टीईसी का मानक दस्तावेज

टीईसी 57130:2026

STANDARD DOCUMENT OF TEC
TEC 57130:2026

प्रसारण सेवाओं के लिए स्थली दूरसंचार माध्यम के मानक

STANDARD FOR GENERIC REQUIREMENTS FOR TERRESTRIAL TRANSMISSION OF BROADCASTING CHANNELS TO DPOs.

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली–110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE KHURSHID LAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

Television broadcasting in India has evolved significantly since its inception in 1959, expanding from analogue terrestrial services to a diverse ecosystem that now includes cable, DTH, IPTV, HITS, and OTT platforms. Technological advancements and availability of economical terrestrial transmission systems have made it possible that the broadcasters may like to choose to transmit their television channels for retransmission at the headend of the DPO using alternate technologies other than satellite medium, in a cost-effective manner. This has necessitated the need to look at the concept of ground-based channels, which can be transmitted using terrestrial communication mediums (other than satellite).

The broadcasters using satellite-based communication medium has been termed by TRAI as Satellite-based Broadcaster (SBB) and that using terrestrial communication medium has been termed as Ground-Based Broadcaster (GBB). GBBs can leverage advanced communication technologies to transmit and distribute content efficiently to DPOs.

This Standard defines type of interfaces requirements for the ground-based transmission of channels, using terrestrial communication mediums (other than satellite). It is also possible that ground-based channels may be carried on multiple DPO networks simultaneously like traditional television channels.

HISTORY SHEET

S. No	Date of issue	GR. No	Remarks
1.	Standard Number TEC 57130:2026	Standard for Generic Requirements for Terrestrial Transmission of Broadcasting Channels to DPOs ~~for Broadcasting Services~~	New Standard For GR

Contents

References

S. No.	Document No.	Description
1	Recommendations on Regulatory framework for Ground-based Broadcasters	Telecom Regulatory Authority of India

CHAPTER-1

1.1 Introduction

Television broadcasting in India began with experimental terrestrial services in 1959 and expanded to regular programming by 1965. The introduction of colour TV and nationwide coverage in 1982 marked a major turning point, enabling rapid sector growth. Over the decades, the rise of satellite and cable platforms reshaped the broadcasting landscape, making television a dominant mass medium. Today, Indian audiences access content through terrestrial, cable, DTH, IPTV, HITS, and increasingly OTT services, though cable and DTH remain the primary distribution modes.

Telecom Regulatory Authority of India (TRAI) has released its Recommendations on Regulatory framework for Ground-based Broadcasters in 15 January 2025. Prior to that TRAI issued a Consultation Paper on 'Regulatory framework for Ground-based Broadcasters' on 18th October 2024, seeking comments/counter comments from stakeholders. Technological advancements and availability of economical terrestrial transmission systems have made it possible that the broadcasters may like to choose to transmit their television channels for retransmission at the headend of the DPO using alternate technologies other than satellite medium, in a cost-effective manner. This has necessitated the need to look at the concept of ground-based channels, which can be transmitted using terrestrial communication mediums (other than satellite). It is also possible that ground-based channels may be carried on multiple DPO networks simultaneously like traditional television channels.

TRAI defined on Regulatory framework for Ground-based Broadcasters in 15 January 2025 that, "Broadcasting Network" means a system used for the transmission of programmes, and provision of broadcasting services. Similarly, "Ground-based Broadcasting" means providing programming services through terrestrial communication medium using ground infrastructure (other than satellite-based communication medium) for delivery of channels to the distributors of television channels and "Terrestrial Communication Medium" means a communication medium using ground infrastructure, which includes but not limited to wireline (e.g. cable/fibre, etc.)/wireless (e.g. cellular/microwave/Wi-Fi, etc.)/internet/cloud or any other equipment/system other than satellite medium.

Ground-based Broadcaster may use any terrestrial communication medium(s), for delivery of channels to the DPOs. There shall be no restriction on the use of terrestrial communication technologies/systems and the entity may use more than one such systems, as per its business decision.

