

**IDENTIFICATION AND ANALYSIS OF
APPROPRIATE REGULATORY FRAMEWORK
FOR UNIVERSAL SERVICE INTERVENTIONS
IN TELECOMMUNICATIONS**

ARCHANA GOYAL GULATI



**BHARTI SCHOOL OF TELECOM
TECHNOLOGY AND MANAGEMENT
INDIAN INSTITUTE OF TECHNOLOGY DELHI**

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Identification and Analysis of Appropriate Regulatory Framework for Universal Service Interventions in Telecommunications

by

Archana Goyal Gulati

Bharti School of Telecom Technology and Management

Submitted

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*to the***



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CERTIFICATE

This is to certify that the thesis entitled '**Identification and Analysis of Appropriate Regulatory Framework for Universal Service Interventions in Telecommunications**' being submitted by Ms. Archana Goyal Gulati to Indian Institute of Technology Delhi for the degree of **Doctor of Philosophy (Ph.D.)**, is a record of bona fide research work carried out by her. She has worked under my guidance and supervision and fulfilled the requirements for the submission of the thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

(Prof. Sushil)
Department of Management Studies
Indian Institute of Technology Delhi
New Delhi-110 016

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(Archana Goyal Gulati)

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Abstract

The importance of telecom connectivity has only been increasing over time. In the digital age, we live in, Information and Communications Technologies (ICTs) have become not just the backbone but also the predominant medium of national and international social, political and economic activity. In such an environment the digital divide wherein some regions or parts of the population are deprived of the benefits of ICTs is not just politically and ethically unacceptable but also undesirable from the viewpoint of a nation's economic growth. This would apply even more to a country like India with a large working-age population and hence tremendous potential to reap the benefits of ICTs for socio-economic growth. The rural-urban digital divide is an especially worrisome problem in India. The Universal Service Obligation Fund (USOF) of India was created with the aim of meeting the obligation to provide Universal Service, or in other words to ensure universal affordability, availability, and accessibility to telecommunications services as per its legal mandate in India, which emphasizes bridging the rural-urban digital divide. While it has contributed to increasing telecom penetration, literature review has revealed that the results of USOF interventions or subsidies have not been commensurate with subsidy outflows. A comprehensive literature review has suggested that these shortcomings could be attributed to the legal framework in which USOF operates. This includes both the overall and telecom-specific institutional framework, and the overall and telecom-specific regulatory environment, apart from USOF's regulatory framework.

The conceptual model of the study arrived at based on literature review delineated a set of variables that would constitute part of these institutional and regulatory dimensions. These were segregated into country, telecommunications (telecom) and USOF institutional strength variables and variables constituting the desirable elements of Universal Service Fund (USF) regulation. These variables were studied further with the help of Total Interpretive Structural Modelling (TISM), which helped delineate drivers that could be the subject matter of policymakers' attention to achieve desirable Universal Service outcomes.

Data Envelopment Analysis (DEA) was used to validate the European Union's (EU) regulatory framework for Universal Service interventions and to compare the Indian regulatory framework's effectiveness in terms Universal Service outcomes relative to its institutional strength, with those of similarly placed EU nations. The analysis carried out with the help of TISM and DEA led to the refinement of the conceptual framework and finalisation of the list of variables to be subject to an empirical study by way of an Expert Survey.

The data obtained from an Expert Survey was subject to Univariate Analysis and Factor Analysis to further validate and organise the regulatory framework. This exercise revealed a good degree of agreement among experts as regards the model arrived at, with some difference in opinion between PSU experts and those from Government and regulatory background, and industry background. In particular, it was found that PSU experts laid less emphasis on competitive neutrality and avoidance of market distortions, as compared to other experts. Overall, the recommended model consists of fifteen variables organised into three sets of rules depending on the stage of a Universal Service intervention.

Thus, some rules related to the regulatory decision-making process at the pre-intervention phase wherein it was to be decided whether or not to intervene in a market by way of a USOF scheme, keeping in view other possible policy instruments and the harm caused by market distortions. The second stage was the scheme design phase wherein having decided to intervene; the recommended rules would guide policymakers and the USOF Administration in ensuring best outcomes in terms of sustaining competition and long-term growth of the targeted market segment. Finally, the third set of rules would apply to the implementation phase of a USOF scheme and would ensure transparent and effective implementation of schemes with feedback for future improvements in scheme design.

