Tata Communications Ltd.'s Response to TRAI Consultation Paper No.02/2014 on Allocation and Pricing of Microwave Access (MWA) and Microwave Backbone (MWB) RF Carriers

INTRODUCTION

Tata Communications Ltd. (TCL) is a global communications and enterprise IT service provider delivering enterprise solutions and partnerships to carriers and businesses worldwide holding NLD/ILD and ISP licenses in Inida. Unlike some of the other Telecommunications Services Providers (TSP) in India, TCL does not provide retail voice and data services to end consumers. Hence, for the purpose of allocation and pricing Microwave Access and Backbone (MWA/MWB), TCL is a TSP which gets allocated spectrum under captive category. Categorically, in the context of the business TCL is into, some of the consultative questions around allocation and pricing of MWA/MWB spectrum to 2G, 3G and BWA providers do not apply to TCL. These questions are relevant only to the extent of captive category that TCL falls under.

With increasing economic progression and resultant increase in demand of data services, access and backhaul technologies have evolved over a period of time and bandwidth requirements would only continue to increase. While Optical Fiber Cable (OFC) is an efficient media for providing higher bandwidths, it has its limitations of cost and operational management. Hence, MWA/MWB would continue to be the mainstay backhaul media in the near future.

It should suffice to say that telecommunications infrastructure by way of the positive externalities it provides is a great economic enabler for communities and businesses the world over. Moreover, the network effect it triggers has a wide-reaching effect. Accordingly, any telecommunications policies should facilitate affordable and inclusive availability of telecommunications services.

Q1. How many total Microwave Access and Backbone (MWA/MWB) carriers should be assigned to a TSP deploying:

a. **2G technology only.**
b. **3G technology only.**
c. **BWA technology only.**
d. **Both 2G and 3G technologies.**
e. **2G and BWA technologies.**
f. **2G, 3G and BWA technologies.**

Please give rational & justification for your answer.

R1. TCL is a NLD and ISP license holder and procures MWA/MWB backhauls under captive category. The question does not hold any relevance in the company's current context.

Q2. How many MWA/MWB carriers need to be assigned to TSPs in case of 2G, 3G and BWA at the start of their services (i.e. at the beginning of rolling of services). Please justify your answers.

R2: TCL is a NLD and ISP license holder and procures MWA/MWB backhauls under captive category. The question does not hold any relevance in the company's current context.

Q3. Should excess spectrum be withdrawn from the existing TSPs?

R3. TCL is a NLD and ISP license holder and procures MWA/MWB backhauls under captive category. The question does not hold any relevance in the company's current context. >

Q4. If yes, what should be the criteria for withdrawal of excess allocation of MWA and MWB carriers, if any, allocated to the existing service providers?

R4. TCL is a NLD and ISP license holder and procures MWA/MWB backhauls under captive category. The question does not hold any relevance in the company's current context.

Q5. What should be the preferred basis of assignment of mwa/mwb carriers to the TSPs i.e. "exclusive basis assignment" or "link-to-link based assignment"?

R5. So as to contain interference among Microwave (MW) links, "exclusive basis assignment" of MWA/MWB carriers should be preferred. In an environment wherein tens of hundreds of MW links get commissioned and de-commissioned, exclusive basis assignment eases tracking and managing inter-system interference.

In case of "link-to-link basis assignment" ensuring frequency coordination among different TSPs would be an elaborate exercise. By following such a system, there is a distinct possibility of increased inter-system interference, in turn resulting in lower spectral efficiency and defeating the very purpose of such a method of assignment. Further, the onus of ensuring inter-system and intra-system interference would shift from the TSPs to the Wireless Planning Commission (WPC), creating operational complications. In view of the above, "link-to-link basis assignment" is not a preferred mechanism.

Q6. Incase "exclusive basis" assignment is preferred, whether MWA and MWB carriers should be assigned administratively or through auction. Please comment with full justification.

R6: Assignment of frequencies for MWA/MWB networks for TSPs should be done administratively. The assignment process should encourage investment in the deployment of networks and the implementation of new services.

