

**Consultation Paper No. 02/2024**



**भारतीय दूरसंचार विनियामक प्राधिकरण**  
**Telecom Regulatory Authority of India**

**Consultation Paper on**  
**Connectivity to Access Service VNOs From More Than one NSO**

New Delhi, India

23.02.2024

Mahanagar Doorsanchar Bhawan, Jawahar Lal Nehru Marg, New Delhi – 110002

**Written Comments on the Consultation Paper are invited from stakeholders by 22.03.2024 and counter-comments by 05.04.2024. Comments and counter-comments will be posted on the TRAI's website. Comments and counter-comments may be sent, preferably in electronic form, to Shri Akhilesh Kumar Trivedi, Advisor (Networks, Spectrum and Licensing), TRAI, on the email ID: advmn@traigov.in. For any clarification/ information, Shri Akhilesh Kumar Trivedi, Advisor (Networks, Spectrum and Licensing), TRAI, may be contacted on Telephone No. +91-11-23210481.**

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**CHAPTER I**  
**INTRODUCTION AND BACKGROUND**

1.1 Prior to the year 2013, the Government of India granted standalone licenses for various telecommunication services such as access service, national long distance service, international long distance service, internet service etc. In 2013, the Government established the regime of Unified License for the provision of telecommunication services in the country. In this regime, eligible entities may obtain appropriate authorization(s) under the Unified License from the Government and provide a range of telecommunication services to their customers. In 2016, the Government introduced virtual network operators (VNOs) under the regime of Unified License. A VNO may provide telecommunication services to consumers by using the network of its parent network service operator (NSO).

**A. DoT's Reference Dated 07.07.2023**

1.2 The Department of Telecommunications (DoT), Ministry of Communications, Government of India, through its reference dated 07.07.2023 (**Annexure-I**) on the subject- 'Connectivity to Access Service VNOs from more than one NSO', sought recommendations of Telecom Regulatory Authority of India (hereinafter, also referred to as "TRAI" or "the Authority") under Section 11(1) (a) of the TRAI Act, 1997 (as amended). The DoT's reference letter dated 07.07.2023 is reproduced below:

*"Department of Telecommunications has examined the issue related to Licensing Reforms on various aspects like Procedural Reforms, Reform for Licensing Terms & Conditions, Compliance Reforms for reducing compliance burden on Telecom Service Providers (TSPs) etc. Following issue/ matters amongst them are indicated here to seek recommendation of TRAI:*

2. Based on the TRAI's recommendations dated 01.05.2015 on "Introduction of Virtual Network Operators", the Department of Telecom issued guidelines/ agreement for Unified License (virtual Network Operator) {Unified License (VNO)} on 31.05.2016.

3. As per these guidelines, there would not be any restriction on the number of VNO licensees per service area. VNOs are allowed to have agreement with more than one NSO for all services other than Access Service and such services, which need numbering and unique identity of the customer.

4. The Department has received representation that Access Service VNOs may also be permitted to take connectivity from more than one NSO in specific conditions. For example:

- i. When an Access Service VNO wants to take connectivity from a NSO for wireline services and another NSO for wireless services (Eg. A case when Access Service VNO takes connectivity from a NSO who is providing only wireline services in that area then such VNO has no option for providing wireless services in that area due to existing restrictions.)
- ii. Access Service VNOs who intend to provide wireline services only, may require to take connectivity from more than one NSOs. For example, a case, when an Access Service VNO takes connectivity from a NSO for wireline services, but that NSO may not have services in some other areas within the LSA where the VNO wants to provide its services. In such case, the VNO may be permitted to take connectivity from more than one NSOs for wireline service."

5. Accordingly, recommendations of TRAI are sought on the following issues:

- i. Appropriate number of NSOs with whom VNOs having Access Service authorization and providing wire line services can be permitted to take connectivity in an LSA.
- ii. VNOs having Access Service authorization and providing both wireless and wire line services can be permitted to take connectivity from one NSO for wireless services and other NSO for wire line services in an LSA."

6. *In this regard, TRAI is requested to kindly examine the above issues and submit its recommendations under section 11(1)(a) of TRAI Act, 1997 (as amended)*”.

