場，並創建以大灣區框架為模型的應用。

要明智地投資商業案例，必須考慮網絡要求和應用能力。 為此，華為與香港的多家大學、香港科學園、業內組織及團體通力合作。華為積極為 5G 開發提供免費硬件模塊及軟件培訓初創，促使香港建設科技生態系統以開啟 5G 世代。內地推動 5G 是一項全國性的舉措，由中央政府提供資金支持，而香港則建立在自由貿易的基礎上，這影響了 5G 的發展速度。

President of Smart City Consortium – Mr. Gary Yeung, MH
智慧城市聯盟會長─楊文銳先生，MH

Hong Kong's Smart City Consortium (SCC) was set up by various industry leaders and professional bodies to provide assistance to the HK government to build HK into a Smart City. SCC serves as a platform to connect government, academic, and commercial organizations regarding smart city issues. SCC promotes awareness to the public about adopting Smart City technologies, which includes initiatives that align lots of researchers from various countries to research IOT products (e.g. on capacity, security, connectivity).

In order for 5G to successfully redefine people's lifestyles, there need to be three steps: Technology first, policy second, people third. Technology is obviously needed to utilize data and its accompanying applications, but it is not enough by itself. There must be policies that inform the population of what is acceptable and safe before applications can follow. Once policies are set, the last step rests on people adopting the latest technology.

Many buzzwords are associated with 5G. Laypeople often associate 5G with Big Data, Internet of Things, Artificial Intelligence, augmented reality, and virtual reality. But how do these processes interact? According to Mr. Yeung, IOT "adds then subtracts." That is, connected devices enabled by IOT captures Big Data via sensors and automated systems (thus creating an overabundance of information), then artificial intelligence combs through the raw data to find relevant data to uncover solutions. We live in the digital age where data is arguably the most valuable asset, but there is often too much data for humans to manage.

香港的智慧城市聯盟由一群業內領袖及不同的專業人士所創立，旨在協助香港政府把香港發展成為智慧城市。智慧城市聯盟是一個連繫政府、學術界及商業機構的平台，共同協作創建智慧城市的相關事宜。智慧城市聯盟致力提升大眾對運用智慧城市科技的認識，包括促進來自海外研究人員開發的 IoT 產品科研（如：容量、安全性及連接性）的一致性。

要 5G 成功重新定義人們的日常生活行徑，必須 3 個步驟：第一是科技，第二是政策，第三是人。科技顯然地需要依賴數據及其附加應用才足夠；然後，必須配合相對應的政策去讓大眾知道何謂可接受和安全，然後方可付諸應用。當政策落實，最後一步就是靠人去應用最新的科技。

與 5G 相關的流行詞彙眾多。一般人會將 5G 與大數據、物聯網、人工智能（AI）、擴增實境（AR）和虛擬實境（VR）等掛上聯繫，但它們彼此之間是如何互動？楊先生表示，IoT 是「先加後減」，意即 IoT 將不同的終端連繫，然後透過感應器及自動系統取得大數據，再歸納成海量資訊。AI 則梳理原始數據找出相關的數據及產生結論和方案。我們身處在數碼時代，數據可以說是最重要的資產。但龐大的數據量並非人類能一一管理。

Living in a Data-Driven 5G World

As the exceptional leaders noted, 5G will lead to a myriad of changes that impacts people's daily lives. But since 5G is not an isolated phenomenon in Hong Kong, we have to consider the implications of living in a data-driven 5G era in a global context. While we cannot confidently elaborate all the implications given that we are still in the early stages of 5G, we discuss four trends. These are:

1) 5G creates quantified societies that use digital information to predict people's behavior

2) 5G creates concerns about job automation

3) 5G generates questions about accountability when intelligent systems fail

4) 5G applications are dependent on the country's policies and values.

Quantified Societies Use Digital Information to Predict People's Behavior

As 5G connects millions of devices and transforms smart learning, smart health, smart education, and more across all age groups, there would be tons of data that is able to predict people's affect, behavior, and cognition on various levels of analysis from the individual to groups to nations. While using data to predict people is how social science research is usually conducted, the amount of data that 5G reveals will be unprecedented.

