



TeraGo Networks Inc.
800 - 55 Commerce Valley Dr. W.
Thornhill, ON L3T 7V9
1.866.837.2461
www.terago.ca

September 14, 2017

Innovation, Science and Economic Development Canada (ISED)
c/o Senior Director, Spectrum Licensing and Auction Operations
235 Queen Street, 6th Floor
Ottawa, Ontario K1A 0H5

Email: ic.spectrumauctions-encheresduspectre.ic@canada.ca

RE: Canada Gazette, Part I, June 2017 - Notice SLPB-001-17 - Consultation on Releasing Millimetre Wave Spectrum to Support 5G

Pursuant to the procedures set forth in Gazette Notice SLPB-001-17 - *Consultation on Releasing Millimetre Wave Spectrum to Support 5G* published on June 5, 2017 (the “**Consultation**”), TeraGo Networks Inc. (“**TeraGo**”) is pleased to submit the following comment letter.

A. Introduction

1. TeraGo welcomes the opportunity to make this submission in response to the Consultation. TeraGo supports ISED’s objective of employing licencing methods that respond to changing technology and demands. We also support its tradition of working closely with the international community to harmonize the use of spectrum so that there is an adoption of common industry standards.
2. Since participating in Industry Canada’s 1999 24 GHz and 38 GHz wireless spectrum auction, TeraGo has been proud of its ability to offer economical, reliable and scalable wireless broadband services. These services have been subscribed by thousands of Canadian businesses and public institutions over the years who may not otherwise have access to any internet services. TeraGo has also since expanded and complemented its service offerings to include both cloud and colocation services, some of which is also being delivered through its wireless spectrum.
3. TeraGo submits that the use of wireless spectrum has been critical in the deployment of fixed wireless services over the last fifteen years in both major urban centers and rural communities across Canada. In particular, TeraGo currently utilizes 24 and 38 GHz auctioned licences, as well as licence-exempt spectrum for both network backhaul and last mile direct access to customer business locations. It has also used its spectrum for backhauling mobile traffic.
4. In addition to the costs TeraGo incurred in acquiring its 24 and 38 GHz spectrum licences, it has incurred significant costs to investing and building out its national wireless IP network. These costs have included investment in research and development activities as well as purchasing Canadian equipment in the 24 and 38 GHz bands. Since 1999, TeraGo

has invested in excess of \$10 million in spectrum equipment and technology development in order to operate its business.

B. Executive Summary

5. As a competitive service provider and dependent user of spectrum, TeraGo acknowledges that spectrum is a critical and valuable resource. Access to these resources are fundamental in the development of next-generation wireless technologies such as 5G and that it will be important for Canada to work in concert with international communities and industry standards to ensure harmonization.
6. In lending its support for 5G innovation and adoption, TeraGo believes that the “flexible use” service area licensing model for the 28 GHz and 37-40 GHz frequency bands along with the proposed band plan is the right approach being considered by ISED. Moreover, given that the 24.75-27.5 GHz band shares similar technical characteristics as the aforementioned bands, and has also been contemplated for 5G usage in certain other areas of the world, we believe that ISED should likewise consider it for inclusion in the “flexible use” model in a future consultation.
7. When releasing spectrum for 5G use, ISED must ensure that the interests of existing licence holders (including the businesses that they have built under the reliance of spectrum) be taken into consideration and that their interests do not become secondary to the latest technological trend. Moratoriums on new licence issuances for example should only be implemented in frequency bands if there will be little financial and operational impact to existing operators today. In this particular case, TeraGo is not supportive of any moratoriums in the 38.4-40 GHz bands since there are numerous users and operators that rely and will continue to rely on FCFS licences in these bands to operate their business. A moratorium would be detrimental for many, both in the short and medium term.
8. To ensure that adequate consideration is given to existing licensees, TeraGo strongly believes that existing Tier 3 licence holders who hold an amount of spectrum that is workable and in line with the new band plan for 37-40 GHz (i.e.; 200 MHz or multiples thereof), be reissued with the same amount of spectrum after its conversion to flexible use. This will help existing licence holders continue to operate and grow their business without impact. In addition, re-issuing these licences at par to existing holders will only represent a small fraction of the entire inventory of spectrum that will be reserved and designated by ISED for potential 5G use. Finally, there are compelling reasons why existing licence holders should retain this limited spectrum in a Tier 3 area once it is converted over to flexible use. This group (including TeraGo) are already in the business of utilizing spectrum, are generally early adopters of technology since they previously invested in the licences well before fixed wireless technology was fully matured, and are likely in the best position to commit additional resources needed to take advantage of 5G applications.