Two case studies were used to validate this recommended regulatory framework. These comprised of the Wireline Broadband Scheme of USOF and USOF's Shared Mobile Infrastructure Scheme. The case studies revealed that schemes that had closely followed the recommended regulatory framework had better outcomes both in the short run and long term in terms of competition and growth of the affected market segment.

Having validated the recommended regulatory framework, the next step was to synthesise the finding and thereby, a consolidated model of a legal framework was arrived at which could serve as a guide for policymakers, not only in regard to Universal Service Interventions in telecommunications but also in other sectors such as airlines, railways, and posts.

Finally, the limitations of the study were recorded, and the way forward identified in terms of scope for further research.

सार

टेलीकॉम कनेक्टिविटी का महत्व केवल समय के साथ बढ़ता गया है। हम डिजिटल युग में रह रहे हैं, सूचना और संचार प्रौद्योगिकी (आईसीटी) न केवल आधार बना हुआ है, बल्कि राष्ट्रीय और अंतर्राष्ट्रीय सामाजिक, राजनीतिक तथा आर्थिक गतिविधि का प्रमुख माध्यम भी हैं। ऐसे माहौल में, डिजिटल विभाजन जिसमें कुछ क्षेत्र या आबादी के हिस्से आईसीटी के लाभों से वंचित हैं, जो न केवल राजनीतिक और नैतिक रूप से अस्वीकार्य हैं, बल्कि राष्ट्र के आर्थिक विकास के दृष्टिकोण से भी अवांछनीय हैं। यह बात व्यापक कार्यशील-आयु वाली आबादी वाले भारत जैसे देश के लिए और भी अधिक लागू होगी और इसलिए सामाजिक-आर्थिक विकास के लिए आईसीटी के लाभों को पाने की काफी संभावना है। ग्रामीण-शहरी डिजिटल विभाजन भारत में विशेष रूप से चिंताजनक समस्या है। यूनिवर्सल सर्विस ऑब्लिगेशन फंड (यूएसओएफ) ऑफ इंडिया का सृजन सार्वभौमिक सेवा प्रदान करने या अन्य शब्दों में, भारत में इसके वैधानिक शासनादेश के अनुसार दूरसंचार सेवाओं के लिए सार्वभौमिक सामर्थ्य, उपलब्धता और पहुंच सुनिश्चित करने के दायित्व को पूरा करने के उद्देश्य से किया गया था, जो ग्रामीण-शहरी डिजिटल विभाजन को जोड़ने पर बल देता है। हालांकि, इसने दूरसंचार पैठ बढ़ाने में योगदान दिया है, परन्तु लिटरेचर समीक्षा से पता चला है कि यूएसओएफ के अंतःक्षेपों और सब्सिडी के परिणाम सब्सिडी परिणामों के अनुरूप नहीं हुए हैं। एक व्यापक लिटरेचर समीक्षा ने सुझाव दिया है कि इन

कमियों को विधिक ढांचा, जिसमें यूएसओएफ संचालित होता है को जिम्मेदार ठहराया जा सकता है। इसमें यूएसओएफ के नियामक ढांचे के अलावा, समग्र और दूरसंचार-विशिष्ट संस्थागत ढांचा एवं समग्र तथा दूरसंचार-विशिष्ट विनियामक वातावरण शामिल हैं।

लिटरेचर समीक्षा के आधार पर किए गए अध्ययन का संकल्पनात्मक मॉडल जिससे एक सेट तैयार हुआ है, इन संस्थागत और नियामक आयामों के हिस्से का निर्माण करेगा। इन्हें देश, दूरसंचार (संचार) और यूएसओएफ संस्थागत मज़बूत परिवर्ती कारक और यूनिवर्सल सर्विस फंड (यूएसएफ) विनियमन के वांछनीय घटकों का निर्माण करने वाले परिवर्ती कारकों में विभाजन किया गया था। कुल व्याख्यात्मक संरचनात्मक मॉडलिंग (टीआईएसएम) की सहायता से इन परिवर्ती कारकों का आगे अध्ययन किया गया, जिससे ऐसे वर्णित संचालकों को मदद मिली जो वांछनीय सार्वभौमिक सेवा परिणामों को प्राप्त करने के लिए 'नीति निर्माताओं' के ध्यानाकर्षण की विषय-वस्तु हो सकते हैं।