On an individual level, people's digital transactions – which are becoming increasingly common over cash payments – can be used to describe the trajectory and predict how people spend their money. Admittedly, this is already happening on online shopping platforms with huge implications for targeted marketing, but as more e-payment platforms are promulgated, more digital transactions will occur. People or companies who complete transactions via WeChat, Octopus card, or e-Wallets would have a clean digital record of where their money went, but digital transactions leave a digital trail that may be used to predict behavior.

These digital footprints, e-payments or otherwise, will continue to reveal more than what we want others to know. For instance, Ophir et al. (2019) was able to accurately predict adolescents' depressive symptoms, victimization of bullying, and social rejection by analyzing their social media content. While these findings may be good for educators and parents, it may not appreciated by the participants. Even innocuous daily behaviors serve as digital footprints, such as what one music one listens to. Anderson et al. (2020) asked thousands of participants to submit

在數據驅動的 5G 世界中生活

正如這些優秀的領導者所指，5G 將為人們日常的生活帶來五花八門的影響。由於 5G 不是只在香港出現的單獨現象，因此，我們從全球環境來考量，在以數據驅動的 5G 世界裡生活的含意。由於我們仍在 5G 的早期階段，所以我們無法自信地闡釋所有含意，但我們仍探討了四個趨勢，分別是：

1) 5G 建立了量化的社會，並利用數碼訊息來預測人們的行為

2) 5G 引發對工序自動化的擔憂

3) 5G 在智能系統出現故障時，將產生有關責任的問題

4) 5G 應用取決於國家的政策和價值觀

量化的社會利用數碼訊息來預測人們的行為

5G 連接數百萬個終端裝置，並在所有的年齡群裡轉化成智能學習、智能健康，智能教育等，導致出現龐大數據量，而這些數據能夠從個人，到群體，再到國家的層面，依據人們不同的分析水平，來預測人們的影響，行為和認知的程度。雖然使用數據來預測人們是社會科學研究的方式，但 5G 將會揭露空前的數據量。

從個人層面而言，人們的數碼交易（相比現金支付變得越來越普遍）可用於描畫軌跡和預測人們的消費模式。誠然，網上購物平台已有這情況發生，並出現大量推廣目標市場的宣傳，但隨著更多的電子支付平台面世，將會增加更多數碼交易。人們或公司透過微信、八達通或電子錢包完成交易，將會留下一個清晰的數碼記錄，記下他們的金錢花在哪裡，然而，數碼交易還留下可以用來預測行為的數碼軌跡。

這些數碼足跡，電子支付或其他，會繼續揭露一些比我們希望他人知道的東西還要多。舉例來說，Ophir 等（2019 年）透過分析青少年的社交媒體內容，可以準確地預測他們的抑鬱症狀、受到欺凌和社交排擠等。雖然這些發現對教育工作者和父母來說都有用處，但對參加者來說則不然，甚至一些無關痛癢的日常行都會變成數碼足跡，如一個人所聽的音樂。Anderson 等（2020 年）邀請幾千名參加者提供他們

their Spotify data over a 3-month period (i.e. app usage, account details, listening history) which was able to accurately predict the participants' mood, demographic information, and personality traits. These results, which were confirmed with the participants' self-reported data, show data-driven predictions models have moderate to high accuracy.

超過 3 個月時間的 Spotify 數據，（即程式使用量、帳戶資料和歌曲播放紀錄），這些都有助準確預測參加者的情緒，人口訊息和個性特徵。這些得出的結果都與參加者自我匯報的數據吻合，顯示數據驅動的預測模型具有中度至高度的準確性。

On a social level, people can be tracked based on their social network, conceptualized as ties between individual nodes. While social network analysis as a methodology is not new, its predictive power will only increase as there are many online social groups that a person simultaneously subscribes to (Facebook, Google+, LinkedIn, Instagram, SnapChat, Twitter) and more to come in the near future. One's connection to others is more easily maintained but also made more transparent. People can look up a person's ties that include Facebook friends, Twitter followers, LinkedIn connections, Whatsapp groups, coauthorship on academic papers.