Auctions are the preferred mechanism only when demand is expected to exceed supply. However, MWA/MWB carriers in the 6-42Ghz range of spectrum are available in abundance for allocation to TSPs. Moreover, unlike access spectrum which is assigned mostly by auction in a number of countries, backhaul spectrum in most countries is generally assigned administratively while taking care of various technical (spectrum bands, interference, antenna characteristics and path length) factors

Q7. In case "link-to-link basis" assignment is preferred, how the carrier assignment for different links should be carried out, particularly in nearby locations?

R7. In case of "link-to-link basis" assignment, while assigning carriers to nearby locations, WPC would need to undertake interference analysis and ensure th.at the newly assigned carrier doesn't interfere with links of all other TSPs in the geography. To accomplish this, among other parameters, the WPC must be equipped with all the

necessary planning tools, requisite expertise, complete details of all links, viz. antenna height, antenna gain, antenna radiation pattern, complete radio parameters of the device, etc. WPC would further need to ensure frequency coordination among the TSPs so as to avoid inter-system interference. In view of the above, “link-to-link basis assignment” is NOT a preferred mechanism.

Q8. Considering the fact that different TSPs may require additional carriers at different point of time, what should be the assignment criteria for allocation of additional carriers for MWA and MWB?

R8. Assignment criteria for allocation of additional carries for MWA and MWB should be on need-basis, after examining full justification of the requirements and availability of spectrum and upon taking into consideration spectrum requirement of other users with a view to ensuring electromagnetic compatibility etc.

Q9. How can it be ensured that spectrum carriers assigned are used optimally and the TSPs are encouraged to move towards the OFC?

R9. While technically both MW and OFC-based backhauls are both suited to cater to increasing bandwidth requirements, it is the commercial viability that holds the key. Although OFCs have near unlimited bandwidth capability, deployment of OFC is suitable only in areas with high density of customers that help justify investing in OFC. Particularly in areas with no pre-existing media, MW is the best access media option.

Backhauls tend to extend beyond limits of a metro area into vast reaches across the country. Extending OFCs into sparsely populated areas with limited business potential would be an unwanted and avoidable financial burden on TSPs and in turn on the end users. Instead, MW would be an operationally manageable and financially viable media.

As for dense metro areas, in view of the steep Right Of Way (ROW) charges being levied by most municipal corporations in India, laying and building OFC routes turns out to be expensive. This is the primary reason behind TSPs relying on MW media even within city limits.

TSPs can be motivated to move towards OFC by lowering the current ROW charges being levied by various municipalities. In the absence of a centralized authority coordinating across various municipal corporations and government bodies, TSPs today are charged disparate ROW charges across the country, which are often arbitrary.

OFCs also have a high cost of operational manageability. Given rampant infrastructure development across the country, OFCs are subject to frequent cuts. Infrastructure developers and the utility providers undertake digging unmindful of the presence of buried OFCs. Introducing formal obligation and liability on part of infrastructure developers would help improve reliability of OFCs and in the process encourage TSPs to switch to the media. Till such time, MW would continue to be the more reliable option of the two.

The permission to install overhead fiber would be another enabler for TSPs. Installation and operational maintenance of overhead fiber is far cheaper than that for buried OFCs. In many parts of the world, laying overhead fiber is encouraged and adequate governing rules and regulations are in place.

Without addressing issues faced in OFC deployment, enhancing spectrum charges further with the hope of forcing TSPs to move to OFC would burden the TSPs, impacting their network roll-out and growth plans.

Q10. Should an upfront charge be levied on the assignment of MWA or MWB carriers, apart from the annual spectrum charges?

R10. No, MWA or MWB carriers are natural resources and do not need any upfront investment to make them available for use. Therefore, apart from administrative charges, no upfront charges should be levied on their assignment to TSPs.

Q11. What should be the pricing mechanism for MWA and MWB carriers? Should the annual spectrum charges be as a percentage of AGR or on "link-by-link" basis or a combination of the two?

R11. Annual spectrum charges for MWA and MWB carriers should be levied on "link-by-link" basis as per a modified MCW formula. Please refer response 13 for the proposed formula. For a TSP procuring MWA/MWB under the captive category, an AGR based model is justified only if the annual spectrum charges are applied to AGR directly arising from the use of microwave spectrum, i.e. excluding any AGR arising as a result of use of any other media.

