HKT Here To Serve

Spectrum Supply in Hong Kong

There are several indisputable facts in regard to spectrum and mobile services in Hong Kong (and other developed markets).

First, mobile telecommunications services play an important role for both individual and business users, for example, video streaming, web browsing and cloud services are increasingly critical to consumers and businesses. The Four Pillar sectors that the Hong Kong Government promotes all rely heavily on mobile services.

Second, this importance and demand for high quality and innovative mobile services will only increase as 5G and the "Internet of Things" ("IoT) develop.

Third, to meet the varied and exponentially growing demand of users, and to support a services based economy, mobile operators require more spectrum. This is recognized by all Governments as well as the International Telecommunications Union ("ITU"), the Geneva based UN entity which coordinates spectrum releases. Major markets are therefore expediting their efforts to release more spectrum.

The Hong Kong Government recognizes the above indisputable facts. Unfortunately, its three year plan to release new spectrum indicates its intent to bring **"zero" new spectrum** to the market.

Thus, while all other major markets are making more spectrum available (including clearing inefficient spectrum users and re-farming spectrum bands), the Hong Kong Government has no clear plans to meet the community's need for new services, new investment and new innovation. This needs to change immediately. Spectrum identified as available by the industry and the ITU needs to be released now – otherwise consumers, businesses and the Hong Kong economy will suffer irreparable damage.

Hong Kong has been one of the most successful mobile markets[1] in the world. As at October 2016, Hong Kong's mobile subscriber penetration rate had reached 232%[2] and local mobile data usage[3] had surged to 22,898 Terabytes (TB) representing data annual growth rate of CAGR at 61% over the period 2010 to 2015 – see Figure 1.

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1 The World Bank, "Mobile Cellular Subscriptions – overview by country", http://data.worldbank.org/indicator/it.cel.sets.p2

2 OFCA, "Key Communications Statistics", http://www.ofca.gov.hk/en/media_focus/data_statistics/key_stat/index.html

3 OFCA, "Data & Statistics of Wireless Service", http://www.ofca.gov.hk/en/media_focus/data_statistics/index.html

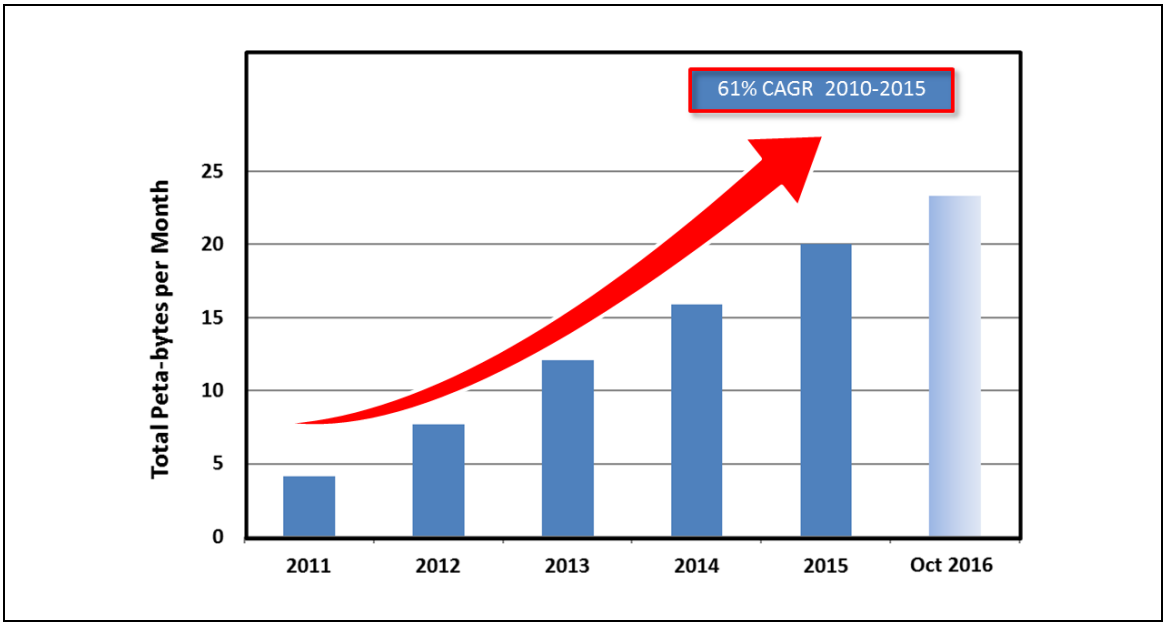

Figure 1: Mobile Data Usage Trend in Hong Kong

Mobile telecommunications has become an essential infrastructure for Hong Kong's economy

Mobile broadband applications such as web browsing, cloud services, and video streaming are important to mass market (consumers and businesses) for obtaining real-time information, education and entertainment. Emerging mobile IoT applications such as machine to machine ("M2M") connectivity with sensors, remote control and data collection will be the new drivers to enhance business innovation and operational efficiency and to create new industries - Figure 2 gives a glimpse of the emerging technologies and services that Hong Kong must adopt to stay competitive.