C. TeraGo's Responses to the Consultation

Question 4-1: Given the disruptive nature of 5G, will new business models and network applications develop that may require policy and regulatory consideration from ISED? Please describe potential new business models and network applications as well as their benefits to Canadians.

9. TeraGo notes that new technological innovations and their applications developed from 5G may not always fall within existing technical and regulatory policies set forth by ISED. Architecture for 5G may aggregate multiple bands to deliver high capacity services which entails harmonization and flexibility across millimeter wave (mmW) bands and requiring changes to existing policies (as contemplated under this Consultation). TeraGo anticipates that new applications in 5G will impact existing business models for delivering services and will develop new avenues for growth. As 5G applications begin to emerge, ISED must provide consideration to future policy and carry out regulatory reviews to ensure these new applications provide fair and affordable services directly to Canadian consumers.
10. TeraGo submits that 5G will be a catalyst which will continue to accelerate development and innovation across many industry sectors. In particular, the deployment of highly dense mmW 5G networks will bring forth enhanced capabilities in multi-gigabit bandwidth, ultra-low latency, large data volumes and high device density which will support a diverse mix of use cases along with applications which have yet to emerge. TeraGo anticipates applications in IoT (Internet of Things) will leverage ultra-low latency and high device density to deploy smart grids, smart cities and massive sensor deployments. In addition, media rich content will fully utilize all capabilities to stream Virtual and Augmented Reality in mobile or fixed applications. All such applications will have the potential to improve the lives of Canadians, enrich their experience with technology and strengthen the digital economy in Canada.

Question 5-1: ISED is seeking comments on developing a flexible use licensing model for fixed and mobile services in the 28 GHz and 37-40 GHz frequency bands, and allowing licence-exempt use of the 64-71 GHz frequency band ahead of WRC-19 and before 5G technology standards are finalized.

11. Given the propagation characteristic of these mmW bands, the majority of current deployments within these bands have been limited to short-haul fixed services. TeraGo recognizes that the technological advancements that are being contemplated will enable new applications for mobile services in these mmW bands that will surely unlock opportunities to maximize its use potential.
12. TeraGo supports the development of a flexible use licensing model for the 28GHz and 37-40GHz frequency bands as it enables operators with the flexibility of deploying for a host of suitable applications. It will also allow existing operators to expand into mobile services as they respond to technology evolutions within the mmW band. TeraGo maintains that the ability to deploy flexibly will also promote increased efficiency in the use of the

spectrum when providing ubiquitous coverage in dense urban areas along with fixed site specific applications.

13. Operators who are currently limited to fixed wireless service will benefit with the capability to expand their operations to mobile services. This will result in furthering competition and adding choice for Canadian consumers in the mobile marketplace while promoting further investments into the mmW bands.
14. TeraGo believes there to be low risk in developing a flexible-use licensing model in the bands 28 GHz and 37-40 GHz ahead of WRC-19 and before 5G technology standards are finalized, especially in light of various commitments to these bands made already from countries such as the U.S., Japan and South Korea. As noted in the Consultation, the Federal Communications Commission (FCC) of the U.S. has already adopted the same flexible-use model for the 28GHz and 37-40GHz in 2016. Earlier harmonization in the bands will mean that Canadian operators will benefit from global equipment availability.
15. In addition to ISED's contemplated flexible-use model for the 28GHz and 37-40GHz bands, TeraGo urges ISED to give consideration in the near future for the inclusion of the 24.25-27.5GHz bands into this model after a consultation similar to this one. TeraGo notes that such bands are under consideration as an International Mobile Telecommunications (IMT) band and is slated for discussion under Agenda Item 1.13 at WRC-19. Furthermore, pursuant to the FCC's Further Notice of Proposed Rule Making (FNPRM) process as cited in the Consultation, bands such as the 24.25-27.5 GHz band are also being contemplated for both fixed and mobile use.
16. With better propagation characteristics than 28GHz and 37-40GHz band, the 24.25-27.5 GHz bands will allow for better network coverage and less deployment requirements in metro and suburban areas. TeraGo already maintains deployments servicing Canadian businesses in the 24 GHz band with fixed point-to-point and multi-point, and believes operators (new and old) will benefit further if this adjacent band is also considered for use with 5G in a subsequent consultation.