**B. The present consultation paper**

1.3 In this background, the Authority is issuing this consultation paper for soliciting comments of stakeholders on the issues related to connectivity to access service VNOs from more than one NSO. The consultation paper is divided into three chapters. This Chapter deals with the introduction and background of the consultation paper. Chapter II examines the issues. Chapter III summarizes the issues for consultation.

## **CHAPTER II**

### **EXAMINATION OF ISSUES**

2.1 In 1990s, many countries introduced the first phase of reforms by privatizing their national operators. Until that time, telecommunications services were largely provided by the public sector. In July 1992, the Government of India opened eight value added services (viz. Electronic Mail, Voice Mail, Data Services, Audio Text Services, Video Text Services, Video Conferencing, Radio Paging, Cellular Mobile Telephone) for private participation and introduced a licensing regime for telecommunication services in the country. In the year 1994, the licenses for cellular mobile telephone services were granted to private entities for the first time. Since then, many telecommunication services have been brought under licensing regime.

#### **(1) Introduction of Unified Licensing Regime in the year 2013**

- 2.2 National Telecom Policy - 2012 (NTP – 2012) provided the impetus for moving towards a Unified Licensing regime to exploit the attendant benefits of convergence, spectrum liberalization and to facilitate delinking of the licensing of networks from the delivery of services to the end users. NTP-2012 aimed to facilitate resale at the service level under the proposed licensing regime, both wholesale and retail, by introducing virtual operators.
- 2.3 In the year 2013, the Department of Telecommunications (DoT) introduced Unified Licensing regime with the objective of providing a single license for all types of telecommunication services. While introducing the Unified Licensing regime, DoT decided that this regime may be introduced over two phases with the delinking of licensing for networks from the delivery of services be taken up in a second phase.
- 2.4 On 07.07.2014, DoT sent a reference to the Authority seeking its recommendations *"for delinking of licensing of networks from delivery of*

*services by way of virtual network operators etc. including associated issues such as Adjusted Gross Revenue, terms of sharing passive & active infrastructure etc. under Unified Licensing Regime”.*

- 2.5 In response, the Authority, through its recommendations on ‘Introducing Virtual Network Operators in telecom sector’ dated 01.05.2015, recommended that virtual network operators (VNOs) should be introduced through a proper ‘licensing framework’ in the Indian telecom sector. In the said recommendations dated 01.05.2015, the Authority examined the issue of ‘parenting of a VNO by more than one NSO in a service area’ and recommended that *“VNOs will be allowed to have agreements with more than one NSO for all services other than access services and such services which need numbering and unique identity of the customers.”* The Authority observed that *“[f]or those services which require unique identity in terms of numbering, lawful interception, spectrum usages etc. the VNO can have parenting with only one NSO for an authorization”.*

## **(2) Introduction of Unified License for VNO regime in the year 2016**

- 2.6 After considering the TRAI’s recommendations on ‘Introducing Virtual Network Operators in telecom sector’ dated 01.05.2015, DoT decided to introduce Unified License for VNO [UL(VNO)] regime. On 31.05.2016, DoT issued ‘Guidelines on Grant of Unified License (Virtual Network Operators)’. Relevant extracts of the Guidelines on Grant of Unified License (Virtual Network Operators) dated 31.05.2016 are given below:

*“3. ... The basic features of UL (VNO) are as follows:*

- (i) VNOs are treated as extension of NSOs (Network Service Operators) or TSPs and they would not be allowed to install equipment interconnecting with the network of other NSOs.*
- (ii) Applicant can apply for UL (VNO) along with VNO authorization for any or more services listed below:*
  - (a) Unified License VNO (All Services)*

- (b) Access Service (Service Area-wise)*
- (c) Internet Service (Category-A with All India jurisdiction)*
- (d) Internet Service (Category-B with jurisdiction in a Service Area)*
- (e) Internet Service (Category C with jurisdiction in an SSA)*
- (f) National Long Distance (NLD) Service*
- (g) International Long Distance (ILD) Service*
- (h) Global Mobile Personal Communication by Satellite (GMPCS) Service*
- (i) Public Mobile Radio Trunking Service (PMRTS) Service*
- (j) Very Small Aperture Terminal (VSAT) Closed User Group (CUG) Service*
- (k) INSAT MSS-Reporting (MSS-R) Service*
- (l) Resale of International Private Leased Circuit (IPLC) Service"*

2.7 In essence, through the UL (VNO) regime, DoT introduced a "service only layer". UL (VNO) regime is parallel to the Unified License regime for delivery of services. Under each authorization of UL (VNO), a licensee is permitted to provide telecom services like those which are permitted to the Unified License holders.