डेटा एनवेलपमेंट एनालिसिस (डीईए) का इस्तेमाल यूरोपीय संघ (ईयू) के विनियामक ढांचे को सार्वजनिक सेवा अंतःक्षेप के वैधीकरण करने और ईयू के समान स्थापित उन राष्ट्रों के साथ इसकी संस्थागत मजबूती के लिए संबंधित सार्वभौमिक सेवा परिणामों के अनुसार भारतीय नियामक ढांचे के प्रभावकारिता की तुलना करने के लिए किया गया था। टीआईएसएम और डीईए की सहायता से किए गए विश्लेषण ने वैचारिक

ढांचे को परिष्कृत किया और विशेषज्ञ सर्वेक्षण के माध्यम से एक आनुभविक अध्ययन के अधीन होने के कारण परिवर्ती कारकों की सूची को अंतिम रूप दिया गया।

विशेषज्ञ सर्वेक्षण से प्राप्त आंकड़ा विनियामक ढांचे को आगे और वैधीकृत तथा सुव्यवस्थित करने हेतु वस्तुगत विश्लेषण तथा तथ्यात्मक विश्लेषण के अधीन था। इस अभ्यास से विशेषज्ञों के बीच अच्छे समझौते की जानकारी मिली कि पीएसयू विशेषज्ञों और सरकार तथा विनियामक पृष्ठभूमि, और उद्योग पृष्ठभूमि के मध्य वैचारिक मतभेद के साथ, मॉडल तैयार हुआ। विशेष रूप से, यह पाया गया कि पीएसयू विशेषज्ञों ने अन्य विशेषज्ञों की तुलना में, प्रतिस्पर्धी तटस्थता और बाजार की विकृतियों से बचने पर कम जोर दिया। कुल मिलाकर, अनुशंसित मॉडल में सार्वभौमिक सेवा अंतःक्षेप के स्तर पर आधारित नियमों के तीन सेटों में संयोजित पंद्रह परिवर्ती कारक शामिल हैं। इस प्रकार, अंतःक्षेप-पूर्व चरण में विनियामक निर्णय लेने की प्रक्रिया से संबंधित कुछ नियम जिसमें यह सुनिश्चित करना था कि यूएसओएफ योजना, अन्य संभावित नीतिगत साधनों तथा बाजार विरूपण के कारण नुकसान के मद्देनज़र बाजार में अंतःक्षेप करना है या नहीं। दूसरा चरण स्कीम तैयार करने का चरण था जिसमें अंतःक्षेप करने का निर्णय लेकर अनुशंसित नियमों से नीति निर्माताओं और यूएसओएफ प्रशासन को लक्षित बाजार खंड की प्रतिस्पर्धा और दीर्घकालिक विकास को बनाए रखने के लिए सर्वोत्तम परिणाम सुनिश्चित करने के लिए मार्गदर्शन मिलेगा। अंततः नियमों का तीसरा सेट यूएसओएफ योजना के कार्यान्वयन चरण पर लागू होगा और योजना

तैयार करने में फीडबैक के साथ भविष्य में सुधार के लिए योजनाओं का पारदर्शी और प्रभावी कार्यान्वयन सुनिश्चित करेगा।

इस अनुशंसित विनियामक ढांचे को मान्य करने के लिए दो केस स्टडी का उपयोग किया गया था। इनमें यूएसओएफ की साझा मोबाइल अवसंरचना योजना और यूएसओएफ की वायरलाइन ब्रॉडबैंड योजना शामिल है। केस स्टडी से पता चला कि अनुशंसित विनियामक ढांचे का बारीकी से पालन करने वाली योजनाओं ने प्रभावित बाजार खंड की प्रतिस्पर्धा और वृद्धि के संदर्भ में अल्पावधि और दीर्घकालिक दोनों में बेहतर परिणाम प्राप्त किए।

अनुशंसित विनियामक ढांचे को मान्य करने के बाद, अगला कदम परिणामों को संश्लेषित करना था और इस तरह कानूनी ढांचे का एक समेकित मॉडल प्राप्त हुआ जो नीति निर्माताओं के लिए न केवल दूरसंचार में सार्वभौमिक सेवा अंतःक्षेप (यूनिवर्सल सर्विस इंटरवेशन) के संबंध में बल्कि अन्य क्षेत्र जैसे एयरलाइंस, रेलवे और डाक के क्षेत्र में भी मार्गदर्शक के रूप में काम कर सकता था।

अंत में, अध्ययन की सीमाएं दर्ज की गईं, और आगे अनुसंधान के लिए इस क्षेत्र के संदर्भ में अगली कार्यनीति की पहचान की गई।