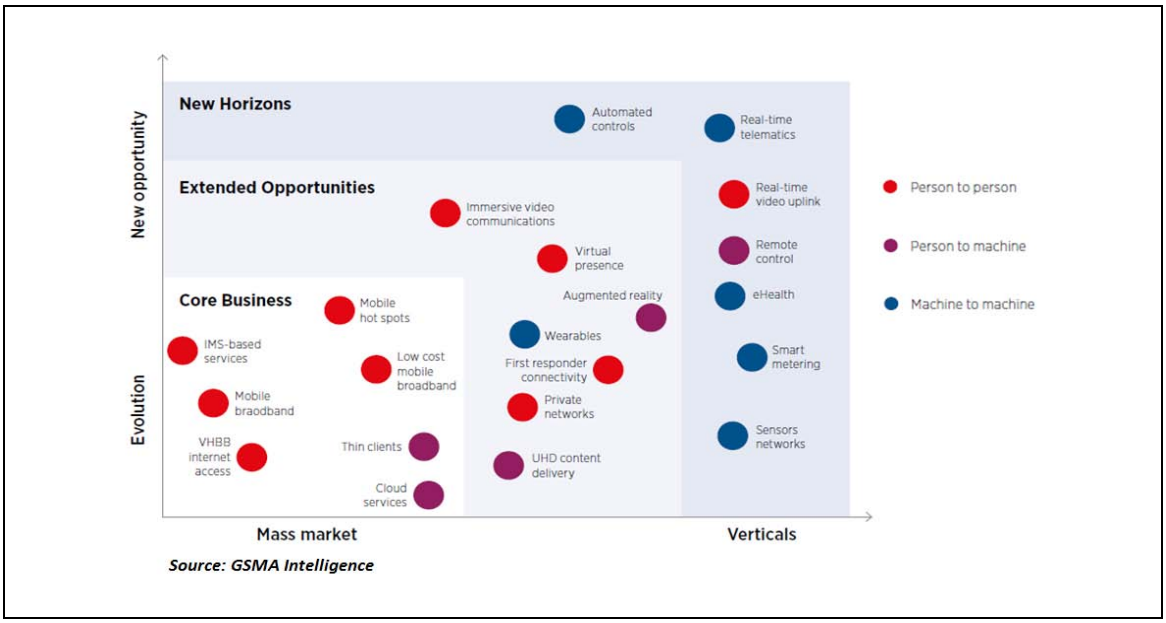

Figure 2: Mobile Applications for Mass Market and Verticals

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As advanced mobile applications such as virtual reality, augmented reality, and autonomous driving are further developed, both expanding the network capacity of 4G and the evolution to 5G technology will be necessary to meet the growing demand for mobile data throughput up to 1Gbps or higher and to keep latency requirements down within 10ms i.e. all these new services are bandwidth hungry and demand ultra-high speeds - all of which means that only new and additional spectrum can meet these requirements hence all regulators (other than here in Hong Kong) are scrambling to make this new spectrum available. Figure 3 gives some insight to these new services and their speed and latency requirements.

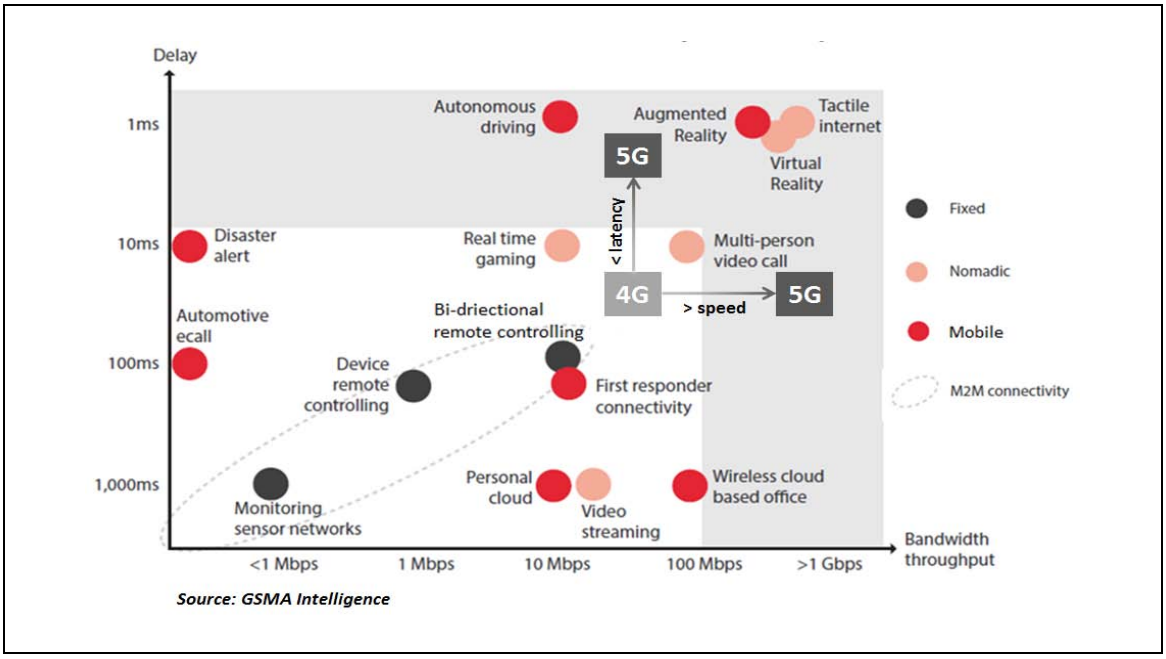

Figure 3: Advance Mobile Applications demand Network Capacity and Performance

The release of new spectrum is now the key pre-condition for meeting Hong Kong's requirements for new, innovative high quality, high speed services with minimal latency. Only with additional spectrum will the mobile operators be able to even begin to cope with the challenges of 5G and the IoT.