Social network data can be collected via archival, survey, or behavioral methods. Some aspects of people's social networks are recorded (e.g. attendance records of events), some can be elicited by asking people or through social engineering techniques, and some can be observed by looking at comments (Clifton & Webster, 2017). There have already been research on social network analysis on hiring networks, how friendship networks are affected by extraversion (Kalish & Robbins, 2006), and even one's reputation online (Costello & Srivastava, 2020).

On top of tracking social groups, digital information could also track schools, nations, and other large-scale entities. Tracking how citizens behave within a social/cultural/political system sheds light on how technologically-driven changes in various institutions affect the populace. While cross-cultural psychology today already analyses nation-level data (e.g. well-being and health, population density, socio-ecological stressors), more data in the future will yield additional predictive validity in how 5G-driven applications affect the human psyche.

從社交層面而言，將人們的社交網絡概念化為各個節點之間的聯繫，便可以追蹤他們。儘管把社交網絡分析作為方法論並不新鮮，其預測力只會在人們同時訂閱不同的社交群組（臉書、Google+、LinkedIn、Instagram、SnapChat、推特）時而遞增，並在未來繼續增加。一個人與其他人的連繫較易維繫，但同時亦增加透明度，人們可以藉著查看某人的臉書朋友、推特關注、LinkedIn 聯繫、WhatsApp 群組、學術論文合著等來了解某人的人際關係。

社交網絡數據可以藉著存檔，調查或行為方法等來收集。有些社交網絡的面向是會被紀錄下來（如：活動出席記錄），有些可以通過詢問他人來抽取，或借助社交工程技巧，而有些則可從觀察評論而獲得（Clifton 和 Webster，2017 年）。另外，亦有關於招聘網的社交網絡分析，研究朋友網絡如何受外向性的影響（Kalish 和 Robbins，2006 年），甚至是一個人在網上的名聲都已經進行了研究（Costello 和 Srivastava，2020 年）。

除了追蹤社交群組外，數碼資訊還可以追蹤學校，國家及其他大規模的機構組織。追蹤市民大眾在一個社會 / 文化 / 政治體系裡的行為表現，就可以了解各個不同機構組織中的技術驅動的轉變如何影響民眾。即使現時的跨文化心理學已有國家級別的數據（如：健康與福祉、人口密度，社會經濟壓力來源等），未來將會產生更多數據預測，進一步引證 5G 驅動的應用如何影響人類的心理。

Concerns about Job Automation

Whenever there is an incoming advance in technology, there comes with it a fear that some jobs will be automated and thus contribute to unemployment. This fear can be traced back to the Industrial Revolution, where textiles workers actively protested against machines and steam engines (Autor, 2015). Throughout the 20th century, there have been resistance against technological advances in the realm of tractors, automobiles, assembly lines, and even spreadsheets. These concerns, while understandable from a practical and psychological level, tend to subside in the long run.

On a practical level, computers outperform humans in task that are routine, be it manual labor or cognitive tasks. Computers are outperforming humans in even highly specialized fields that are routine. For instance, Enlitic's deep-learning systems outperformed radiologists in detecting tumors and wrist fractures. The best way not to get automated, according to The Economist, is a non-routine but highly cognitive field (The Economist, 2016). That being said, some even argue that jobs can be broken down into a string of routine tasks that can in turn be done by machines, though this is not possible in every field (Frey & Osborne, 2017).

On a psychological level, high unemployment rates enacted by the 2007-2009 financial crisis and the COVID-19 pandemic incites fear of job scarcity. Studies that sampled American and European participants found that concerns about downsizing due to automation is associated with negative attitudes towards immigrants (Gamez-Djokic & Waytz, 2020). In an experimental design, participants who read about a company that plans to lay off employees due to adopting new technology (vs. downsizing to cut costs) were more likely to see immigrants as both a threat to existing resources and threat to existing cultural values, which in turn incited anti-immigrant response (relative to nonimmigrants).

Nowadays, there is a huge rise of remote work as a result of the pandemic, and some of our interviewees believe this trend would likely continue after pandemic is over. Advances in technology might influence blue-collar workers most, since clerical work and services will be less demand when the physical footprint of various institutions decrease (The Economist, 2020). There is also no doubt that artificial intelligence would have effects on innovation, international trade, inequality, and productivity growth that will alter the job market and economy in unpredictable ways (Furman & Seamans, 2019). Some even argue that automation is good for growth but exacerbates inequality (Berg et al., 2018).

