How 5G enables highly interactive cloud based gaming
5G 支援高度互動雲端電子遊戲

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Imagine a world where cars can alert drivers about dangerous road conditions to help them take action to avoid collision, and where devices can help fleets of cars drive autonomously and predict traffic patterns. Consider a new Industrial Revolution where Internet of Things (IoT) devices or sensors report data collected in real time from large and small machines, allowing for intelligent automation and orchestration in industries such as manufacturing, agriculture, healthcare, and logistics. Envision city and public services that provide intelligent parking, congestion management, pollution detection and mitigation, emergency response, and security. While this is happening, internet users access bandwidth of 10 times the current maximums and latencies at 1/100th of current averages, using a seamless combination of mobile, WiFi, and fixed access. Fifth-generation mobile network (5G) applications are enabling these scenarios by providing 10 times the current bandwidth maximum and network latency up to 1ms.

This new generation of applications is fuelling technological developments and creating new business opportunities for mobile operators. One such technological and business development, which is key to enabling many new generation of applications, is "Edge Computing." Edge computing addresses the latency requirements of specialized 5G applications, helps manage the potentially exorbitant access cost and network load due to fast-growing data demand, and supports data localization where necessary. By providing a cloud-enabled platform for edge computing, mobile operators are well positioned to take a leading role in the 5G ecosystem, while opening up completely new business cases and revenue streams.

Multi-Access Edge Computing (MEC) is a cloud-based IT service environment at the of networks that serves multiple channels of telecommunications access, for example, mobile-wide-area networks, Wi-Fi or LTE-based local-area-networks, and wireline. MEC addresses the need for localized cloud services and leverages the capabilities inherent in mobile networks. MEC provides a standards-based solution that enables an ecosystem of edge applications with added benefits of:

a) Extremely Low Latency
b) Broadband Delivery
c) Economical and Scalable
d) Privacy and Security

With the growing digital and intelligent computing requirements for terminals, terminal costs are increasing rapidly. Terminal computing is fundamentally limited by power consumption, costs and space, and moving to the cloud can overcome some of these limitations. On the other hand, cloud computing capabilities cannot meet real-time service requirements, therefore services need to move

試想像你生活在這樣的世界：汽車可提示駕駛者危險的路面情況，協助他們及時避免碰撞；車上設備可以協助車隊自動駕駛及預測交通狀況；在新一輪工業革命中，物聯網設備或轉感器可在各類機器實時收集資訊，在製造業、農業、醫療及物流等行業實現智慧型自動化及協調；未來城市和公共服務可提供智能泊車、交通流量管理、污染監測及調節、緊急應變及保安等功能。這些願景已逐漸成真，網絡用戶使用的頻寬將是現時最高流量的十倍，而時延將較現行的平均數大幅下降 99%，使流動網絡、WiFi 及固定網絡得以無縫連接。這些場景均需要第五代 (5G) 流動網絡應用，利用可提供超越現行頻寬極限十倍的流量，以及大幅降低網絡反應時間至 1ms 的技術在背後支撐。

這種新一代應用支撐著流動電訊商的技術發展，並為他們創造莫大商機。其中一種支援多種新世代應用的技術，就是邊緣運算 (Edge Computing)。邊緣運算可滿足 5G 專設應用程式所需的極低時延要求，幫助控制因快速增長數據量所產生的高昂網絡成本及極大的網絡流量，支援所需的數據本地化 (data localization)。流動電訊商通過建設可支援邊緣運算的雲端平台，引領 5G 生態系統的發展，同時開放全新的商業應用及收益流。

多端接取邊緣運算 (Multi-Access Edge Computing，MEC) 是一種雲端為本的 IT 服務環境，可透過流動網絡、Wi-Fi 或 LTE 網絡，甚至固網等多渠道連接電訊服務。MEC 回應本地化雲端服務的需求，同時運用流動網絡的固有功能，提供標準化的解決方案，建構邊緣應用程式生態系統，帶來下列多項好處：