Question 6-1: ISED is seeking comments on the changes proposed above to introduce flexible use licensing in the 28 GHz band, including consequential changes to the CTFA domestic footnotes and the policy on this band contained in SP 3-30 GHz, *Revisions to Spectrum Utilization Policies in the 3-30 GHz Frequency Range and Further Consultation.*

17. TeraGo supports ISED's proposal to implement flexible-use licensing in the frequency band 28GHz for similar reasons stated in response to Question 5-1 above.
18. TeraGo agrees with ISED that soft partitioning and existing means of coordination will provide sufficient coexistence between flex-use services and fixed-satellite services ("FSS"). Given the limited number of FSS in this band, TeraGo submits that interference can be managed through site specific co-ordination and/or exclusion zones outlined in section 6.5.1 of the Consultation.

Question 6-2: ISED is seeking comments on the moratorium for new site-specific fixed service licences as described above.

19. Since there have been no fixed service licences issued under the current licensing framework for the 28GHz band, TeraGo supports the placement of a moratorium in this band for new site specific licenses in an effort to preserve the spectrum for future development and deployment. We agree that such moratorium will unlikely have any detrimental effect for spectrum utilization in this band in either the short or medium term. TeraGo notes however that an exception to the moratorium should be made for applications for developmental licences which should be allowed to continue. Equipment development in this band and existing trials will play an important role for the initial development of 5G.
20. TeraGo also advises that there is sufficient FCFS spectrum in the 18 and 23GHz band with similar propagation characteristics, equipment availability and capability to support any requirements for site-specific licensing in lieu of licensing in the 28GHz band.

Question 6-3: ISED is seeking comments on its proposal to adopt the band plan (as shown in figure 3 above) in the 28 GHz band.

21. TeraGo generally supports the adoption of a new band plan for the 28GHz which removes the FDD pairing of frequencies and facilitates the deployment of spectrally efficient 5G technology in large channel bandwidths. However, additional consideration should be given by ISED to the proposed plan of 2 x 425MHz channels which limits a maximum of 2 operators for any given Tier area. TeraGo believes this may limit choice and availability for Canadian consumers for applications utilizing the 28GHz.
22. TeraGo suggests a band plan similar to 37-38GHz which divides the 27.5GHz-28.35GHz into 4 x 200MHz blocks as it allows up to 4 operators to deploy in a given Tier area with capability to provide gigabit services.

Question 7-1: ISED is seeking comments on the proposal to implement flexible use licensing in the frequency band 37-40 GHz, including the consequential changes to CTFA footnote C51, while continuing to allow for fixed-satellite service (space-to-Earth) in the band.

23. TeraGo supports ISED's proposal to implement flexible use licensing in the frequency band 37-40GHz which would then allow these frequency bands to also support the deployment of 5G.
24. As a major licence holder and user of the 38 GHz spectrum, fixed wireless makes up for and remains a dominant portion of the services TeraGo provides to its customers. The technology being deployed in the 38 GHz spectrum for fixed wireless is still experiencing development and will continue to mature such that the cost of equipment will become increasingly affordable. We support the fact that the flexible use licensing model will help us preserve and further grow our current business, and allow us and others to take advantage of future fixed wireless technology, all the while opening up the possibility of

broader use application of such spectrum. We believe this is consistent with the guidelines of the *Spectrum Policy Framework of Canada* which states that spectrum management practices, including licencing methods be responsive to changing technology and market place demands.