2.8 Notably, through the Guidelines on Grant of Unified License (Virtual Network Operators) dated 31.05.2016, DoT prescribed as below in respect of parenting of VNOs:

*"(xxii) VNOs will be allowed to have agreements with more than one NSO for all services other than access services and such services which need numbering and unique identity of the customers."*

### **(3) Introduction of Access Service Category B Authorization under UL (VNO)**

2.9 Earlier, in the year 1994, DoT had introduced a scheme called Direct Inward Dialing (DID) to provide facilities of the group Electronic Private Automatic Branch Exchange (EPABX) by private entities as franchisees of DoT.

2.10 In this regard, on 05.07.2016, DoT issued 'Guidelines for Grant of Unified License (Virtual Network Operator) Category B for Access Service Authorization'. Through the said guidelines dated 05.07.2016, DoT prescribed, *inter-alia*, as below as an interim measure for a period of one year:

(a) There shall be a category of UL (VNO) Cat-B for Access Service authorization. The service area under this category shall be a geographical area of a district of a State/ Union Territory.

(b) The existing DID franchise of any Telecom Service Providers may migrate to District-wise UL (VNO) for Access Services.

2.11 With a view to regularize the UL (VNO) Category B for Access Service authorization, DoT, through its reference dated 11.07.2016, sought recommendations of TRAI on the matter stating, *inter-alia*, as below:

*"The Government has decided to introduce Category B license in Access Service Authorization with districts of a State as a service area for VNO particularly for entrepreneurs like Direct Inward Dialing (DID) franchisees. DID franchisees maintain Group EPABX (Electronic Private Automatic Branch Exchange). These DID franchisees are in vogue since 1995 and it has been decided by the Government to enable them in VNO regime.*

*2. The guidelines for grant of VNO operators have been issued on 31.05.2016 ... These guidelines provide for VNO at service area level for access service authorization, which is typically a State or metro city. The DID franchisees operate in a very small pocket and have been contributing for provisioning of telecom services as an entrepreneur.*

3. *As an interim measure, guidelines for category B VNO have been issued to facilitate the continuance of DID franchisees on 5/7/2016.... It has been decided to seek TRAI recommendations for Access Service authorization for category B licence with districts of a State as a service area for VNO for regularizing the same.*

4. *Therefore, it is requested that recommendations for Access Service authorization for category B license with districts of a State as a service area for VNO may please be provided."*

2.12 After following a consultation process, the Authority issued recommendations on 'Introduction of UL (VNO) for Access Service authorization for category B License with Districts of a State as a Service Area' dated 08.09.2017. Through these recommendations, the Authority recommended, *inter-alia*, as below:

- (a) A new category of authorization may be introduced under Unified License (VNO), for Access Service as Category 'B' license with districts as a Service Area on non-exclusive basis.
- (b) To continue their services, existing DID franchisees should migrate to UL (VNO) Category 'B'.
- (c) New license should not be restricted only to existing DID franchisees and should also be open to new entities intending to offer such services.
- (d) Scope of proposed UL (VNO) Cat 'B' license should be to provide only wireline access services within a district. Wireless access services shall not be a part of the scope of UL VNO Cat 'B'.
- (e) The number of districts to be served by a UL (VNO) Cat 'B' licensee in a telecom circle should be limited to four. If a licensee wishes to provide services in more than four districts of an LSA, the licensee should be mandated to obtain UL (VNO) Access Service Authorization License for entire LSA.
- (f) In order to meet the requirement of connectivity UL (VNO) Cat 'B' licensees may be allowed to have arrangement for connectivity at different locations with different TSPs/ NSOs in its licensed area of operation i.e.

within the geography of a district, only in case of provision of wireline access services through EPABX.

- (g) UL (VNO) (Access service) license may be amended to enable the provision of allowing parenting with multiple NSOs by a VNO for wireline network at different locations of the LSA only in case of provision of wireline access services through EPABX.
- (h) The arrangements for allowing connectivity from more than one TSP/ NSO at same EPABX can be allowed only after suitable examination and approval by TEC/ DoT with desired specifications.