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Nomenclature

ADC	:	Access Deficit Charges
AGR	:	Adjusted Gross Revenue
AUSPI	:	All India Universal Service Providers India Association
BB	:	Broadband
BCC	:	Banker, Chames and Cooper
BEREC	:	Body of European Regulators for Electronic Communications
BSNL	:	Bharat Sanchar Nigam Ltd.
BSO	:	Basic Service Operators
BTS	:	Base Trans-receiver Stations
BWA	:	Broad band Wireless Access
C&AG	:	Comptroller and Auditor General
CCR	:	Charnes, Cooper and Rhodes
CDMA	:	Code-Division Multiple Access
CIS	:	Country Institutional Strength Variables
COAI	:	Cellular Operators Association of India
CPE	:	Customer Premises Equipment
CRS	:	Constant Returns to Scale
CSC	:	Common Service Centres
DEA	:	Data Envelopment Analysis
DMU	:	Decision-Making Units
DoT	:	Department of Telecommunications
DSL	:	Digital Subscriber Loops
DSLAM	:	Digital Subscriber Line Access Multiplier
EFA	:	Exploratory variable analysis
EoI	:	Expression of Interest
EU	:	European Union
GDP	:	Gross Domestic Product
GoI	:	Government of India/Central Government
GSM	:	Global System for Mobile
HFCL	:	Himachal Futuristic Communications Ltd.
ICRA	:	Indian Credit Rating Agency

ICTs	:	Information and Communications Technologies
IIMA	:	Indian Institutes of Management, Ahmedabad
ILD	:	International Long Distance
IP	:	Internet Protocol
ISER	:	International Society for Engineers and Researchers
ISM	:	Interpretative Structural Modeling
ISP	:	Internet Service Providers
ISPAI	:	Internet Service Providers Association of India
ISU	:	USOF Institutional Strength Variables
ITR	:	Indian Telegraph Rules
ITS	:	Indian Telecommunications Services
ITU	:	International Telecommunications Union
IUC	:	Inter-connection Usage Charges
IVRS	:	Integrated Voice Response System
KMO	:	Kaiser-Meyer-Ohlin
LLU	:	Local Loop Unbundling
LoI	:	Letters of Intent
MS	:	Member States
MTNL	:	Mahanagar Telephone Nigam Limited
NCP	:	Draft National Competition Policy 2011
NDCP	:	National Digital Communications Policy 2018
NLD	:	National Long Distance
NM	:	Numeral Taxonomy
NOFN	:	National Optic Fibre Network Project
NRA	:	National Regulatory Authorities
NRF	:	New Regulatory Framework
NTP	:	National Telecom Policy
OECD	:	Organisation for Economic Co-operation and Development
OFC	:	Optic Fibre Cable
PBG	:	Performance Bank Guarantees
PCA	:	Principal Component Analysis
QoS	:	Quality of Services
RDELS	:	Rural Direct Exchange Line

SP	:	Service Providers
SPSS	:	Statistical Package for Social Sciences
TDSAT	:	Telecom Disputes Settlement and Appellate Tribunal
TEC	:	Telecom Engineering Centre
TEMA	:	Telecom Equipment Manufacturers Association
TIS	:	Telecom Institutional Strength Variables
TISM	:	Total Interpretive Structural Modelling
TRAI	:	Telecom Regulatory Authority of India
TV	:	Television
UAG	:	Universal Access Gap
UDAN	:	Ude Desh ka Aam Naagrik (Regional Connectivity Scheme)
UK	:	United Kingdom
URL	:	Uniform Resource Locator
US	:	Universal Service
USA	:	United States of America
USAL	:	Universal Access Service License
US-Directive	:	Universal Service Directive
USF	:	Universal Service Funds
USL	:	Universal Service Levy
USOF	:	Universal Service Obligation Fund
USP	:	Universal Service Provider
USR	:	USOF Regulatory Framework Variables
USSP	:	Universal Service Support Policy
VAS	:	Value Added Services
VoIP	:	Voice over Internet Protocol
VRS	:	Variable Returns to Scale
V SAT	:	Very Small Aperture Terminal
VSNL	:	Videsh Sanchar Nigam Ltd.
WEF	:	World Economic Forum
WLBB	:	Wire Line Broadband Agreement
WLL	:	Wireless Local Loop
WTO	:	World Trade Organization