Question 7-2: ISED is seeking comments on whether a moratorium on the issuance of new licences under the *New Licensing Framework for the 24, 28 and 38 GHz Bands and Decision on a Licence Renewal Process for the 24 and 38 GHz Bands* is required at this time.

25. TeraGo does not support a moratorium on the issuance of new licences under the *New Licensing Framework for the 24, 28 and 38 GHz Bands and Decision on a Licence Renewal Process for the 24 and 38 GHz Bands* (the “**Framework**”). It is submitted that TeraGo currently relies on obtaining new licences in the 38 GHz spectrum bands (for geographic areas that it doesn’t otherwise hold spectrum licences in) to operate its current business.
26. Since the 2014 decision to discontinue 38GHz FCFS grid licenses, TeraGo along with other operators have had to apply for new site specific licenses in order to service newly acquired customers. Initiating any kind of moratorium on the issuance of new licences will severely impede TeraGo’s ability to service these customers. This has the impact of denying certain Canadian businesses from obtaining affordable high speed internet for their location and will restrict the growth of TeraGo’s wireless internet business. Moreover, several long-term strategic decisions and deployment investments by TeraGo have already been made in reliance of the decisions ISED announced under the Framework. TeraGo has governed itself under the assumption that the Framework (issued in December 2014) would seek to provide operators like TeraGo some operational certainty in the relevant bands. To implement a moratorium on the issuance of 38 GHz site-specific licences would therefore be inconsistent with some of the determinations made under the Framework.
27. TeraGo recommends that no moratorium be placed on the issuance of new site-specific licences in the 38.4-40 GHz bands since there are numerous other users and operators in this band that may be similarly impacted like TeraGo. Unlike in the 28 GHz band, a moratorium here would be detrimental for many, both in the short and medium term.

Question 7-3: ISED is seeking comments on the proposal to adopt the band plan as shown in figure 7 for the frequency band 37-40 GHz.

28. While the current Canadian band plan for 38.6-40GHz comprises of paired 50 MHz frequency blocks, it should be noted that TeraGo holds auction licences in this frequency band ranging from 100 MHz up to 600 MHz, with the bulk of licences in a Tier 3 area comprising of at least 200 MHz. In light of that, TeraGo would support the adoption of the band plan set out in figure 7 of the Consultation for frequency bands 37-40 GHz with certain modifications to such plan.
29. Pursuant to such modified band plan, it is respectively submitted that all existing licence holders who hold multiples of 200 MHz frequency blocks in a Tier 3 area, be allowed to

retain an amount of frequency in such band that will be no less than what was held immediately prior to the adoption of the plan. Licence holders who hold at least 200 MHz of frequency, but whose individual blocks of 50 MHz may not be contiguous with each other, would work with ISED and other licence holders in the Tier 3 area (during a sufficient transition period) to re-allocate and re-assign their blocks such that they will hold a full 200 MHz block pursuant to the new band plan. A licence holder who correspondingly holds a 400 MHz block in a Tier 3 area would be reissued 2 x 200 MHz blocks under the new band plan, and so on.

30. In a scenario where a licence holder holds less than 200 MHz frequency blocks in a Tier 3 area, it is proposed that ISED issue site specific licences to the licence holder for existing sites they have deployed and are in operation. It is suggested that ISED set aside a 200 MHz frequency block under the new band plan to accommodate the issuance of such site specific licences for fixed wireless operators who may be relinquishing their less than 200 MHz blocks in a Tier 3 area in favour of site specific licences.

Question 7-7: ISED is seeking comments on:

A. the options and implications for the treatment of incumbent licensees currently holding Tier 3 licences, the percentage that would apply to option 1 and supporting rationale.

B. the options and implications for the treatment of incumbent licensees currently holding FCFS licences and supporting rationale.

