SIKLU COMMUNICATION's SUBMISSION ON ICASA's DISCUSSION DOCUMENT, GENERAL NOTICE NO. 895 AS PUBLISHED IN THE GOVERNMENT GAZETTE NO. 39180 OF 08-SEPTEMBER-2015: **"THE USE AND LICENSING OF THE BAND 57-66 GHZ (V BAND) AND THE BAND 71-76 GHZ PAIRED WITH THE BAND 81-86 GHZ (E BAND)"** FOR CONSULTATION.

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Introduction

Siklu Communication would like to thank Independent Communications Authority of South Africa for the opportunity to comment on the discussion document "the use and licensing of the Band 57-66 GHz (V Band) and the Band 71-76 GHz paired with the Band 81-86 GHz (E Band)". As one of the global market leaders for 2012-2014 mmWave deployed links, we are pleased to participate in this consultation, and we will comment on the topics related to our products and worldwide experience.

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1 Do you think light licensing would be an appropriate approach for the E Band in South Africa?

1. Yes. The light licensing approach, as described here by ICASA, has proved to be most efficient for fast and reliable capacity-rich link deployments, even, or maybe especially, in extremely crowded cities such as Manchester, Moscow and San-Francisco. In these cities alone hundreds of deployed links operate over the E Band frequencies. Siklu experience with planning and supporting its customers indicate that light approach works well and interference scenarios are very seldom encountered.

2 Are there any other licensing approaches that should be considered by the Authority for the E Band?

2. Siklu is aware of 3 other possible approaches:
    a. Fully coordinated
    b. Splitting thE Band between fully-coordinated and lightly licensed
    c. License exempt

    The Fully coordinated scheme is used by some countries (e.g. Germany, Switzerland). Its advantage is that the regulator gets full responsibility for controlling the interference in thE Band. The disadvantage is that this scheme often causes the license fees to increase, therefore inhibiting the efficient economic utilization of this spectrum. Such inefficient use might lead to underdeveloped cellular and networks and underserved business connectivity needs, ultimately negatively impacting the economy.
    The split approach is used by some countries (e.g. UK), and enable users to choose whether they want to operate in a fully coordinated or a lightly licensed portion of the Band, thus allowing market forces to determine which approach works best. Siklu experience in the UK, in which it has a considerable install base, indicates that most users of the Band prefer to use lightly licensed section.
    The license exempt approach is very popular in the V Band spectrum, but Siklu is not aware of any country using it in the E Band spectrum.
    Based on Siklu experience, the light licensing approach (used in countries, such as USA, Australia, and many others) seems to be the best choice. While it is the preferred combination that usually pleases both service providers, who are interested in simpler coordination procedures, and alternative service providers. These alternative SPs, often a crucial factor contributing to competitive market conditions, view this licensing scheme (with the open data-base) as an enhanced alternative to overcrowded bands such as 2.4GHz an 5GHz and it has the added value of enabling them to easily commit to an enhanced business class SLA (Service Level Agreement).

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3 What other applications for E Band spectrum should the Authority consider as part of this process, and should such applications impact either the licensing approach?

3. Based on our experience, and in addition to cellular backhaul, the most commonly uses applications for E Band links are:
    a. Business connectivity. Both as a fiber extension and as the main infrastructure.
    b. Campus connectivity. Usually as a fiber backup, and also as a fiber extension.
    c. Intermediate service delivery (usually by WISPs [wireless internet-service providers]) for both business and residential (MDU) customers.
    d. Fiber extension for fixed line operators.
    e. Surveillance networks. The combination of V Band (60GHz) at street-level for direct camera connectivity, and E Band on rooftops with dedicated antennas masts, is gaining momentum all over the world. This development is due to the constantly expanding proliferation of security cameras, as well as the introduction of high-megapixel HD and 4K-HD devices. Another factor impacting the growth in surveillance infrastructure and technologies is the extensive usage and importance of such networks to municipalities and law-enforcements forces. In addition, the unique small form factor of leading mmWave radios (due to the technology and the very nature of these frequencies) further contributes to the expanding adoption of this application.
    f. Wi-Fi backhaul. Demand for this application is increasing for the very same reasons described above for surveillance-networks. Moreover, current trends such as the continuously expanding Wi-Fi as a service, and the introduction of higher-capacity Wi-Fi technologies (such as 802.11ac) that occupy most the of the Wi-Fi spectrum, further serve to promote mmWave - both E Band and V Band products, as preferred wireless backhaul solutions. These operate over non-overlapping bands and deliver futureproof capacity for today's bandwidth-rich applications.