1.2 Description of Terrestrial Communication Mediums and Architecture

1.2.1 Cable (Coaxial Cable):

Figure 1 below illustrates the method of transmission of Ground-Based Broadcasting over Co-axial Cable to DPOs. Coaxial cable is a traditional terrestrial medium widely used for last-mile distribution of broadcast signals. This can also be used by the Broadcasters to deliver channels to the DPOs. The Headend of the Broadcaster can deliver channels to DPOs using high-quality coaxial cables that can carry RF-modulated TV signals with low loss over moderate distances. It is robust, cost-effective, and compatible with existing MSO/LCO infrastructure. However, long-distance transport is limited due to signal attenuation and the need for amplifiers, making cable suitable mainly for local or in-building distribution.

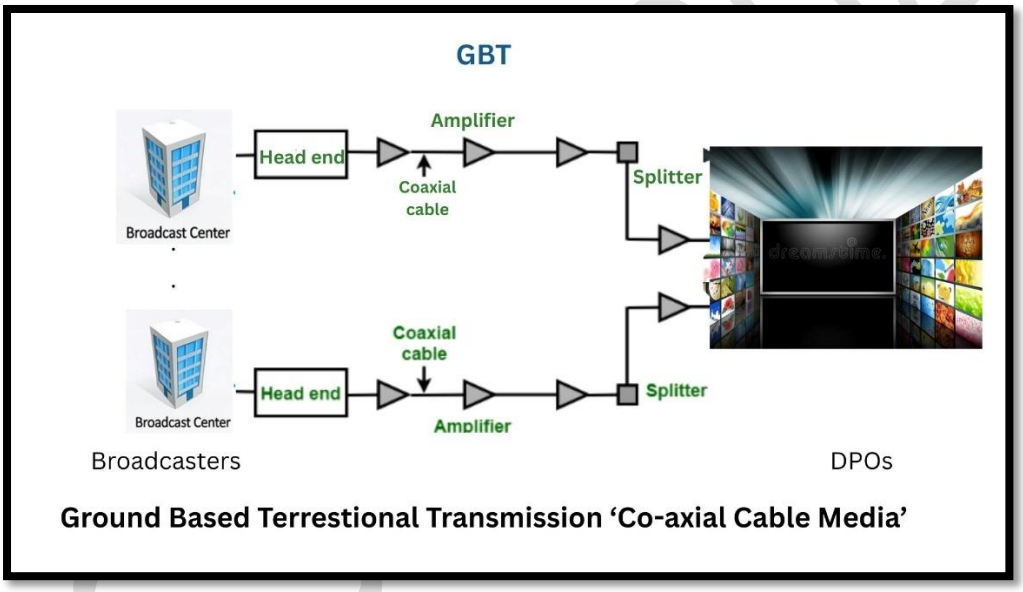

Figure 1: Transmission overview of Ground-Based Broadcasting over Co-axial Cable to DPOs

A. Physical Cable Interfaces

Common coaxial interfaces at broadcaster and DPO handover points:

- 75-ohm Coaxial Cable
- BNC / F-Type connectors
- RG-6 / RG-11 cables (depending on distance and loss requirements)

B. Cable Network Interfaces

1. RF Distribution over Coax
- Analog RF (legacy systems)
- Digital RF (QAM-based)
2. DOCSIS-Based Transport (where applicable)

- DOCSIS 3.0 / 3.1
- Hybrid Fiber Coaxial (HFC) architectures

C. Service-Level Cable Interfaces

- RF-modulated TV channels
- MPEG-TS over RF
- Limited IP carriage (control/monitoring)

(Primarily used for last-mile or local distribution.)

1.2.2 OFC (Optical Fiber Communication):

Figure 2 below illustrate the method of transmission of Ground-Based Broadcasting over Optical Fiber Communication (OFC System). Optical fiber is the most reliable medium for transporting broadcast content over long distances with minimal latency and virtually zero signal degradation. Broadcasters use optical networks to send high-bandwidth content (ASI, SDI, IP streams) to DPO headend using LC/SC/FC connectors. OFC supports huge data rates, immunity to electromagnetic interference, and scalability required for HD/4K/8K broadcasting. This is now the primary backbone medium for most broadcaster-to-DPO content delivery.