While these fears are legitimate in some contexts, many argue that we should not fear as humans have long adapted alongside technological advances. Past technology has created more jobs overall in the long term despite substituting labor in the short term. When jobs are automated, people are free to do other tasks that will no longer occupy their time. For instance, the advent of ATMs in 1970s were initially been met with criticism with fears of automating bank tellers. But later more banks opened to respond to more specific sales and customer services (Bessen, 2015). Similarly, advances in technology have led to employment in jobs that did not previously exist such as video-game designers and cybersecurity specialists.

工序業自動化引發的擔憂

一直以來，當有新科技推出時，伴隨而來的便是憂慮某些工作將會被自動化替代，而導致失業情況。這種憂慮可以追溯至工業革命，當時的紡織工人積極抗議使用機器和蒸汽機（Autor，2015 年）。在整個 20 世紀，拖拉機、汽車，組裝線，甚至是電子表格的領域都一直對技術進步持對抗態度。從實際上和心理上都可以理解這些擔憂，但長遠來說這些憂慮往往都會消退。

從實際層面來看，電腦從事一些恆常性的任務，不論是人手操作或認知的任務，都比人類更加勝任；甚至在一些要求高度專注的專業領域裡的常規化任務，電腦的表現都比人類優勝。例如：Enlitic 的深度學習系統在檢測腫瘤和腕部骨折方面的表現優於放射科醫生。根據《經濟學人》所言，要避免被自動化替代的最佳方法，是從事一些非常規性但需要高度認知能力的工作（《經濟學人》2016 年）。話雖如此，有些人認為可以將工作分拆成一連串的恆常任務，然後由機器負責，不過，這方法並非每個範疇都適用（Frey 和 Osborne，2017 年）。

從心理層面來看，2007-2009 年的金融危機觸發高失業率，而 COVID-19 新冠肺炎大流行亦引起人們對就業不足的憂慮。一項邀請美國和歐洲參加者進行的抽樣調查發現，他們對因為自動化而引致裁員的擔憂，促使他們對移民出現負面態度（Gamez-Djokic 和 Waytz，2020 年）。在一項實驗性設計的調查中，參加者看到一間公司表示由於採用新科技而計劃裁員時（以裁員削減成本），使他們認為移民是現有資源和文化價值的威脅，從而導致出現反移民情緒（相對於非移民）。

現今，大流行疫情令遙距工作急增，部分受訪者認為這趨勢在疫情過後可能仍然持續。技術進步對藍領工人的影響最大，當不同機構組織減少物理足跡時，對一般文職工作和服務的需求亦同步遞減（《經濟學人》，2020 年）。毫無疑問，人工智能將對創新、國際貿易、不平等和生產力增長帶來影響，這將會以不可預測的方式改變就業市場和經濟（Furman 和 Seamans，2019 年）。有些人則認為自動化有助增長，但就業會加劇不平等情況（Berg 等，2018 年）。

儘管這些擔憂在某些情況下是合情合理，但許多人認為我們不應該擔憂，因為人類早已適應科技進步。過去的科技雖然在短期裡替代了勞動力，但長遠來看卻創造了不少職位。當工作變成自動化後，人們便有空處理其他不用佔據他們時間的任務。例如：在 1970 年代推出自動櫃員機時都曾受到非議，擔心銀行櫃台服務會變成自動化，到後來銀行開拓更多針對性的銷售和客戶服務來作出回應（Bessen，2015 年）。同樣，科技的推進亦創造了以前不存在的職業，如視頻遊戲設計師和網絡安全專家等。

Questions about Accountability when Intelligent Systems Fail

Artificial intelligence will outperform human in many tasks, but accidents or bad decisions can still occur (Tegmark, 2018). When the unlikely scenario happens where the A.I. system is responsible for an accident such as a casualty caused by a driver-less car, who becomes accountable? While we are not delving into legal theories of liabilities that varies across nations, we highlight the conundrum of who to blame since machines presumably do not have malicious intent and there was no human directly involved in causing the accident.