Most of the above applications require extremely fast deployment times, and are likely to be used simultaneously for a variety of scenarios should not impact light licensing that proved to be as the most effective at most of the world.

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4 Do you think a self-coordinated approach is appropriate under certain circumstances in the E Band?

4. A self-coordinated approach proved to enable carrier grade reliability and availability for the largest E Band market in the world, the USA. Both challenges faced by mobile operator, and also other applications (as described in question 3), share the same frequency bands, even in the densest of urban areas, such as New York City, Los-Angeles and San-Francisco. Another example is from the world's second largest location for deployment of E Band solutions, Russia. Here, the free-of-charge mmWave approach is widely successful. Depicts carriers for both mobile backhaul and fiber extension applications. To summarize, the self-coordinated approach offers a proven and satisfying approach to address such concerns raised by operators.

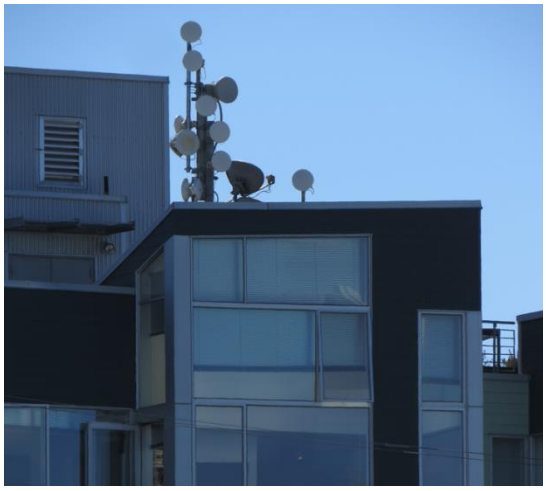

Figure 1: E Band network hub, SF, CA. USA

5 Are there any other potential approaches apart from band segmentation to accommodate the different spectrum demands in the E Band?

5. Due to the strong spatial separation, and availability of TPC mechanisms, there is no real need for band segmentation. TDD, FDD in many forms of channel aggregation can co-exist. It may be beneficial to consider charging by channel bandwidth to avoid any misuse of spectrum.

6 What other applications for V Band spectrum should the Authority consider as part of this process?

6. The most commonly used applications for outdoor FS link-based service over 57-66GHz V Band are:
    a. Small cell backhaul
    b. Street-level Wi-Fi backhaul
    c. Street-level surveillance networks connectivity
    d. Building-to-building connectivity
    e. LAN-to-LAN (campus)

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f. Residential broadband access (as a complementary service to FTTH)
g. Gigabit connections at large venues (such as football and rugby stadiums)
h. Temporary connectivity for large outdoor events where high capacity links are needed for ad-hoc, while the option to lay fixed infrastructure or other bands (based microwave links that suffer from both larger form factor and lower capacities) is not feasible.

7 What technical sharing criteria should apply in a licence-exempt environment?

7. TPC (transmit power control) is mandatory to enable a license-exempt environment. On top of the inherent high-attenuation this band has, the TPC technique leads to enhanced efficiency and optimal transmit power levels, which reduces significantly the chances of mutual interference. A minimum antenna gain of 30dBi is typically required for V Band outdoor use, which results in a relatively narrow antenna beamwidth, considerably contributing to interference mitigation. Other interference avoidance techniques, such as attempting to dynamically select the operation, and avoiding use of already occupied channels, might also contribute to reducing interference levels in this band

8 What principles should guide the allocation of spectrum for V Band services?

8. Unlicensed. No allocation. V Band, just as Wi-Fi today, should be available for free utilization - as an enabler for high capacity wireless applications. As correctly described in this gazette, the V Band comes inherently with a significantly higher re-use factor thus channels overlap and/or side-lobs interference is minimal. The highly directional, "pencil-beam" propagation characteristics of V Band wireless systems mean that operators can plan and deploy networks with an extremely high degree of frequency reuse. No frequency coordination is required, and links may be deployed very close to one another with minimal interference concerns. Due to antenna transmission patterns (beam width 4-5 times narrower), we can assume a re-use factor that is around 5 times higher in the V Band compared to 2.4/5.8 GHz bands (this is without taking propagation into account since it is factored into the link distance).

9 As a general principle with, should the Authority relax the transmit power restrictions on case by case basis e.g. rural areas where interference risk is lower than in urban/densely populated areas.