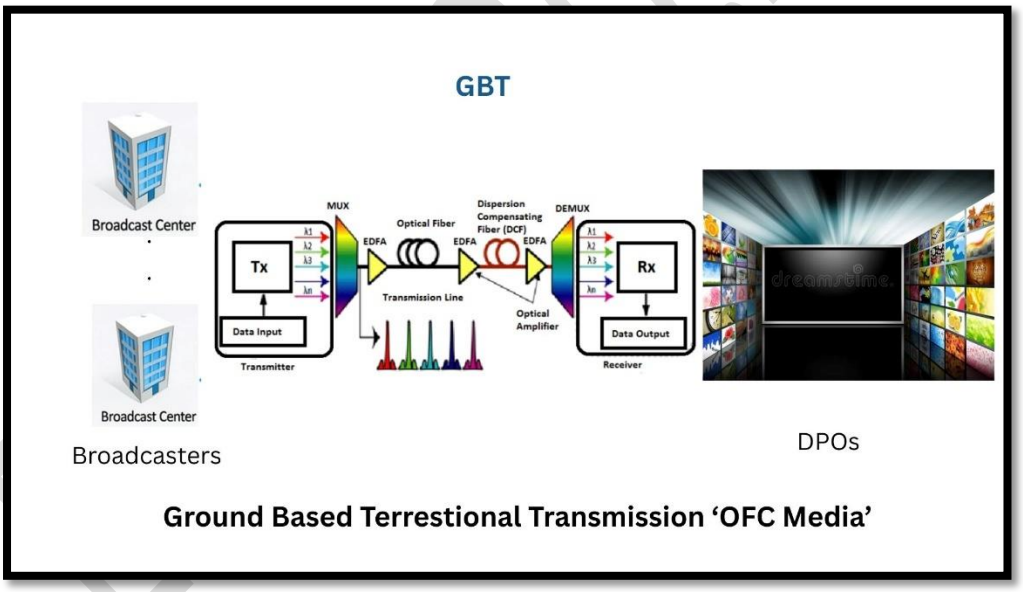

Figure 2: System Overview of Ground-Based Broadcasting (Optical Fiber Communication)

This architecture highlights how GBT leverages OFC media transport and MPLS routing to create a robust, end-to-end terrestrial broadcast delivery network. It eliminates dependence on satellite capacity, ensures low transmission delays, and provides a stable and scalable medium for distributing a large bouquet of television channels across regions.

These are the primary and most reliable interfaces used to bring content from studios/content providers to the DPOs station. Type of interfaces required at the various layers in the Optical systems as given below;

A. Physical Optical Interfaces

Common fiber connectors at connection points:

- LC / SC / FC optical connectors
- Single-Mode Fiber (SMF) – ITU-T G.652, G.655, G.657
- Multi-Mode Fiber (MMF) – ITU-T G.651 (less used for broadcasting due to distance limitation)

B. Optical Network Interfaces

1. Ethernet over Fiber

Used widely because encoders/IRDs are IP-ready.

- 1G Ethernet (IEEE 802.3z)
- 10G Ethernet (IEEE 802.3ae)
- 25G/40G Ethernet (for large contribution hubs)

2. SDH / PDH Interfaces (Traditional Telecom Contribution)

- STM-1 / STM-4 / STM-16
- E1 / DS3

3. Optical Transport Network (OTN)

For national broadcasters (DD, BBC, NHK):

- OTU1/OTU2 (10G/40G encapsulation)
- ITU-T G.709 OTN mapping

C. Service-Level Optical Interfaces

1. IP Connection Interfaces

Carrying:

- MPEG-TS over IP (RTP/UDP)
- SRT / RIST / Zixi (secure contribution)
- SMPTE ST-2110 (professional uncompressed audio/video)
- SMPTE ST-2022 (compressed / uncompressed video)

2. WDM Interfaces
CWDM/DWDM for multi-channel content from multiple providers

1.2.3 Microwave (Terrestrial Microwave Links):

Figure 3 below illustrate the method of transmission of Ground-Based Broadcasting (Microwave). Microwave communication is used when laying fiber is difficult—such as remote, rural, hilltop, or

temporary broadcast setups. Licensed microwave links (7–28 GHz) or ENG/OB links allow broadcasters to send MPEG-TS or IP streams wirelessly to a DPO or uplink location. These point-to-point links require line-of-sight but provide high capacity and quick deployment. They are especially useful for live events, OB vans, and disaster recovery connectivity.