2.13 On the issue of multi-parenting at the same EPABX, the Authority had made, the following observations through the afore-mentioned recommendations dated 08.09.2017:

*"3.81 On another aspect of allowing connectivity from more than one TSP/ NSO at the same location or same EPABX of the licensee, the Authority has taken note of the concerns raised by some stakeholders regarding possible bypassing and routing of STD and ISD traffic that may result into the security breach. The EPABX cannot be allowed to function as mini TAX; hence the Authority feels there is a need to carry out further analysis on the virtual partitioning of the EPABX. As many cases are reported to DoT on the issues of illegal routing of calls, the Authority is of the opinion that such arrangements can be allowed only after suitable examination and approval by TEC/ DoT with desired specifications. Continuation of such type of existing arrangements shall depend on the outcome of the decision of DoT/ TEC."*

2.14 Based on the afore-mentioned recommendations of TRAI, DoT carried out, *inter-alia*, the following amendments in licensing regime for UL (VNO):

- (a) DoT introduced a new authorization under the Unified License for VNO, known as the Access Service Category 'B' authorization. The Service Area of the authorization is *"geographical area of a district of a State/ Union*

*Territory". The scope of the authorization reads, inter-alia, as "The Licensee may provide wireline access services only".*

- (b) DoT introduced the following para [para 4(1)(vi)] in the Guidelines for Grant of Unified License (Virtual Network Operators):

*"In case VNO authorization is required for more than 4 Districts in a State/ Union Territory for Access Service Category B, Access Service authorization in respective Circle Service area is to be applied for."*

- 2.15 Subsequently, through a notification dated 02.03.2020, DoT issued, *inter-alia*, the following amendments in UL (VNO):

- (a) DoT inserted a new para in Chapter VIII (Access Service Authorization) of UL (VNO) as below:

*"5.2 For wire line access services through EPABX, the connectivity of different NSOs at different EPABX is allowed, however, the connectivity with more than one NSO at a particular EPABX shall not be permitted. "*

- (b) DoT Inserted a new para in Chapter XVII (Access Service Category B Authorization) of UL (VNO) as below:

*"5.2 For wire line access services through EPABX, the connectivity of different NSOs at different EPABX is allowed. However, for connectivity with more than one NSO at a particular EPABX the licensee shall ensure non-breachable logical/ virtual partitioning in the EPABX and logical separation of junctions from different NSOs with no inter NSO call flow. Also, the EPABX should not support internet connectivity and NLD/ ILD calls shall be ensured through normal NLD/ ILD network only & shall in no way directly or indirectly cause bypass of licensed National Long Distance Operator (NLDO)/ International Long Distance Operator (ILDO) jurisdiction. Further, licensee shall intimate to its NSO(s) and the Licensor regarding connectivity of more than one NSO at a particular EPABX."*

2.16 In view of the above, the present licensing framework of UL (VNO) in respect of multi-parenting may be summarized as below:

<b>Name of the Authorisation under UL (VNO)</b>	<b>Media used for provision of services</b>	<b>Use of EPABX<sup>1</sup>/ DEL<sup>2</sup></b>	<b>Whether multi-parenting is permitted</b>	<b>Whether multi-parenting at the same EPABX is permitted</b>
Access Service	Wireline	EPABX	Yes	No
		DEL	No	
	Wireless		No	
Access Service Category 'B'	Wireline	EPABX	Yes	Yes
		DEL	No	

Table 2.1: Multi-parenting under the present UL (VNO) regime

2.17 Under the present licensing framework for UL (VNO), in case, a licensee holding Access Service Category 'B' authorization under UL (VNO) intends to expand its business to more than four districts of a State/ Union Territory, it needs to apply for Access Service authorization under UL (VNO) in the respective Circle Service area. However, upon obtaining the Access Service authorization under UL (VNO), it will no longer be permitted to obtain connectivity with more than one NSO at a particular EPABX.

<sup>1</sup> Electronic Private Automatic Branch Exchange (EPABX) is a private telephone system used within a company or organization that allows users to communicate with each other and with the outside world through telephone lines. Source: <https://testbook.com/full-form/epabx-full-form#:~:text=EPABX%20stands%20for%20Electronic%20Private,outside%20world%20through%20telephone%20lines.>

<sup>2</sup> Electronic Private Automatic Branch Exchange (EPABX) is a private telephone system used within a company or organization that allows users to communicate with each other and with the outside world through telephone lines.