This scenario happened in 2018 where a self-driving Uber car killed a pedestrian in Arizona. A report released months after the crash revealed that there were software failures that misrecognized the pedestrian as an object. Unfortunately, it becomes difficult to trace exactly why the intelligent system failed, which leads some to argue for the 'moral crumple zone' (Elish, 2019; Hohenstein & Jung, 2020). When the behavior of an automated system is misattributed to a human actor who had limited control, the nearest human operator (i.e. the passenger who is not driving the car in the first place but could have stopped the accident) often bears the responsibilities of system malfunctions. But sometimes without human involvement it becomes impossible to track who was responsible.

As we need accountability to maintain order and justice in society, some have argued for human-centric artificial intelligence systems to establish human accountability (Bryson & Theodorou, 2019). These type of systems dictates that A.I. protocols are made transparent to the public. Additionally, establishing human accountability involves keeping records of every accident caused by an A.I. system and the reasons behind each one to maintain human control through governance and regulation. Apple claims to keep track of individual programmers who write software apps the iPhone, so similar measures can be implemented to limit the possible accidents by keeping people accountable.

Launching 5G Applications are Dependent on the Country's Policies and Values

There are many factors that influence the successful launch of 5G applications. In addition to technical aspects (e.g. coverage, low-latency), each country and populations within each country will have a different angle pertaining to what 5G applications should be permitted. Some places will embrace 5G technology, but other countries might ban installing 5G infrastructure. Some people even fear new technology to the point of believing a conspiracy theory that 5G is a cause behind the coronavirus (Jolley & Patterson, 2020).

On a macro-level, each country has norms that allow or forbid certain ideas to be expressed, and this has implications on every 5G application. Certain AR and VR applications might be legal in one country, but illegal in another. Smart health applications also vary but country, depending on what medical procedures are legal. The curriculum behind Smart learning will also cater towards the country's national values. Even some 5G games on smartphones will be permitted in one country but banned in another. In the future, additional conflicts between countries could arise due to disagreements on what limits of 5G applications should be. Given the conflicts between China and the United States that led to the banning of the other country's technology, Huawei (alongside WeChat and TikTok) and Apple have been constantly targeted. As conflicts between nations arise, the trend of banning technology that originate from those nations will likely continue.

智能系統出現故障時產生的責任問題

人工智能在處理許多任務上都比人類優勝，不過，仍然會出現意外事故或作出錯誤決定（Tegmark，2018 年）。當一些未必會發生的情形，但仍需 AI 系統負責的意外時，如無人駕駛汽車引致的傷亡，到時應由誰來承擔責任？當然，我們不是要鑽研不同國家的責任法律理論，我們只想強調事故出現應歸咎於誰的難題，因為機器不會有意圖引起事故，而且亦沒有人直接參與造成事故的發生。

這情況曾經在 2018 年發生，一架自動駕駛的 Uber 汽車在亞利桑那州殺死了一名行人，數月後發出的報告指出，導致意外發生是因為出現軟件故障，令無人駕駛汽車誤以為該名行人是一障礙物。遺憾地，要追查智能系統發生故障的原因並不容易，這導致一些人爭辯「道德緩衝區」的問題（Elish，2019 年；Hohenstein 和 Jung，2020 年）。當自動化系統的行為歸因於控制能力有限的人類時，最接近的操作人員（即那位不是駕駛者，但有能力阻止意外發生的乘客）便可能承擔系統錯誤的責任。有時候若沒有牽涉人為參與，那便無法找到誰人來承擔責任。

由於我們需要問責制來維持社會秩序和正義，因此有人認為要以人為中心的人工智能系統來建立人類問責制（Bryson 和 Theodorou，2019 年）。這類系統主張 AI 通訊協定需向公眾透明，再者，建立人類問責制時需要紀錄每樁由 AI 系統引發的意外事故及背後原因，以維持人類透過政策及規管條例來進行操控。蘋果聲稱有追蹤使用 iPhone 編寫軟件應用程式的獨立程式員，因此可以考慮繼續由人來問責，以減少出現意外事故的可能性等類似措施。