How much is the spectrum requirement and how much is the spectrum gap?

The ITU[4] predicts that 1340-1960MHz of total mobile spectrum will be required in a market for mobile services by 2020. The ITU at the World Radio-Communications Conference 2015 (WRC-15) stated that it is now necessary for most governments to make 600-800MHz of new spectrum available, or it could be too late for mobile services to meet growing demand. The Hong Kong Government's three year plan of **"zero" new spectrum**[5] is therefore extremely troubling both generally and because Hong Kong is a services based economy characterised by earlier adopters and usage levels well above global averages.

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4 GSMA, "Future Mobile Spectrum Requirement", 13 July 2015. https://www.itu.int/en/ITU-D/Regional-Presence/Americas/Documents/EVENTS/2015/0713-MX-Spectrum/3_3.pdf

5 OFCA SSAC Paper 10/2016, "Proposed Spectrum Release Plan for 2017-19", 10 Nov 2016

Table 1 shows how Hong Kong has already fallen behind the UK in allocating spectrum to mobile services.

Spectrum	**UK (OFCOM)**	**HK (OFCA)**
Spectrum in use	661.9MHz	582MHz
Spectrum to be released	190MHz	**"ZERO" release in 2017-2019**
Total Spectrum	851.9MHz	582MHz
Spectrum Gap		less 269.9MHz (i.e. -32%)

Table 1: Spectrum Resource Benchmark between HK and UK

In addition to lagging behind the UK, Hong Kong also lags behind the USA. Tom Wheeler[6], the chairman of the Federal Communications Commission ("FCC") has stated clearly that the vision for American leadership in 5G must be a national priority.

- In April 2015, the FCC[7] made **150MHz** of contiguous spectrum in the 3550-3700MHz band available for mobile broadband.
- In July 2016, the FCC[8] made new rules to open up **11GHz** of high-frequency bands on 28GHz, 37GHz, 39GHz and 64-71GHz for wireless broadband.
- Currently underway, the FCC[9] is re-farming the 600MHz broadcasting band with an initial target of **126MHz** spectrum for mobile broadband through the spectrum trading process in the form of Incentive Auction orchestrated by the FCC.

Similarly in China, the Ministry of Industry and Information Technology ("MIIT")[10] has stated clearly their plan for 5G spectrum development in China at the 2nd Global 5G Event in Rome, Italy on 9 Nov 2016.

- To enable business success for 5G mobile broadband by providing **more than 100MHz per operator** at medium band, and **2GHz per operator** at high band.
- Medium band (3-6GHz):
  - 3.4-3.6GHz: Adjacent band compatibility trial between IMT @3.4-3.6GHz and FSS @3.6-4.2GHz to be finished by 2017;
  - 3.3-3.4, 4.4-4.5, 4.8-5.0GHz: domestic coordination in progress of IMT identification in Chinese Regulations on the Radio Frequency Allocation (new version).
- High band (above 6GHz):
  - High priority for 20~40GHz for outdoor deployment.

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6 FCC, "The Future of Wireless: A Vision for U.S. Leadership in a 5G World", 20 June 2016. http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0620/DOC-339920A1.pdf

7 FCC, " FCC makes 150MHz of contiguous spectrum available for mobile broadband and other uses through innovative sharing polices", 17 April 2015, https://apps.fcc.gov/edocs_public/attachmatch/DOC-333083A1.pdf

8 FCC, "FCC takes steps to facilitate mobile broadband and next generation wireless technologies in spectrum above 24GHz". https://apps.fcc.gov/edocs_public/attachmatch/DOC-340301A1.pdf

9 FCC, "Broadcast Incentive Auction", 2016. https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions

10 Bureau of Radio Regulation, MIIT, China, "Consideration on Spectrum for 5G", at the 2nd Global 5G Event on 9 Nov 2016. https://5g-ppp.eu/wp-content/uploads/2016/11/03_9-Nov_Session-2_Chang-Ruoting-1.pdf