31. TeraGo supports option 1 to convert existing Tier 3 fixed service licences to flexible use licences, but based on the new band plan as modified in our response for Question 7-3 above. Licensees would need to be provided a transitional period to migrate existing systems conforming to the current plan over to the proposed plan. For clarity, the amount of spectrum issued after the conversion of the Tier 3 fixed service licences to flexible use licences will be a percentage equal to 100% for those licence holders who hold multiples of 200 MHz (i.e.; 4 x 50 MHz blocks, whether such blocks are contiguous or not). This approach would help with the alignment of the newly proposed band plan which seeks to establish a new channel/block size of 200 MHz within the 37-40 GHz band.
32. For licence holders who hold less than 200 MHz in aggregate in any given Tier 3 area or less than a 200 MHz multiple of spectrum, site-specific licences for sites currently in operation at the end of the licence term will be issued in lieu. This model contemplates that ISED will set aside a portion of spectrum under the new band plan to accommodate the site-specific licences that will be issued.
33. TeraGo believes the above suggested model draws a balance in protecting those incumbents who have invested heavily in a Tier 3 area (as a result of their accumulation of a relatively large amount of spectrum and presumed investment on deployment), and ensuring those that do not hold a significant amount of spectrum, can continue to operate with site-specific licences in lieu of their previous area-wide licence. In addition, the proposed model also seeks to draw a delicate balance of providing some protection to incumbents who have pioneered the use of the spectrum for fixed wireless technologies and businesses, while providing a way of sharing portions of that spectrum for future 5G use by new entrants.

34. From TeraGo's perspective, the amount of spectrum it currently holds in the 38 GHz band makes up a small percentage of the entire spectrum available in the entire band. As reported by ISED itself in the 2014 *Consultation on a New Licensing Framework and Licence Renewal Process for the 24, 28 and 38 GHz Band*, supply of spectrum in the 24 and 38 GHz bands exceed its demand. This was also true at the time of ISED's 1999 spectrum auction, as only 260 of the 354 licences it intended to auction were awarded. Unassigned licences were retained by ISED (in addition to a larger quantity of spectrum ISED already retained that was not intended for auction). Since that period, additional licences were relinquished and returned to ISED on an account of not meeting conditions of licence. TeraGo was one of these holders who already forfeited a significant number of licences through the renewal review process in 2015. In light of this, it would be disproportionately punitive to TeraGo if ISED decided to take back TeraGo's remaining Tier 3 licences (for which it continues to meet conditions of licence) and reissue it at a lesser percentage. Such decision would have a detrimental impact on TeraGo's business. The public gain that ISED is seeking from doing so will be proportionately small as such licences of TeraGo only comprise a small proportion of the overall spectrum in the 37-40 GHz band. TeraGo appeals to ISED for a decision whereby any Tier 3 licences that a holder currently has, equivalent to or in multiples of 200 MHz frequencies, be reissued fully after its conversion to flexible use.
35. Another supporting rationale for re-issuing Tier 3 incumbent licensees with new flexible licences that is equivalent in the amount of spectrum under the new band plan is that such licensees are generally the operators that will be best equipped and most likely to succeed in implementing a 5G business strategy. Such licensees already have experience with usage of the spectrum, will likely have resources for further investment and development, and may provide the most efficient use of the spectrum since they (including TeraGo), could use the same spectrum for both fixed service systems and mobile service systems.
36. With respect to the options and implications for the treatment of incumbent licensees currently holding FCFS grid cell or site-specific licences on an annual basis, TeraGo is supportive of the first option to allow licensees to continue operating in the band and be protected from interference from new flexible use licensees. TeraGo believes the onus will be on new licensees who will have influence on the 5G technology, to be able to develop equipment that will be deployable around existing/legacy licensees. As there are currently an abundance of operators deploying under FCFS grid cell and site-specific licences, it would neither be practical nor in the spirit of supporting economic and social benefits from existing fixed wireless deployments, to allow 5G to have a primary right to the spectrum. This would unfairly force existing operators to suddenly operate on a secondary basis and put existing fixed and mobile infrastructure at risk from interference issues.

Question 8-1: ISED is seeking comments on its proposal to designate the band 64-71 GHz for licence-exempt operations on a no-protection, no-interference basis.