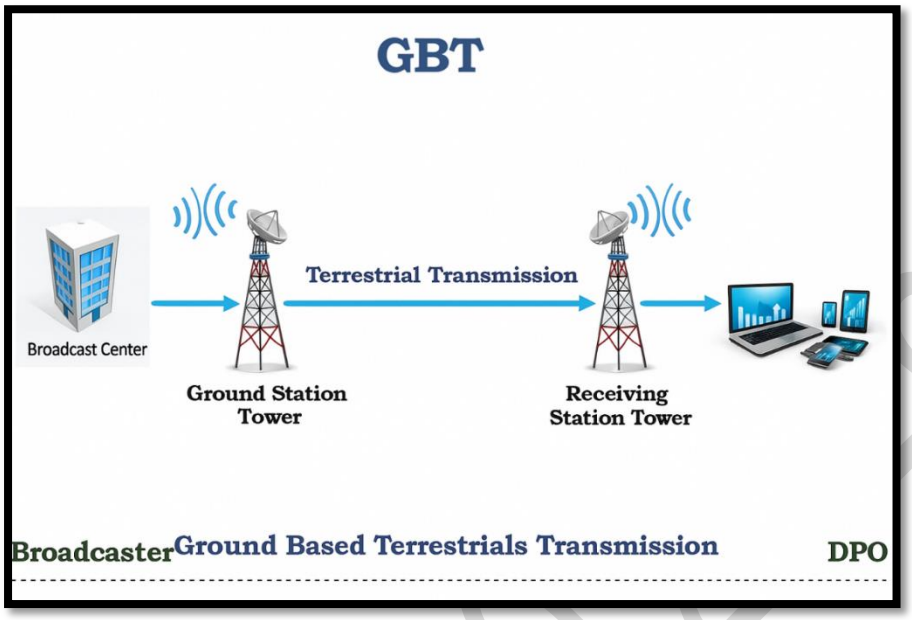

Figure 3: System Overview of Ground-Based Broadcasting (Microwave)

A. Physical Radio Interfaces

- Parabolic dish antennas
- Indoor Unit (IDU) / Outdoor Unit (ODU)
- Line-of-Sight (LoS) paths

B. Microwave Network Interfaces

Licensed microwave bands:

- 7, 13, 15, 18, 23, 26 / 28 GHz

Link types:

- Point-to-Point (P2P)
- Protected 1+1 or ring topology

C. Service-Level Microwave Interfaces

- ASI (MPEG-TS)
- IP (compressed video/audio)
- Baseband SDI (broadcast microwave)
- COFDM for ENG/SNG links

(Used where fiber is unavailable or as backup.)

1.2.4 Cellular (4G/5G Networks):

Figure 5 below illustrate the method of transmission of Ground-Based Broadcasting (Cellular Networks). Cellular networks, particularly 5G, provide high-bandwidth wireless connectivity for mobile newsgathering, temporary contribution links, and backup feeds. Broadcasters use bonded cellular systems (combining multiple SIMs) to transmit live video reliably from the field to the DPO network. While latency and network congestion can be challenges, 5G's ultra-low-latency and high throughput make it increasingly suitable for real-time content delivery and disaster-recovery connectivity.