Q12. In case of percentage AGR based pricing, is there any need to change the existing slabs prescribed by the DoT in 2006 and 2008? Please justify your answers.

R12. This question is not applicable for a TSP falling in captive category of MWA/MWB carriers.

Q13. In case link-by-link based charging mechanism is adopted:

a. Should the spectrum be priced differently for different MW spectrum bands (6GHz/7GHz/13GHz/15GHz/18GHz/21GHz/26GHz/28GHz/32GHz/42GHz etc)? If yes, by what formula should be charged?

What are the factors (viz as mentioned in para 3.22) that should appear in the formula? Please elaborate each and every factor suggested.

R13. Yes, pricing across spectrum bands must be different. Since higher band carriers have lower propagation characteristics than lower bands, carriers at higher frequencies should be progressively low priced. The following band factor values are being recommended:

= 1 frequency band <= 1 GHz

= 0.9 for frequency band > 1 GHz and <= 3 GHz

= 0.7 for frequency band > 3 GHz and <= 6 GHz

= 0.5 for frequency band > 6 GHz and <= 10 GHz

= 0.3 for frequency band > 10 GHz and <= 20 GHz

= 0.2 for frequency band > 20 GHz and <= 30 GHz

= 0.1 for frequency band > 30 GHz and <= 42 GHz

Along with the usual factors such as end-to-end distance, channel bandwidth & the number of carriers, the formula should also consider demographic and geographic factor. Thinly populated rural areas should attract relatively lower charges as against dense urban and suburban areas.

The following geographical factor values are being recommended:

= 1 for Metro circles

= 0.5 for A & B Circles

= 0.25 for C Circles

A revised royalty calculation formula, with the inclusion of frequency band and geographic area as determining factors, would then be as mentioned below:

R (Royalty) = M x C x W x FB x GEO

where,

FB represents frequency band and

GEO represents geographic area

Though this is not part of the Q13, it is related to link-by-link pricing and, hence, is being mentioned here. Currently, under link-by-link charging mechanism, royalty is calculated based on a mathematical formula as given below:

R (Royalty) = M x C x W,

where,

M is a factor for distance

C is a factor related to number of carriers and

W is a factor for bandwidth

The issue is the way WPC calculates the value of M factor. The different M factor values, as given in the WPC order dated 22nd March 2012, are as given in the following table:

Table-B For The 'M' Factor

Distance Cat.	"Maximum Distance (KM) Over Which the F/L/LM Network would operate"	Royalty Charges (in Rs.) for of the Basic Link.
		M
I	<= 2	*1500*
II	<= 5	*3000*
III	> 5 <= 25	*6000*
IV	> 25 <= 60	*12000*
V	> 60 <= 120	*22500*
VI	> 120 <= 500	*37500*
VII	> 500	*50000*

While deciding on the applicable value of M, WPC considers all conjoined links as part of the same link and calculates value of factor M based on end-to-end link distance. For instance, WPC charges spectrum fees as per M x C x W formula based on aggregate distance (AB + BC) in applicable distance slabs as represented in Figure 1 below.

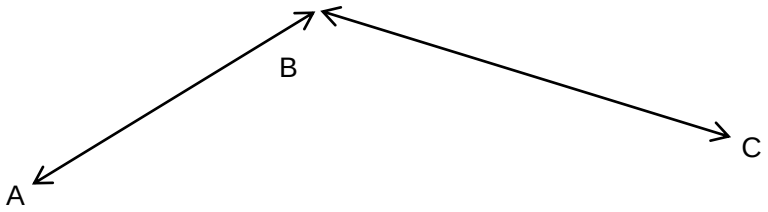

Figure 1: **Conjoined Microwave links**

However, for incremental links commissioned (links shown dotted in *Figure 2* below), WPC issues new AIPs considering 3 additional networks: CD+DE, BF and GH and charges for three additional networks without considering any earlier allocation and payment made for (AB+BC). This methodology leads to an unwarranted increase in the total royalty charges.

In this mode of charging, every incremental growth of the NW within the same city will be treated separately as independent NWs which makes deployment of MW links totally unviable on the basis of spectrum cost.