1. 極低時延
2. 提供寬頻連結
3. 節省成本及容易擴容
4. 保障私隱及網絡安全

隨著終端的數碼化和智能運算要求日漸提高，終端的成本正快速增加。終端運算基本受制於能源消耗、成本及空間，而轉移至雲端則可克服此等限制。但另一方面，雲端運算能力又難以滿足實時服務傳輸要求，因此服務需要轉移至邊緣。考慮到成本和性能方面的優勢，運算終將集中在邊緣。

其中一項常見的網絡服務，是雲端運算支援的雲端遊戲。在雲端遊戲的運作模式中，遊戲畫面皆在雲端伺服器運行的程式產生，並透過網絡傳送至用戶的設備。與傳統遊戲模式比較，雲端遊戲的順暢運行程度取決於網絡傳輸的時延，而當中的多媒體傳輸更是對網絡時延非常敏感。當網絡連接欠佳時，用戶立刻會感受到他們的輸入與呈現圖像的更新之間出現極大時延，大幅影響遊戲的體驗。在多媒體串流直播中呈現的遊戲環境，其質素亦取決網絡通訊的頻寬。在這情境下，我們可以運用 5G 網絡的低時延、高頻寬及低抖動等的優勢。當雲端

to the edge. Taking into consideration costs and performance advantages, computing will ultimately converge at the edge.

Typical services include cloud games based on cloud computing. In cloud game operation mode, all games run on the cloud server, and the rendered game images are transferred to users through the network. Compared with traditional game modes, cloud games can greatly reduce user equipment costs. However, the interaction latency of cloud games heavily depends on the network communication latency. The multimedia transmission of cloud games is very sensitive to the network latency. When the network communication quality is poor, players immediately experience high latency between their input and the update of output images, which significantly degrades the quality of experience. The quality of multimedia streams rendered in game scenarios also depends on the network communication bandwidth. It is possible to take advantage of 5G networks, such as low latency, high bandwidth and bearer jitter, in this context. When cloud games are deployed near the user, it is possible to reduce transmission latency and improve the cloud game service experience.

"Every operator is looking for valuable 5G applications. 5G adoption will take some time and we are forecasting major transformation in how games are being enjoyed today. With Asia Pacific being most populous, operators in this region will have most benefits." highlighted Sunil Gupta, Telco Solution Lead of HPE APAC, at start of the year.

Singapore's Cloudzen partnering with HPE is one such example of an edge cloud gaming platform which is about to extend their services to telecommunication and infrastructure partners around Asia regions to offer mass market. Cloudzen's streaming technology leverages edge computing and next-generation connectivity to allow consumers and organizations to optimize device performance. As game servers are hosted in edge datacenters within the country, the distance between players and services are less, providing low latency and better user experience.

So what are consumers getting when pay for locally hosted cloud gaming?

- You are paying for the playing graphic-intensive games without facing limitations on your devices and location (Any Device, Anywhere, Anytime).
- You are paying to access to a wide library of games at your fingertip (Netflix of games. Games on Demand (GOD).)
- You are paying for the affordability as you don't have to own a new consoles devices, or upgrade desktop computer or increase storage space.

遊戲部署於較接近用戶的位置，傳輸時延可減少，同時可改善雲端遊戲服務體驗。

HPE 亞太區電訊解決方案首長 Sunil Gupta 在今年初指出：「每一個電訊商均尋求有價值的 5G 應用。我們正預測遊玩電子遊戲模式會因 5G 帶來重大轉變，而位於亞太區這個人口密集區域的電訊商受惠最多。」新加坡雲端遊戲及娛樂平台 Cloudzen 與 HPE 合作，有意在亞太區夥拍當地電訊商擴展服務。Cloudzen 的串流直播技術借助邊緣運算及新一代的網絡連接，提升消費者設備表現。遊戲伺服器放置於本地的邊緣數據中心，可縮短遊戲玩家與服務間的距離，降低時延及改善體驗。具體而言，位於本地的雲端遊戲可為消費者帶來下列便利：