2.18 In this background, DoT, through its reference dated 07.07.2023, has stated, *inter-alia*, as below:

*"4. The Department has received representation that Access Service VNOs may also be permitted to take connectivity from more than one NSO in specific conditions. For example:*

- i. When an Access Service VNO wants to take connectivity from a NSO for wireline services and another NSO for wireless services (Eg. A case when Access Service VNO takes connectivity from a NSO who is providing only wireline services in that area then such VNO has no option for providing wireless services in that area due to existing restrictions.)*
- ii. Access Service VNOs who intend to provide wireline services only, may require to take connectivity from more than one NSOs. For example, a case, when an Access Service VNO takes connectivity from a NSO for wireline services, but that NSO may not have services in some other areas within the LSA where the VNO wants to provide its services. In such case, the VNO may be permitted to take connectivity from more than one NSOs for wireline service. "*

*5. Accordingly, recommendations of TRAI are sought on the following issues:*

- i. Appropriate number of NSOs with whom VNOs having Access Service authorization and providing wire line services can be permitted to take connectivity in an LSA.*
- ii. VNOs having Access Service authorization and providing both wireless and wire line services can be permitted to take connectivity from one NSO for wireless services and other NSO for wire line services in a LSA.*

*6. In this regard, TRAI is requested to kindly examine the above issues and submit its recommendations under section 11(1)(a) of TRAI Act, 1997 (as amended)".*

2.19 In essence, through the present consultation paper, the following situations require to be examined in respect of the parenting of UL (VNO) licensees holding access service authorization in an LSA:

Situation No.	Present parenting from an NSO in an LSA for providing -		Issue to be examined
	Wireless access service	Wireline access service	
1 (a)		✓	Maximum number of NSOs with whom the Licensee may seek connectivity for providing wireline access service in the LSA
1 (b)	✓	✓	
2 (a)		✓	Suitability of permitting the licensee to seek connectivity from another NSO for providing wireless access service in the LSA
2 (b)	✓		Suitability of permitting the licensee to seek connectivity from other NSO(s) for providing wireline access service in the LSA

Table 2.2: Situations to be examined in respect of the parenting of UL (VNO) licensees holding access service authorization in an LSA

2.20 In this background, the Authority solicits comments of stakeholders on the following set of questions:

**Issue for Consultation:**

- Q1. In your view, what is the maximum number of Network Service Operators (NSOs) from whom a UL (VNO) licensee holding Access Service Authorization should be permitted to take connectivity in a licensed service area (LSA) for providing wireline access service? Kindly provide a detailed response with justification.**
- Q2. In case your response to the Q1 is a number greater than one, what should be the associated terms and conditions for permitting such connectivity? Kindly provide a detailed response with justification.**
- Q3. Whether a UL (VNO) licensee holding Access Service Authorization in an LSA should be permitted to take connectivity from one NSO for wireless access service and other NSO(s) for wireline access service in the LSA? Kindly provide a detailed response with justification.**
- Q4. In case your response to the Q3 is in the affirmative, what should be the associated terms and conditions for permitting such connectivity? Kindly provide a detailed response with justification.**
- Q5. Whether there are any other relevant issues or suggestions related to the parenting of licensees holding Access Service Authorization under UL (VNO)? Please provide a detailed response with justification.**

2.21 The following chapter lists the issues for consultation.

**CHAPTER III**  
**ISSUES FOR CONSULTATION**

Stakeholders are requested to provide responses to the following questions with detailed justifications:

- Q1. In your view, what is the maximum number of Network Service Operators (NSOs) from whom a UL (VNO) licensee holding Access Service Authorization should be permitted to take connectivity in a licensed service area (LSA) for providing wireline access service? Kindly provide a detailed response with justification.**
- Q2. In case your response to the Q1 is a number greater than one, what should be the associated terms and conditions for permitting such connectivity? Kindly provide a detailed response with justification.**
- Q3. Whether a UL (VNO) licensee holding Access Service Authorization in an LSA should be permitted to take connectivity from one NSO for wireless access service and other NSO(s) for wireline access service in the LSA? Kindly provide a detailed response with justification.**
- Q4. In case your response to the Q3 is in the affirmative, what should be the associated terms and conditions for permitting such connectivity? Kindly provide a detailed response with justification.**
- Q5. Whether there are any other relevant issues or suggestions related to the parenting of licensees holding Access Service Authorization under UL (VNO)? Please provide a detailed response with justification.**