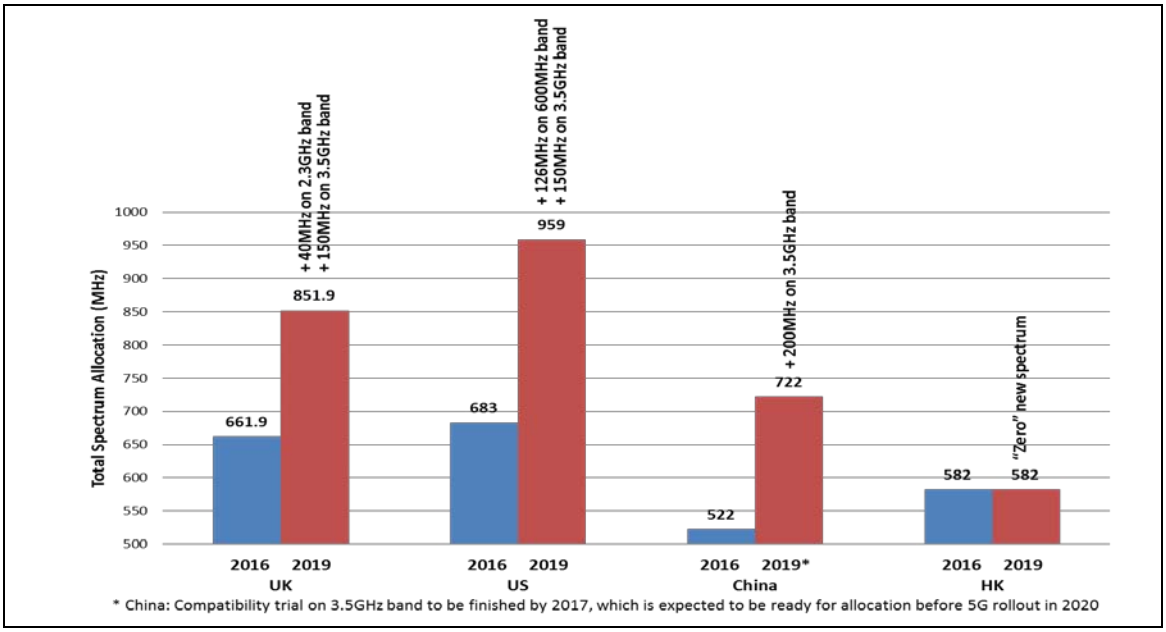

Figure 4: New Spectrum Plan by Country

By benchmarking the spectrum resource plan of Hong Kong with other developed markets as shown in Figure 4, it is obvious that Hong Kong is seriously lagging behind.

The Government's plan of not releasing any new spectrum in the next 3 years will only serve to choke and stifle the growth of Hong Kong's dynamic mobile services sector and this will have negative knock-on effects in all sectors of Hong Kong's economy. There is no doubt that Hong Kong has a world-class mobile services sector and this has been recognised by the World Competitiveness Yearbook from the International Institute for Management Development (IMD)[11] which ranked Hong Kong 1st globally in 2016, and has ranked Hong Kong 1st on "technological infrastructure" for five consecutive years since 2011.

To maintain its leading position Hong Kong needs to triple the availability of usable spectrum without delay. Doing nothing is not an option - neither is wasting time just "thinking about doing something" or launching yet another time-wasting consultation exercise. If other countries can take action why can't Hong Kong?

New spectrum availability per the WRC-15

At the ITU WRC-15, the key outcomes[12] of the conference identified the following bands for mobile usage:

1 3.5GHz C-band (3.4-3.6GHz) with 200MHz spectrum, and
2 700MHz Digital Dividend band (694-790MHz) with 96MHz spectrum.

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11 IMD World Competitiveness Yearbook 2016

12 ITU, "World Radio-Communication Conference allocates spectrum for future innovation", 27 Nov 2015. http://www.itu.int/net/pressoffice/press_releases/2015/56.aspx#.WGOLCGdPqHt

Figure 5 shows these bands in relation to the existing bands plus other potential bands that can be opened up to 5G in higher frequency ranges.

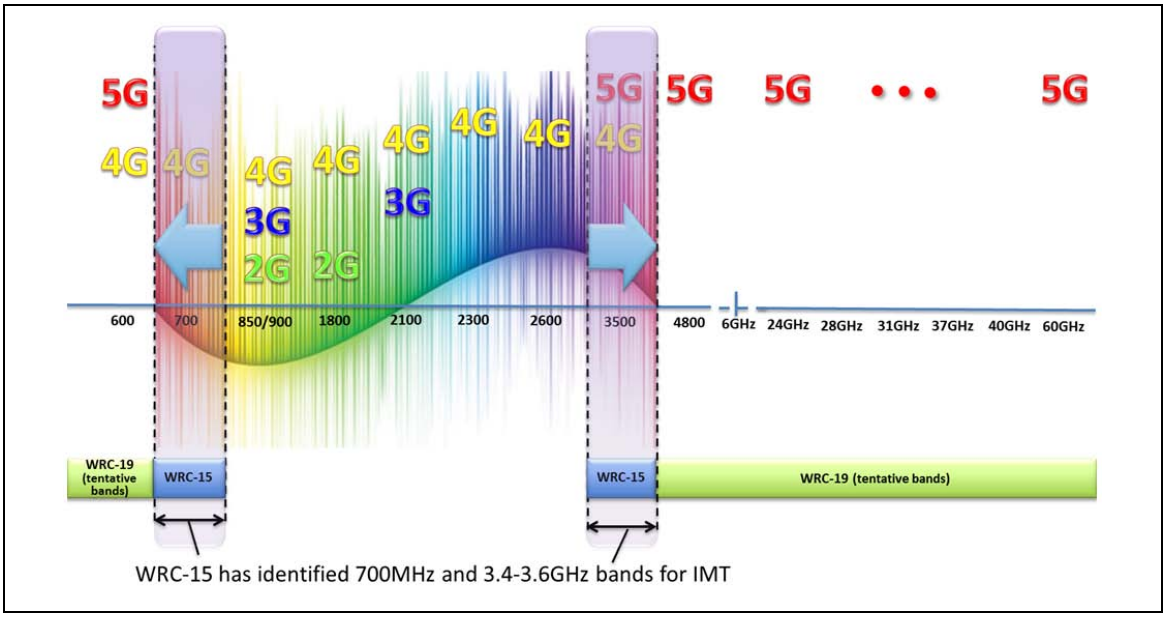

Figure 5: New Spectrum per the WRC-15

True 5G is to enable a fully mobile and connected society supporting countless emerging use cases:

- **Pervasive Video :** Augmented Reality, Virtual Reality, Three-dimensional (3D) Services
- **High Speed Mobility :** up to 1000 passengers at a speed of 500 km/h
- **Extreme Real-Time Communications :** user experienced throughput (1Gbps) and latency (< 1ms)
- **Ultra-reliable Communications :** Autonomous Driving, Collaborative Robots, Public Safety

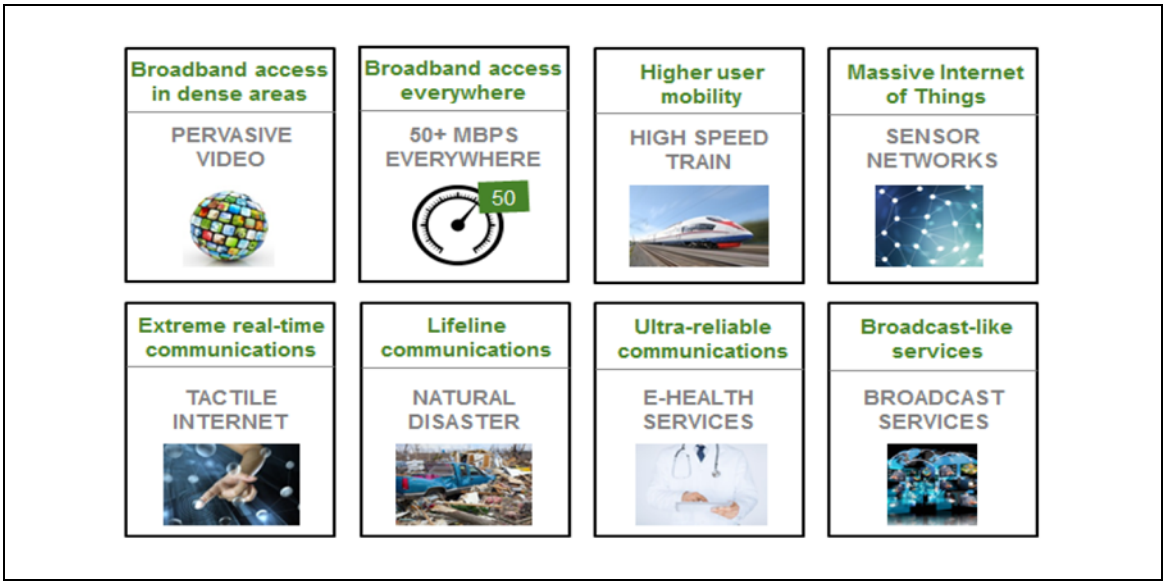

Figure 6: True 5G Use Cases[13]

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13 NGMN 5G White Paper, Feb 2015

True 5G typically requires access to larger bandwidth channels than those of earlier generation voice and slower speed data technologies. This means carrier bandwidths of several 100MHz compared to 5MHz in 3G and 20MHz in 4G. True 5G is not about re-farming existing 3G/4G spectrum.

Therefore, in addition to making spectrum immediately available as per decisions taken at WRC-15 in 2015, regulators around the world have already started clearing spectrum allocations at new bands above 6GHz.

The priority sub-6GHz bands which are available today include global IMT bands at 700MHz and 3.5GHz, which should be available on a technology neutral basis as "5G ready" but leaving maximum flexibility for operators to decide on the optimal technology to be deployed over time.

1 *3.5GHz band*

This 3.5GHz band is of great interest now and can be used initially for 4G deployment with the 4G smartphones that will become available in 2017. With more spectrum available to them these new 4G smartphones will be able to harness advanced 4G features as a natural evolution path towards 5G.

Leading countries are now clearing or have already cleared the 3.5GHz band for 5G services for example:

- **2018 (Korea):** KT intends to launch 5G services at the Winter Olympics next year (i.e. 2018)
- **2020 (Japan):** Docomo intends to launch 5G services at the Summer Olympics in 2020
- **2020 (China):** China Mobile intends to launch 5G services with 10,000 base stations by 2020
- **2020 (Europe):** European operators[14] are required to launch 5G services in at least one city in each of the 28 European Member States

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[14] 17 Major European Telecoms Players, "5G Manifesto for timely deployment of 5G in Europe", 7 July 2016

It is quite clear from Figure 7 that most countries are proposing to make available much more spectrum than that identified at WRC-15.