37. TeraGo supports the designation of the band 64-71GHz for license exempt operations and recognizes its significance in opening 14 GHz of contiguous spectrum. The characteristics of the band include high attenuation and low propagation. This, coupled with the abundance of spectrum quantity, will in TeraGo's opinion provide ideal conditions for dense collocated deployments for new licence-exempt wireless devices.

Question 9-1: ISED is seeking comments on:

- A. Whether flexible use access in these bands should be exclusively licenced or licence-exempt.**
- B. If a licencing approach is proposed, which types of licences (radio licences, spectrum licences with user-defined licence areas, spectrum licences with service areas for competitive licensing, or others) are expected to best lend themselves to licensing flexible use in the 28 GHz and 37-40 GHz frequency bands in order to support a variety of 5G technologies, applications and business cases?**
- C. Whether a licence-exempt dynamic access using data base should be implemented in all, or portions of the 28 GHz, 37-40 GHz, particularly in the band 37-37.6 GHz.**

38. TeraGo believes that flexible use access in the 28 GHz and 37-40 GHz frequency bands should be exclusively licenced. Exclusivity will provide operational certainty and lower overhead costs associated with coordination when compared to a non-exclusive model. Such licences should be tied to the Tier 3 service areas that have already been defined by ISED for competitive licensing. This should be the principal form of licence in these bands.
39. When spectrum is licence-exempt, too many operators will have access to such spectrum, which will lead to many interference issues for the band to be viable and reducing the spectrum to little value of use. As already identified by ISED, it would place Canada in an undesirable and unique position of allowing licence-exempt access in these bands when other countries in the world have not allowed for the same. This will also create little incentive for an operator to provide significant funds for research and development since it will not have clear exclusive access and use to the required resource.
40. Area-based licensing, coupled with exclusive use within the licenced area is critical to efficient development and deployment of these bands. Only in such cases would ISED achieve its goals of encouraging competition, innovation and investment of the spectrum for 5G.
41. In light of the responses immediately above, TeraGo does not believe there should be an implementation at all of a data base for licence-exempt dynamic access.

Question 9-2: If an exclusive licensing approach is implemented, preliminary comments are sought on the benefits and risks related to longer licence terms for these frequency bands.

42. TeraGo is in support of an exclusive licensing approach that will provide licences of use for a term of ten (10) years for holders, consistent with existing licences in the 38 GHz band. We believe the 10 year licensing period will provide the right length of time to incentivize licence holders to commit the required expenditures and investments to deploy 5G equipment, as well as to establish a stable business model to benefit from their investment.
43. As technological advances occur rapidly it is difficult for experts and ISED to predict beyond a certain time period where the industry will take spectrum usage and in which

direction it will go. For that reason, it is incumbent on ISED to ensure they review the status and usage of such licences as a collective, when the licences near their end of term. Therefore, the risk associated with having longer licence terms that go beyond 10 years is that ISED will start to lose its oversight and objective setting ability when the spectrum becomes “locked in” and committed for a specific use that may no longer be desirable or in the public’s interest.

Question 9-3: If an exclusive licensing approach is proposed, ISED is seeking preliminary comments on possible measures that could support competition in light of the current conditions in the Canadian wireless service market and anticipated development and deployment of 5G services if flexible use licensing is developed through a spectrum licensing model.

44. TeraGo recommends that if an exclusive area licensing approach is adopted, certain measures be taken by ISED to set aside millimetre wave spectrum capable of supporting 5G and to subsequently make it available (exclusively and affordably) to smaller operators and new entrants. In light of the existing market conditions that have developed in the mobile telecommunications industry in Canada, where less than a handful of service providers dominant the market, it is incumbent on ISED to ensure that healthy competition will exist at the outset of the 5G era.

TeraGo thanks ISED for the opportunity to provide input on this very important issue and hopes that our comments provide ISED with a cogent perspective in this Consultation.

Sincerely,

TERAGO NETWORKS INC.



Antonio (Tony) Ciciretto
President & Chief Executive Officer