9. Transmit power restrictions are beyond reasonable industry capabilities. There is of course no harm in letting the antenna grow to any size. However, allowing outputs

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which are too high power would inevitably lead to uncontrolled use and contamination in urban areas

10 Is there another approach that should be considered by the Authority?

10. No other approach for regulating the E Band and V Band is known at this time.

11 Should the Authority consider conventional licensing? If so, please provide reasons.

11. This would not be advisable as there are only few countries around the world who adopted conventional licensing for mmWavE Bands and with barely any success at all: the number of mmWave deployments is significantly low, and these did not contribute to improve cellular networks' backhaul capacities, nor to the enhancement of competition in the alternative carrier or WISPs arenas.

12 Do you agree with the concept of segmentation [E Band] for the purposes of providing both a light-licensing and a full -licensing approach? Please provide reasons for your position.

12. The segmentation approach has been proven to work, but the following should be noted:
    a. It limits flexibility by "breaking" the Band
    b. It "burns" valuable 250MHz of spectrum [mid-guard band], that will not be otherwise available for stack holders.
    c. It eliminates future utilization of the wider E Band channels that are feasible for longer range ultra-high capacity links connecting rural areas, where a high numbers of multiple co-located link situation is unlikely.

13 Do you agree with the segmentation as proposed?

13. If segmentation is to be adopted, the current ICASA proposal would be the recommended one.

14 Will online registration be feasible?

14. Yes, online registration is feasible. It works in other countries.

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15 Will a 14 day registration requirement be effective and practical?

15. Yes, a 14-day registration requirement would be effective, and also practical - the system should enable earlier registration. It should be the user's interest to register ASAP in order to be the first to occupy the specific spectrum at any given location.

16 Is there another approach that should be considered by the Authority?

16. No. The self-registration procedure has proved to be the most effective in many countries.

17 Are there any other factors that the Authority should consider?

17. No other known factors need be considered at this time.

18 Is this type of regulation (for at least a portion of the E Band) really necessary in view of light-licensing looking fairly attractive?

18. Light-licensing necessarily means: Per-link application, coordination, assignment and licensing. Wherever possible, it would be advisable to avoid these procedures, and have a fully self-coordinated band, which has proved to work well in many other countries.

19 Do you have any views as to whether the self-coordination approach or the regulator-coordinated approach is preferable?

19. Self-coordination is fast and accommodating, and maintains the flexibility of using the full band. In the UK, there are *minority of registered links using the regulator-coordinated approach, so generally the idea looks promising. However, at the end of the day users always prefer the short and easy way. It might lead to situations when the regulator-coordinated approach portion of the Band will almost not be used at all. Still, the regulator may choose to relax heavy shareholders (usually large telecom operators) allowing portions of the spectrum to be regulator-coordinated, but with a pre-commitment from those shareholders to utilize this valuable spectrum. A 2-3 year grace period may be considered, and if during this time frame the shareholder has not deployed (not just register) a predefined number of links, the regulator will have the right to redefine the rules for that specific spectrum portion.

*UK OFCOM E Band links data base statistics:

- Only one link out of 433 links registered during Q1-Q3 2015, is utilizing the coordinated block.
- None of the 860 links registered during 2014 is utilizing the coordinated block.

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20 Do you think an annual licence fee per point-to-point link is an appropriate approach whereby the licensee has exclusive, protected spectrum?

20. In general, we recommend the annual fee per point-to-point. Exclusive protected spectrum is not viable for mmWave Bands with inherent ultra-high re-use factors. Enabling the approach of an exclusive, protected spectrum would be seen as a waste of valuable spectrum resources.

21 Do you think this is a sensible approach? Please provide alternative suggestions if you disagree.

21. This approach would not be recommended at all. The reasons for this are that assignees would not have the opportunity to do channel bonding for additional capacity, and would not have any solution at all in the rare cases of highly populated wireless network hubs, where a few additional channels are usually required to overcome interference issues. There is a recommended alternative: self-coordination with an open data-base, to operate on a 'first come first served' approach. Whenever a stack holder meets with interference, all other links in the area may easily be located in the regulator's database, and from here, re-coordination of channels may effectively be performed.

22 Do you think it is a reasonable approach to do away with the exclusivity of a frequency channel to a specific user if there is a need for spectrum by other users who cannot be accommodated in alternative channels, because of congestion? Please provide alternative suggestions if you disagree?

22. This approach may work, but would omit the speed and flexibility elements of light licensing. The recommendation would be to either go back to one Band, or apply light licensing to the coordinated band. Anyway, if there is a decision to provide exclusive channel(s), it would be recommended to include the following 2 restrictions:
    a. No more than 1000MHz of spectrum
    b. As mmWave Bands enjoy huge re-use factors, including relatively limited ranges, shareholders will have to indicate areas where mmWave is not required and in this way, these areas will be available for others to utilize.