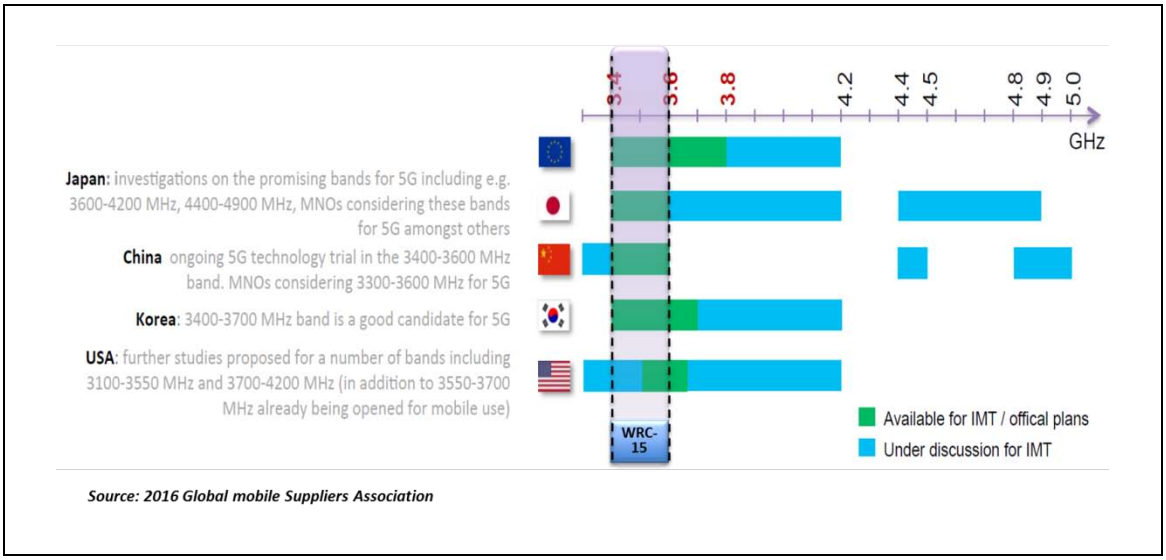

Figure 7: Leading Countries clearing 3.5GHz band for 5G trial

It is simply not credible to believe that Hong Kong can be one of the leading regions to pioneer the launch of true 5G services in 2020, given that no new spectrum to be released by OFCA in 2017-19.

2 *700MHz band*

The 700MHz band is a low frequency band that is capable of providing full area coverage and deep in-building penetration thus allowing cost effective delivery of mobile services. The bandwidth available is 96MHz and this is considerably wider than the other low frequency bands that are currently available to mobile operators in Hong Kong today - therefore the 700MHz band promises a combination of both capacity and coverage. Figure 8 provides details of this spectrum – which is often called the "Digital Dividend Spectrum" as it represents the benefit to the community from switching broadcast TV from analogue technology (which is a wasteful user of spectrum) to the more spectrum efficient digital broadcast technology.

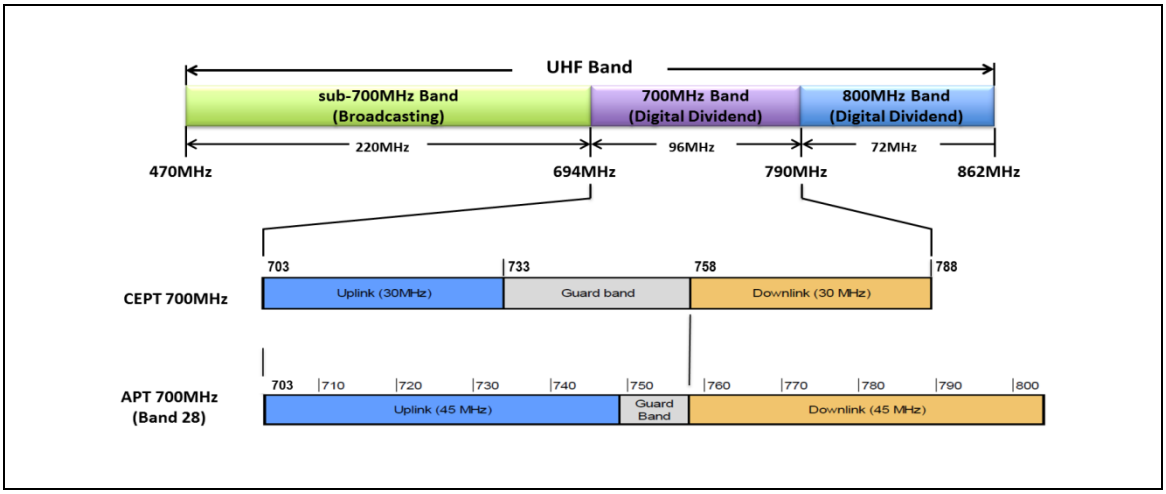

Figure 8: 700MHz Digital Dividend Allocation

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Subsequent to the decision by WRC-15 in 2015 to allocate 700MHz as a globally harmonized band for mobile telecommunications use, regulatory authorities of each region have been pushing forward to re-farm this spectrum as soon as possible, for example;

- **EU**[15]: The European Union has adopted 2020 as the common deadline for repurposing the 700MHz band as this ties in with the EU requirements for operators to initially deploy 5G by 2020.
- **UK**[16]: OFCOM is proposing to award 700MHz in 2018-19
- **France and Germany**: These countries have already auctioned the 700MHz band spectrum in 2015
- **Korea**: In July 2015, the Ministry of Science, ICT and Future Planning (MSIP) announced that 108 MHz in the 700MHz band will be re-farmed into:
  a. 40 MHz for mobile telecommunications,
  b. 30 MHz for UHD broadcasting,
  c. 20 MHz for the national disaster safety communications network, and
  d. 18 MHz for guard bands
- **Singapore**[17]: Singapore aims to make available 90 MHz in the 700 MHz band (2x45MHz) for mobile broadband services from 2018 onward
- **Taiwan**[18]: The NCC already auctioned spectrum in the 700MHz band (2x45MHz) in October 2013.
  a. 2x10MHz to Ambit Microsystems Corp,
  b. 2x10MHz to Asia Pacific Telecom Co., Ltd.,
  c. 2x10MHz to Far Eastone Telecommunications(FET) Co., Ltd., and
  d. 2x15MHz to Taiwan Mobile Co., Ltd
- **China**: SARFT has been managing 700MHz band (2x40MHz) for LTE trials. The pilot trial was conducted in Shanghai, and subsequently extended to four other provinces at Guangdong, Guizhou, Chongqing, and Gansu

In contrast, and most disappointingly, in Hong Kong, OFCA has at least twice delayed the Analogue Switch-off (ASO) target date, the latest delay is until **the end of 2020**, - while OFCA chooses to cite the need for frequency co-ordination efforts with the Mainland authorities it doesn't appear to be a credible excuse for delay when China is already moving forward aggressively with LTE trials in this band and also promoting a rapid deployment of 5G in China.