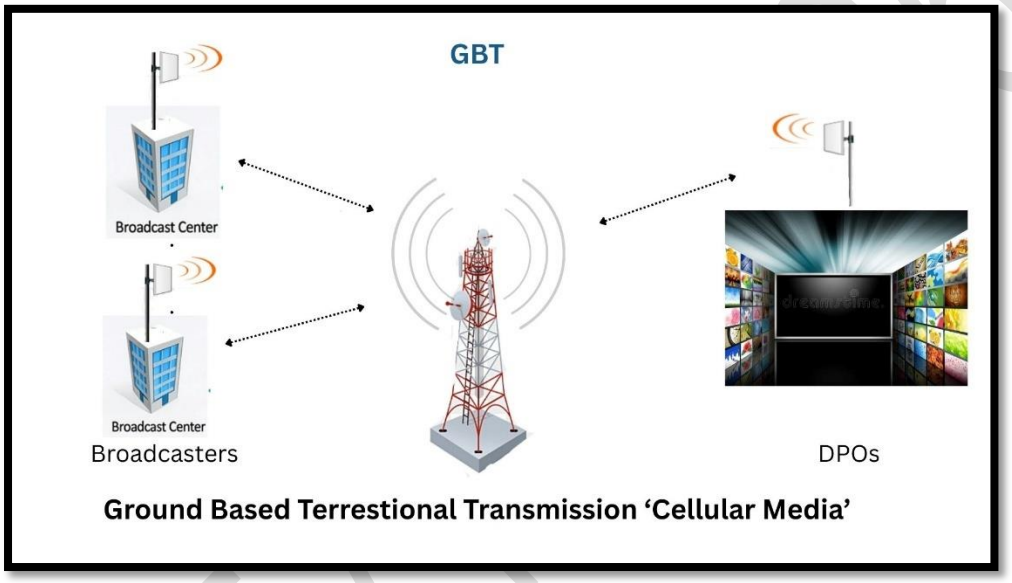

Figure 5: System Overview of Ground-Based Broadcasting (Cellular Networks)

Mobile Network Interfaces (4G/5G Contribution)

Increasingly used by field reporters, remote studios, live events.

A. Mobile Broadband Interfaces

4G LTE / LTE-Advanced (Carrier Aggregation)

- Upload 20–100 Mbps (bonded)
- Used for live video contribution

5G NR (Standalone & Non-Standalone)

- 5G Uplink: 100–1000 Mbps
- Ultra-low latency for live streaming

B. Mobile Contribution Equipment

1. Bonded Cellular Encoders (Multi-SIM)

Supports:

- SRT / RIST / RTMP / HLS
- MPEG-TS over IP

Providers like: LiveU, TVU, AVIWEST.

2. Direct Mobile Interface at Station

- 5G enterprise routers
- Private 5G networks (SA)
- Mobile IP gateways (4G/5G)

C. Physical Cellular Interfaces

- SIM / eSIM
- LTE / 5G modems
- External cellular antennas

D. Cellular Network Interfaces

1. 4G LTE / LTE-Advanced
- Carrier Aggregation
- Bonded uplinks (20–100 Mbps)
2. 5G NR (SA / NSA)
- Uplink 100–1000 Mbps
- Ultra-low latency

E. Service-Level Cellular Interfaces

- MPEG-TS over IP
- SRT / RIST
- Bonded cellular contribution
- Private 5G broadcast links

(Ideal for mobility, backup, and temporary links.)

1.2.5 Wi-Fi:

Figure 6 below illustrate the method of transmission of Ground-Based Broadcasting (WiFi). Wi-Fi is a short-range, high-bandwidth wireless medium used mainly within broadcast facilities or local setups. Broadcasters may use Wi-Fi for internal signal routing, wireless camera feeds, or temporary on-site transmission before uplinking or fiber handover to a DPO. While it's not used for long-distance transmission due to limited coverage and interference issues, it is convenient for indoor workflows or temporary studio arrangements.