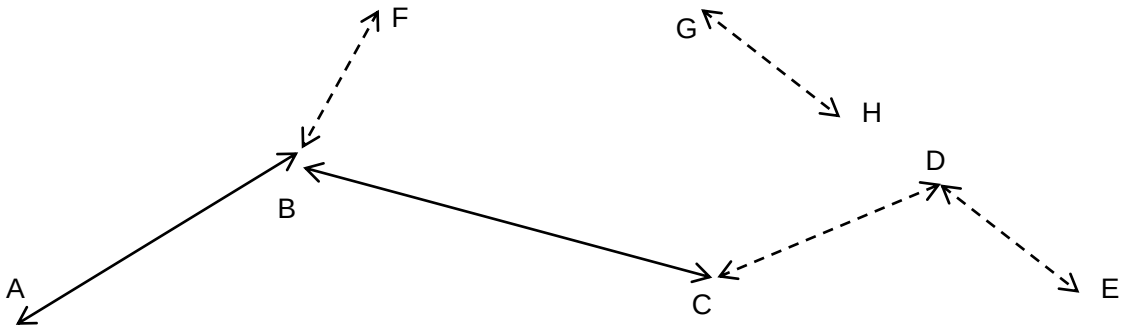

Figure 2: **Disjoint Microwave links deployed as an extension of existing network**

In view of the above, the following change is proposed:

- MW links within a city to be considered as part one homogenous network and the charging to be based on aggregate distance of all point to point links as the NW grows.
- In the above illustration:
    - Incremental Spectrum fee payable = (Spectrum fee for aggregate distance of the links AB+BC+CD+DE+BF+GH) – (Spectrum fee paid for AB+BC)

Q14. Should the option of assignment of MWA carriers in all the spectrum bands in 6-42 GHz range be explored in line with other countries? What are the likely issues in the assignment of MWA carriers in these additional spectrum bands?

R14. Yes, the bands hitherto not explored for assignment of MWA/MWB, should also be considered. With exponential growth of mobile broadband traffic, demand for microwave spectrum is also expected to grow. Availability of additional bands for assignment would ease assignment and manageability across TSPs and facilitate roll-out of high-speed telecommunications services.

- Approximately 37 GHz of spectrum in the bands ranging from 1.4GHz to 86 GHz is available in the UK for fixed terrestrial point to point links, with 19 GHz available between 57-86 GHz.
- In Germany, Frequency assignment for the operation of MW backhaul is generally done in spectrum bands of 6, 7,13,15,18, 23, 26, 28, 32 and 38GHz. However, The Federal Network Agency (FNA) is also considering opening of frequency bands above 50 GHz for microwave wireless backhaul.

For their range limitation, traditionally higher band carriers are less preferred for deployment of MWA/MWB links. Higher frequency carriers experience heavy rain losses, thus limiting their reach. South India happens to fall under rain zone “N” (the second highest rain zone in the world) and most parts of North India fall under rain zone “K” (the third highest rain zone in the world), thus aggravating the impact of rain losses in a large part of the country’s vast geography. However, TSPs can be encouraged to utilize these bands by compensating them by way of levying favorable charges.

Q15. In your opinion, what is the appropriate time for considering assignment of MWA carriers in higher frequency bands viz. E-band and V-band?

R15. MWA carriers in higher frequency bands viz. E-band and V-band should be considered for assignment immediately for the following reasons:

- Given exponential growth in data utilization owing to data hungry applications such as video conferencing, on-line gaming, video upload, video-on-demand, proliferation of social media site, etc., backhaul bandwidth requirement is expected to soon exceed 1000 Mbps

- Big portion of this backhaul is beyond the reach of conventional microwave radios (MWA radios operate in the 13/15/18/23 GHz bands with typical channel size of 28 MHz FDD)
- Fiber and E-band wireless are the only alternatives that can meet this increasing backhaul requirements. However, with higher fiber roll-out costs, it will not be viable to take fiber to every location and only E-Band radios can fill-in this void, and hence, needs to be allotted as early as possible.

Moreover, in view of availability of necessary eco-system, as well as good amount of deployment world over, necessity to allocate higher frequencies is only imminent.