It is inescapable when compared to benchmarks of international best practice, and examples from European, North America and our neighboring countries, that OFCA is quite behind in policy making in releasing both 3.5GHz and 700MHz bands.

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15 https://ec.europa.eu/digital-single-market/en/news/use-470-790-mhz-frequency-band-union

16 OFCOM, “Managing the effects of 700 MHz clearance on PMSE and DTT viewers” on 31 Mar 2016

17 https://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20150707_SecondPublicConsultation/Consultation.pdf

18 https://www.ncc.gov.tw/english/content_field_detail.aspx?site_content_sn=215&is_history=0&pages=0&sn_f=69

Spectrum dilemma in Hong Kong

In the past, OFCA/OFTA has released new spectrum for every new generation of mobile technology. For example,

- **3G**: in 2001 the 2100MHz band was released so as to enable operators to launch 3G service in 2004
- **4G**: in 2009 the 2600MHz band was released so as to enable operators to launch 4G service in 2011

The lead time for rolling out a new generation of mobile network is usually 2-3 years because of the need to take into account the development of the technology ecosystem, market demand and the need to conduct necessary technical trials and rollout networks before the commencement of commercial service. If Hong Kong is to remain an innovative market that leads the region in advanced 4G, 5G and the IoT, then substantially more spectrum needs to be released now i.e. in 2017. OFCA's insistence that **"zero" new spectrum** is available in the next 3 years is simply unacceptable when other regulators can make it available. New spectrum in the 3.5GHz and 700 MHz bands need to be released in 2017, and other spectrum in 2018.

1 *Spectrum Scarcity*

Noting both the current 61% growth rate in data usage and the new requirements of 5G and the IoT, substantial new spectrum is required now. We note that there has been no new spectrum since 2013 as shown in Figure 9.

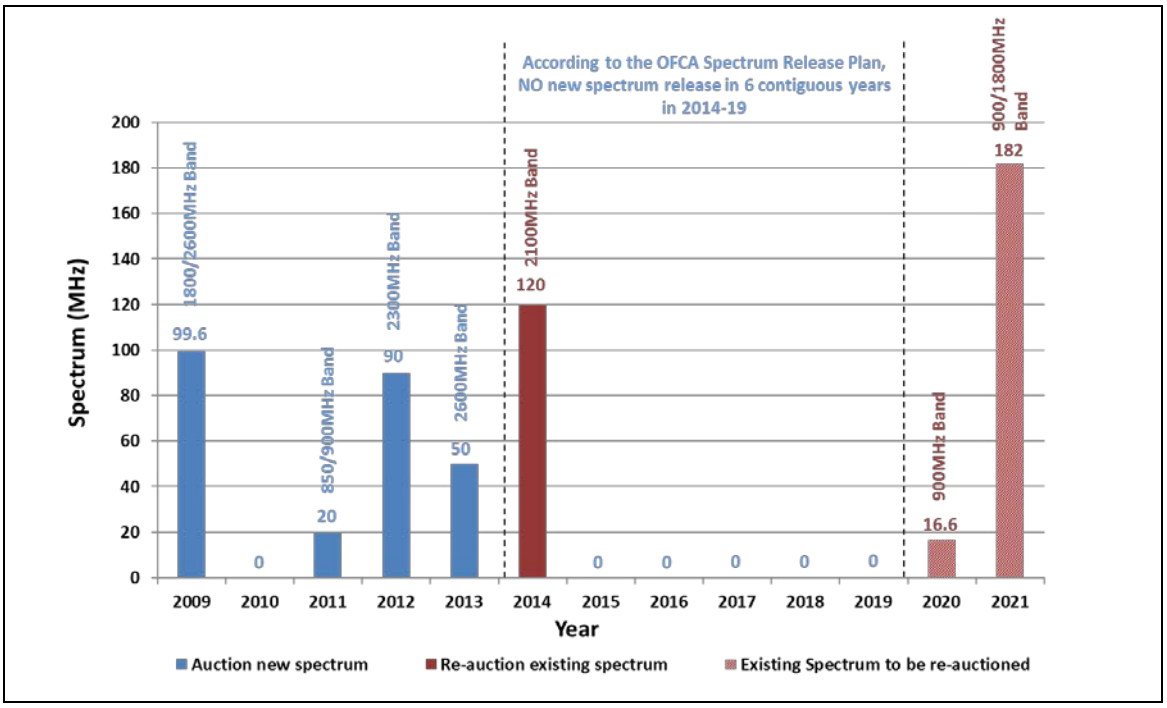

Figure 9: Spectrum Release in Hong Kong

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In 2014, the existing 2100MHz band was re-auctioned upon the existing spectrum licenses expiring in 2016. Again, the 900MHz/1800MHz will be re-auctioned upon its license expiry in 2020/21. Neither of these events bring new spectrum to the market or consumers. Re-auctioning spectrum may bring in massive "windfall" financial gains to the Government but it simply reshuffles existing spectrum among operators and it does nothing to meet the massively growing market demand for mobile services. Re-auctioning spectrum and refusing to release new spectrum into the market can only meet the objective of increasing the Government's "windfall" financial gain and is a form of market manipulation.