23 Whether the Authority should specify channels

23. Yes, it is recommended that the Authority specify channels based on the well-defined ETSI recommendations. Also, it would be a wise approach to have the registration process include the channels to be used, and also the occupied bandwidth.

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24 If the Authority should specify channels, whether they should be for FDD or TDD or both;

24. It is recommended that both FDD and TDD be allowed:

Leverage FDD E Band links for redundant wireless transmission sections:

Areas of the backhaul network where FDD transmission systems are required are mainly rings. Rings are used in areas with heavier traffic where additional redundancy is required; E Band links are the optimal answer for heavy traffic. As rings need to be symmetric, FDD links are a suitable solution for a long-term investment.

Leverage the TDD mmWave links for efficient spectrum usage:

While considering the significant asymmetric behavior of mobile network traffic, the TDD technology would seem to be an ideal fit. Both TDD and FDD are recognized by the American FCC and European CEPT standards, as well as by the standards of other leading countries such as Japan, Australia, and Russia. mmWave links were found by many operators to be an optimal way to efficiently use a single channel in typical mobile backhaul links, Wi-Fi hotspots connectivity and CCTV networks. Figure 2 shows an example of live network cell-site traffic statistics where the actual upload-download ratio is 1:6.

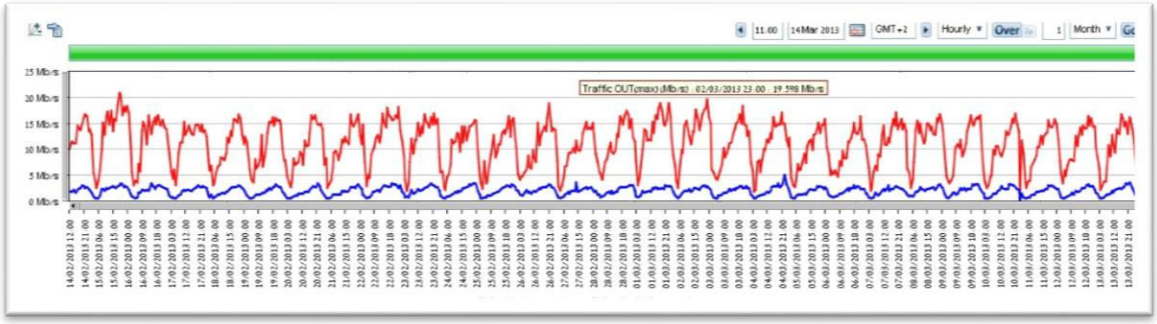

Figure 2: Typical cell-site data traffic, red=download, blue=upload

If we take above example and backhaul this site with a traditional FDD 2 channel wireless transmission system, a ~40% waste of resources may be noted. See example in figure 3 for a typical dual channel based backhaul link:

- 500MHz of spectrum is implemented in each direction
- In the conservative number of 1:5 ratio, 400MHz of spectrum is wasted – and being paid both to the equipment vendor and in the annual fee for the regulator, while less free spectrum is left for other links.

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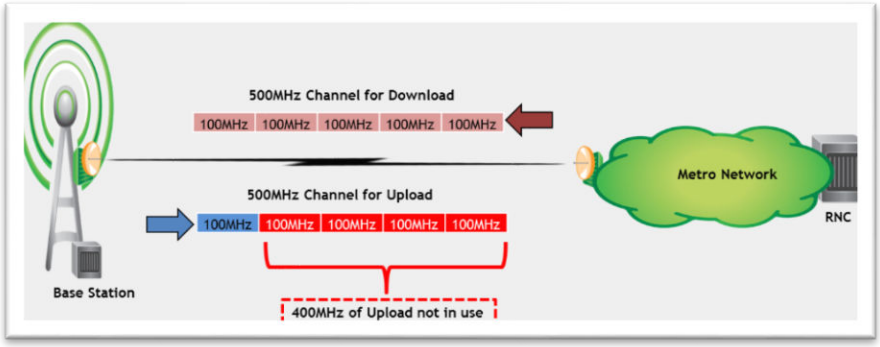

Figure 3: FDD backhaul channel utilization in a typical mobile backhaul link

UK OFCOM statistics: 40% registered E Band links in 2014 and Q1-Q3 2015 are TDD links

25 How the channels should be specified, also considering RF band

25. Today's technology enables efficient 1Gbps data throughputs over 250MHz channels. 2Gbps rates are enabled over 500MHz, and wider channels allow even wider capacities. As such, for both the E Band and V Band, 250MHz channels are the recommended building blocks for future networks - while aggregated channel utilization should be allowed as an option.