Q16. Should E-band be fully regulated or there should be light touch regulations?

R16. While V-Band should be exempted from licensing requirements, E-Band should be lightly regulated (without a radiating power limit) for the following reasons:

- **V-Band:** Highest Oxygen absorption and therefore atmospheric loss and higher rain loss render these frequencies unsuitable for long distance transmission. With "best effort" connectivity, systems can transmit up to a few hundred meters only. Hence, many administrations do not license this band.

  Furthermore, it is a license-exempt band in most parts of the world (with low regulated power limit). The spectrum was opened in US by FCC as a "license-exempt" band in 2005, in Europe by ETSI in 2009 and is being made available in rest of the world as well.

- **E-Band:** E-Band frequencies have several unique characteristics not experienced by conventional lower frequency radio systems. At the high E-band frequencies, antennas are highly directional, with systems communicating point-to-point via highly focused "pencil beam" transmissions. Thus, interference concerns are greatly reduced, and frequency reuse is promoted.

Propagation limitations, particularly rain fading, limit high frequency links to relatively short range distances (a few kilometers). This would result in greater frequency reuse and easier path planning.

In US, the E-band allocation is a single pair of channels, each with a 5 GHz bandwidth (71 to 76 GHz and 81 to 86 GHz). With no channelization, traditional frequency coordination does not need to be considered. Even with channelization, as is being done by ECC in Europe, the frequency coordination is rendered redundant because of unique features of the E-band frequencies as mentioned above.

With no frequency coordination and simplified interference analysis, the burdensome traditional link licensing schemes are not necessary. By necessity, high capacity transmission systems require high bandwidths. This is why the ITU allocated the E-band frequencies of non-scarce spectrum for this purpose.

License fees that are linearly based on link bandwidth or data rate can lead to excessively high license fees of E-band systems vis-à-vis that of lower frequency links. Such license fee would not reflect the cost of administering the license, which can be significantly easier for E-band systems than lower frequency systems which require far more consideration of frequency reuse, frequency channelization and interference mitigation. For these reasons, several regulators manage E-band using “light licensing” techniques that reflect the ease of coordinating, registering and licensing, and set license fees that cover administrative costs, but do not penalize the high data rates and bandwidths that are required for ultra-broadband services.

Wireless regulators in the USA, UK and other countries have implemented “light licensing” schemes that provide the registration, coordination and interference protection benefits that a wireless license guarantees, but at a cost and application time significantly lower than traditional wireless licensing. Countries that employ “light licensing” or licensing schemes that do not penalize higher bandwidth systems in non-scarce frequency bands, are witnessing widespread adoption of E-band systems.

Q17. What charging / pricing mechanism would be appropriate for these bands?

R17: Considering the charging models followed by various countries and usability of the frequency band, WPC should follow long-lease or light license model similar to that followed elsewhere around the world.

Pricing mechanism followed in some of the countries is as given in the following table.

Country	E-Band License Structure	Typical E-Band License Fee
USA	On-line Light License	$75 for 10 year license
UK	Light License	£50 per year (around $100)
Czech Republic	Unlicensed	Free of charge
Russia	Light License	Minimal registration fee
Australia	Light License	AU$187 per year (around $175)

Q18. Apart from Q1-Q17, stakeholders are requested to bring out any other issue, which needs to be examined, with justification.

R18. Increasingly, there are apprehensions expressed against radiations emanating from wireless PoPs. Protest by residents in the vicinity, schools, hospitals, limited physical access at colocation sites, failure of rental negotiations with landlord of premises, etc. are necessitating relocation of wireless PoPs.

In case of administratively allocated spectrum the present WPC process doesn't provide for PoP relocations. One has to surrender the present Operating License (OL) and apply for a fresh Approval -In-Principle (AIP). which is a cumbersome administrative process both for the TSP as well as the WPC.

In order to ensure that original coverage is maintained, PoPs have typically to be relocated within close proximity of the existing site, typically within 100 meters, without any impact on wireless reach. Hence, there should not be any need to surrender the present OL and apply afresh for an AIP. Instead, WPC should provide for application of change of PoP address without the need for OL surrender and applying for a new AIP.