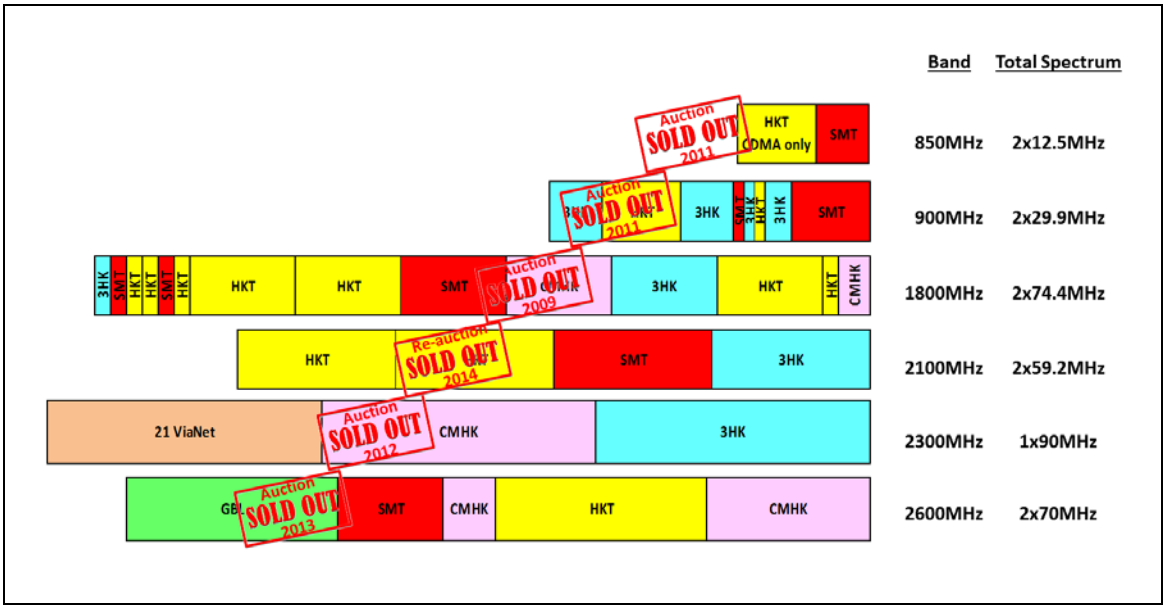

Figure 10: Scarcity of Spectrum in Hong Kong

In the current environment of high growth in demand, it is simply not acceptable that the last new spectrum release was in 2013 and the next new spectrum release will not occur until 2020 at the earliest. It is also totally unacceptable that the Government intends to hold an auction in 2017 to re-farm the 900MHz/1,800MHz spectrum without a proper timetable to release new spectrum into the market. The Government controls the supply of spectrum and is creating an unnecessary scarcity of spectrum while at the same time the Government is the beneficiary of high auction prices benchmarked on high reserve prices set by the Government. As explained previously, these high spectrum prices (and Hong Kong has the highest in the world) must be passed through to consumers as they are a substantial operational cost item for mobile operators.

2 *The Facts about OFCA's claim regarding the available 35MHz Spectrum*

OFCA has stated that there is 35MHz of spectrum available for use. This is a "red-herring" because this spectrum is highly fractured and not particularly usable because it was initially granted for the now obsolete TD-SCDMA technology which is being phased out in China - neither handsets nor network equipment are available to use this spectrum. Hong Kong is an international city that needs globally harmonised technology and spectrum allocations - OFCA should focus on making proper policy decisions rather than making spurious claims based on unusable spectrum.

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Conclusion

It is not acceptable that:

1 no new spectrum has been made available for mobile services since 2013;

2 no new spectrum will be made available in the 2017-2019 period. This will not allow Hong Kong to retain its regional leadership in mobile services. More importantly, 5G will be delayed and technological innovation which drives a services-based economy and sustainable economic growth will be lost. GSMA[19] stated that it is important to governments and regulators to adopt national policy with a spectrum roadmap for 5G networks. New spectrum can be made available in the 2017-2019 time frame as witnessed by the global regulatory community's actions to make it available in many countries across the world;

3 operators are being forced into an expensive auction with high reserve prices set by the Government to re-farm the 900MHz/1,800MHz bands while the Government artificially withholds new spectrum from the market. True 5G services cannot be made available by simply re-farming existing spectrum supply; and

4 the Government's spectrum policies focus on maximising the financial "windfall" gains to Consolidated Revenue rather than proactively managing spectrum availability so that Hong Kong can continue to lead in mobile services globally. The short-term winner is the Government through these financial "windfall" gains; the long-term losers are consumers, businesses and the Hong Kong economy that must have world-class mobile telecommunications services to stay competitive.

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Hong Kong Telecommunications (HKT) Limited
10 January 2017

[19] GSMA, “5G Spectrum Public Policy Position”, Nov 2016.
http://www.gsma.com/spectrum/wp-content/uploads/2016/06/GSMA-5G-Spectrum-PPP.pdf