**DoT's Reference Dated 07.07.2023**

F No. 20-405/2013 AS-I (Vol.-V)(Pt.10)  
Ministry of Communications  
Department of Telecommunications  
(Access Service Wing)  
20, Ashoka Road, Sanchar Bhawan, New Delhi

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Dated the 7<sup>th</sup> July 2023

**Subject: Seeking recommendations of TRAI on issue of connectivity to Access Service VNOs from more than one NSO -reg.**

Department of Telecommunications has examined the issues related to Licensing Reforms on various aspects like Procedural Reforms, Reform for Licensing Terms & Conditions, Compliance Reforms for reducing compliance burden on Telecom Service Providers (TSPs) etc. Following issues/matters amongst them are indicated here to seek recommendations of TRAI:

2. Based on the TRAI's recommendations dated 01.05.2015 on "Introduction of Virtual Network Operators", Department issued guidelines/agreement for Unified License (virtual Network Operator) {UL(VNO)} on 31.05.2016.

3. As per these guidelines, there would not be any restriction on the number of VNO licensees per service area. VNOs are allowed to have agreement with more than one NSO for all services other than Access Service and such services, which need numbering and unique identity of the customer.

4. Department has received representation that Access Service VNOs may also be permitted to take connectivity from more than one NSO in specific conditions. For example:

- i. When an Access Service VNO wants to take connectivity from a NSO for wireline services and another NSO for wireless services (Eg. A case when Access Service VNO takes connectivity from a NSO who is providing only wireline services in that area then such VNO has no option for providing wireless services in that area due to existing restrictions.)
- ii. Access Service VNOs who intends to provide wireline services only, may require to take connectivity from more than one NSOs. For example, a case, when an Access Service VNO takes connectivity from a NSO for wireline services, but that NSO may not have services in some other areas within the LSA where the VNO wants to provide its services. In such case, the VNO may be permitted to take connectivity from more than one NSOs for wireline line service.

5. Accordingly, recommendations of TRAI are sought on following issues:

- i. Appropriate number of NSOs with whom VNOs having Access Service

authorization and providing wire line services can be permitted to take connectivity in a LSA.

- ii. VNOs having Access Service authorization and providing both wireless and wire line services can be permitted to take connectivity from one NSO for wireless services and other NSO for wire line services in a LSA.

6. In this regard, TRAI is requested to kindly examine above issues and submit its recommendations under Section 11 (1) (a) of TRAI Act, 1997 (as amended).

7. This has the approval of competent authority.



(S. K. Singhal) 8/7/23

Deputy Director General (AS)

Phone: 23036918

To

The Secretary  
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New Delhi - 110002.

## LIST OF ACRONYMS

<b>S. No.</b>	<b>Acronym</b>	<b>Description</b>
1.	AGR	Adjusted Gross Revenue
2.	CP	Consultation Paper
3.	CUG	Closed User Group
4.	DID	Direct Inward Dialing
5.	DoT	Department of Telecommunications
6.	EPABX	Electronic Private Automatic Branch Exchange
7.	GMPCS	Global Mobile Personal Communication by Satellite
8.	ILD	International Long Distance
9.	ILDO	International Long Distance Operator
10.	ISD	International Subscriber Dialing
11.	LSA	Licensed Service Area
12.	NDCP 2018	National Digital Communications Policy 2018
13.	NLD	National Long Distance
14.	NSO	Network Service Operator
15.	NTP-2012	National Telecom Policy-2012
16.	PMRTS	Public Mobile Radio Trunking Service
17.	SDO	Service Delivery Operator
18.	SSA	Secondary Switching Area

<b>S. No.</b>	<b>Acronym</b>	<b>Description</b>
19.	STD	Subscriber Trunk Dialing
20.	TEC	Telecom Engineering Center
21.	TRAI	Telecom Regulatory Authority of India
22.	TSP	Telecom Service Provider
23.	UL	Unified License
24.	UL (VNO)	Unified License (Virtual Network Operator)
25.	VNO	Virtual Network Operator
26.	VSAT	Very Small Aperture Terminal