- 遊玩圖像密集遊戲時，無需受限於使用的設備及地點 (任何設備、地點及時間均可遊玩)
- 隨意遊玩龐大資源庫內的大量遊戲 (形同電子遊戲的 Netflix，即 Games on Demand （GOD）
- 無需自行擁有新型電子遊戲設備、升級桌上電腦或增加儲存空間

But the biggest question for telco provider is how to make an attractive offer? Here are some suggestions based on a discussion with an industry expert:

- **Convenience** (3A – Any Device, Anywhere, Anytime) - Convenience is hard to sell but always considered as part of the purchase. A successful service needs to have the same experience and ease of use like Netflix. User experience and set up need to independent of hardware, cabling, long load time and access time

- **Affordable** – Need to be positioned as an alternative to buying a gaming rig (Gaming PC, Disks, etc.). Gamers know it is hard to carry a heavy gaming laptop and requires constant upgrades to get the desired performance.

- **Enhanced user experience** – It will be slow for the subscriber to adopt cloud gaming if the experience is only marginally better than consoles and PCs. Experience needs to include ecosystem technologies like the ease of payments, game accessories etc. Even a simple boost in computing power adds user experience like streaming movie-quality graphics to our TV screens.

"With HPE's experience in enterprise solutions and Cloudzen proprietary technology Game Cloud, the synergy of our combined expertise unleashes a new entertainment era for consumers with new advances in connectivity with 5G and MEC, where Game Cloud's vision for consumers to Play Everywhere becomes reality." said Robin Tan, CEO of Cloudzen.

With audiences shifting their attention from traditional media and TV to gaming and mobile, the whole recreation & entertainment industry has to adapt their live performances to new audiences spending time in an ever-increasing virtual world. In the current environment, the demand worldwide for virtual world interactions has exploded in every genre of entertainment and live event industry has to shift to new online business models. Highly interactive cloud based gaming will be one such good example.

然而，電訊商最大的困難在於如何構建一個具吸引力的計劃？參考行業專家的意見後，我們建議電訊商可考慮：

- **便利性**（任何設備、地點及時間）— 便利性難以作為賣點但仍然是服務的一部份。成功的遊戲服務需要具備與 Netflix 相同的體驗和簡易操作特點。用戶體驗和安裝需不受限於硬體、電線，亦不可出現漫長的加載時間和接入時間。

- **可負擔** — 遊戲服務的定位需可替代單次購買遊戲（遊戲機、光碟等）。玩家明白攜帶沉重的電玩手提電腦和定期持續的更新才能獲得良好體驗甚為困難。

- **改善用戶體驗** — 若遊戲服務的體驗僅略優於遊戲機或桌上電腦，用戶邁向雲端遊戲的速度將甚為緩慢。這種體驗需包含付款、遊戲配件等一系列的相關技術配套。單單提升運算能力亦可改善用戶體驗，例如將電影質素的圖像引入至電視屏幕。

Cloudzen 行政總裁 Robin Tan 表示：「配合 HPE 在企業解決方案的經驗和 Cloudzen 自身的 Game Cloud 科技，我們可運用 5G 及多端接取邊緣運算所提升的網絡連接，引領消費者邁向全新的娛樂時代。這正是 Game Cloud 實現消費者可隨時隨地遊戲的願景。」

當受眾從傳統媒體及電視轉向電子遊戲及流動網絡，消閑及娛樂產業需將重心由現場表演轉移至傾向花更長時間於虛擬世界的用家。現時，全球的虛擬世界互動需求正帶動各種網上娛樂及現場直播活動高速增長，進而產生不同的商業模式，高度互動雲端電子遊戲將會是其中一個好例子。