26 Please indicate if you agree with the Authority's view: to make the V Band (57-64 GHz) licence exempt would best satisfy the needs of users.

26. We are in total agreement with the Authority's view. In countries where a license exempt approach was adopted, the V Band is gaining momentum as the relief band for the oversubscribed and interference-challenged 2.4 GHz and 5 GHz bands, especially with the recent introduction of the 802.11ac technology with its ultra-wide (up to 160MHz) channels, and the emerging LTE-U (which is seriously considering the same Wi-Fi spectrum). The V Band is also recognized as a complementary technology for Wi-Fi networks operating over above-mentioned bands: Backhauling Wi-Fi access networks over the V Band enables significantly enhanced services also for city surveillance networks, which are today equipped with 4K-HD and multi-focal megapixel cameras that are hungry for reliable connectivity solutions and have found the-V Band to be the perfect match.

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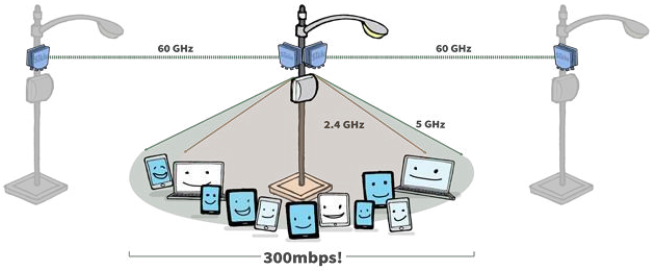

Figure 4: Wi-Fi network connected with V Band radios



Figure 5: 4k-HD CCTV connected with V Band radios

27 What other considerations should guide the Authority's decision in this regard?

27. We would not recommend additional considerations to guide the Authority's decision in this regard at this time. It is clear the Authority conducted serious background research, investigating regulation schemes from around the world and this led to a well-defined and established approach.

28 Do you think there are any risks or other factors that the Authority should consider before making the decision that a licence-exempt approach is appropriate for the V Band?

28. The type approval process, that should ensure well defined: minimum and maximum channels bandwidths, maximum Tx power and minimal antenna gain, will enable relaxed utilization of this band.

29 Do you think there may be benefits to requiring link registration in this band and that this should be considered?

29. No. Siklu is not aware of such benefits at this time.

30 If you think that links should be registered, would you consider that to be compatible with MWGS to be licence-exempt?

30. The high attenuation of oxygen, as well as a well-defined equipment type approval process are both proven factors that lead to the license-exempt approach.

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31 Do you agree with the parameters set out above? Please substantiate your response.

31. Siklu does agree with most of the parameters set out above. We would recommend a minimum antenna gain be reconsidered and set a value of 30dBi to cater for scanning antennas, and for short distances of 100 meters.

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About Siklu

Our Revolution in Ultra High Capacity Wireless

Millimeter wave frequencies were the Antarctica of telecoms before Siklu – very few went there and those who did paid a lot for it. Then we invented our all-silicon radio and started a revolution: prices were sliced by 90% and more, devices shrunk in size, performance skyrocketed – and a market was born.
Our Gigabit throughput E Band (70/80 GHz) and V Band (60 GHz) radios are the market's most cost-effective solutions for short-range wireless ultra-high capacity point-to-point links. Based on more than 30 patents, they include the first SiGe E Band chip and other unique achievements.

Best-Selling Millimeter Wave Radios

Siklu already sold thousands of radios worldwide to service providers, mobile operators, wireless security network operators, enterprises and governments. And with 30% market share, we firmly lead the millimeter wave radio market. Top operators have tested our radios rigorously, and they are now deployed in all climates, working smoothly even through monsoons and hurricanes.

What's Next? Transforming Street-Level Connectivity

We're now taking our all-silicon innovation to the street – with a low-priced, tiny, and unobtrusive V Band (60 GHz) radio that will enable mass deployment of street-level networked devices, from small cell backhaul through Wi-Fi connectivity to security networks.
As the business of connectivity is being transformed by new breeds of services and new kinds of networks, we now partner with top industry movers to provide the high performance wireless connectivity that will enable these innovations.

When, who, where

Founded in 2008 by a team of wireless veterans experienced in consumer electronics, with the vision of using all-silicon technology advances from the consumer electronics industry to transform high capacity networks. They used cutting edge technology to reduce cost and increase reliability of carrier grade wireless connectivity. Privately held, Siklu is backed by leading investment funds and private investors, including Argonaut Private Equity, Evergreen Venture Partners, DFJ Tamir Fishman, Amiti Ventures, Tamares Capital and a strategic investment by Qualcomm Ventures.

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