推出 5G 應用取決於國家的政策和價值觀

5G 應用的成功推出是受許多因素影響的，除了技術特性（如：覆蓋度和低時延）外，每個國家和其人口對允許那些 5G 應用都有不同的看法。有些地方十分樂意採用 5G，但有一些國家則禁止安裝 5G 基建架構。有些人對新科技的恐慌程度去到認為是陰謀論的地步，甚至相信 5G 就是引發新冠肺炎的背後原因（Jolley 和 Patterson，2020 年）。

從宏觀層面來説，每個國家都有允許或禁止表達對某些想法的規範，這對每個 5G 應用都有影響。某些 AR 和 VR 應用可能在一個國家裡是合法使用，但在另一個國家則屬違法。智能健康應用亦視乎每個國家的醫學程序的合法性而有所不同；智能學習背後的課程大綱亦會迎合一個國家的自身價值觀來定立；一個國家可能允許在智能手機上安裝某些 5G 遊戲，但在另一個國家則會禁止。未來，由於在 5G 應用的限制範圍上存在分歧，國家之間可能因此而出現其他衝突。就以中國和美國為例，兩國之間的衝突使一方禁止對方的技術，華為（以及微信和 TikTok）和蘋果一直成為目標，經常性地受到攻擊。隨著兩國之間的衝突升溫，禁止使用源自這些國家的技術的趨勢將會持續下去。

On a micro-level, a person's choice of what 5G applications and what smartphone to use could signal a social identity. As smartphones are a primary medium for 5G applications, and one's smartphone choice has long been a marker for social group affiliation (Katz & Sugiyama, 2005), one's choice of what smartphone to use and what applications to support serves as cues for impression management. One's decision to use Huawei or Apple or another brand could signal allegiance to certain ideas/values.

Concluding Remarks: From 1G to 5G

The creators of 1G allowed people to make calls between phones. Every telecommunication generation thereafter made gigantic leaps in technology that strengthened many aspects of life via digital connectivity. Soon, 5G would connect millions of devices together, utilize Big Data in various institutions, and improve countless people's jobs, safety, healthcare, education, transportation, entertainment, transactions, social life, business-customer relations, and even everyday convenience.

As we move into the 5G era and as Hong Kong transforms into a Smart City that radically improves people's lifestyles and various institutions, we should remember that it is made possible by various initiatives spearheaded by telecom operators, manufacturers, research institutes, SMEs, and many more organizations.

A great deal of research has examined the social impact of 4G, and we outlined several significant trends of 4G in this book chapter. As we move forward with 5G as a society, we are confident that research on the social impacts of smart city will be even more immense at the individual, local, regional, and global level. ●

從微觀層面來説,人們選用那些 5G 應用和智能手機可以説是展示社會身份的象徵。智能手機是 5G 應用的主要媒介,長久以來,一個人選擇什麼型號的智能手機,都是作為社交群組裡聯繫的標記 (Katz 和 Sugiyama,2005 年),一個人就智能手機和支援那些應用的選擇,成了印象管理的線索。一個人選擇使用華為,蘋果或其他品牌的決定,都可能表示他們對某些意念 / 價值觀的忠心標記。

總結:從 1G 到 5G

1G 的創造者讓人們可以用電話來進行話音通話。每一個流動通訊時代的科技革新都有大躍進,並藉著數碼連接來加強日常生活的不同面向。不久將來,5G 將會連接數以百萬個終端裝置,並在不同機構組織裡利用大數據,來改善無數人的工作、安全、醫療保健、教育、交通運輸、娛樂、交易、社交生活、業務與客戶關係,甚至日常的便利。

隨著我們步入 5G 世代,與及香港逐漸轉變成為智慧城市,並從根本改善人們的生活方式和影響不同機構,我們要緊記,這些都有賴電訊商、製造商、研究組織、中小企和許多企業及機構,率先採取各種措施和應用,才得以造就 5G 新世代的可能。

有大量研究就 4G 對社會的影響作出檢視,我們在此章節亦有論及幾個 4G 的重點趨勢。隨著我們朝向 5G 社會邁進,我們有信心,在個人、本地、區域和全球層面上對 5G 的社會影響進行的研究數量,將會更加龐大。●

CAHK Christmas Cocktail Party 5G Development in Hong Kong 2019
香港通訊業聯會聖誕聯歡酒會 5G 在香港的發展 2019

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