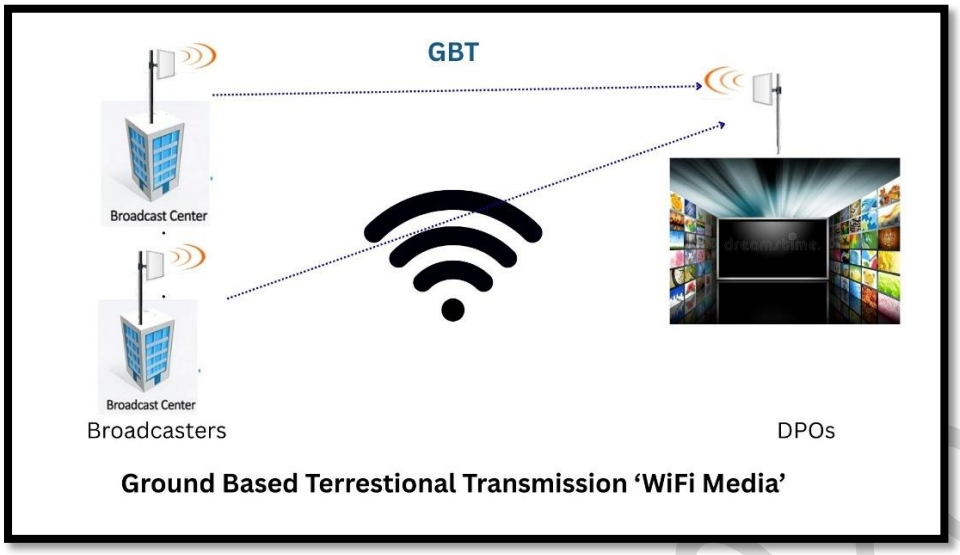

Figure 6: System Overview of Ground-Based Broadcasting (WiFi)

A. Physical Wi-Fi Interfaces

- Wi-Fi Access Points
- Client radios (CPE)
- Directional / sector antennas

B. Wi-Fi Network Interfaces

- IEEE 802.11ac (Wi-Fi 5)
- IEEE 802.11ax (Wi-Fi 6)
- Point-to-Point / Point-to-Multipoint

C. Service-Level Wi-Fi Interfaces

- IP video streams
- MPEG-TS over IP
- Monitoring and control traffic

(Used for short-range, campus, or temporary broadcast setups.)

1.2.6 Internet (IP Contribution/Distribution):

Figure 4 below illustrate the method of transmission of Ground-Based Broadcasting (Internet).The Internet enables broadcasters to deliver live or linear channels using IP-based contribution feeds. Protocols such as SRT, RIST, Zixi, or HLS/DASH allow secure, low-latency and reliable content delivery over public or private IP networks. This medium is cost-efficient and flexible, enabling easy remote distribution to multiple DPO sites. However, quality depends on the availability of stable, high-bandwidth internet at both ends.

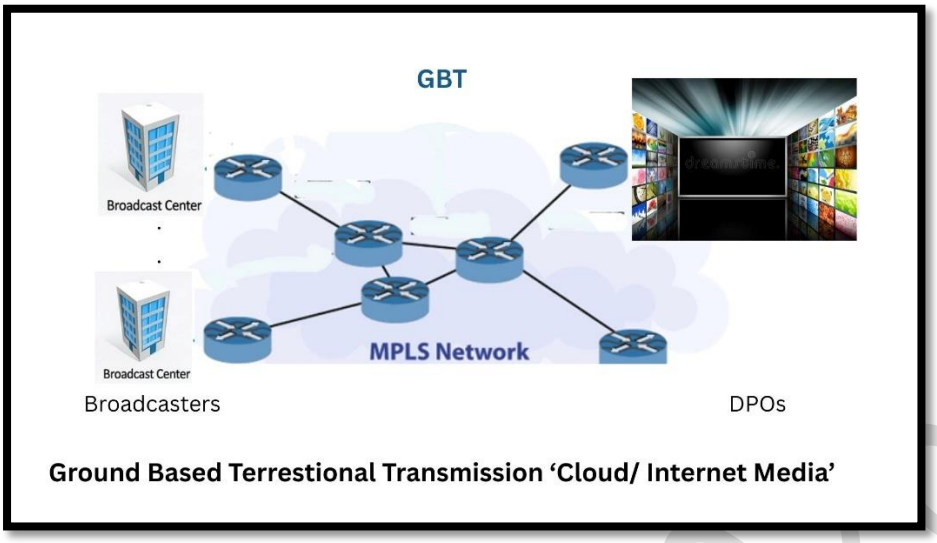

Figure 4: System Overview of Ground-Based Broadcasting (Internet)

A. Physical Access Interfaces

- Ethernet (RJ-45)
- Fiber last-mile
- ISP-provided broadband links

B. Internet Network Interfaces

- Public Internet
- Private IP/MPLS
- VPN / Secure tunnels

C. Service-Level Internet Interfaces

- SRT / RIST / Zixi
- RTMP / HLS / DASH
- MPEG-TS over IP
- Cloud playout pull feeds

(Cost-effective and flexible but QoS dependent.)

1.2.7 Cloud (Cloud-Based Content Delivery):

Figure 7 below illustrate the method of transmission of Ground-Based Broadcasting (Cloud). Cloud platforms allow broadcasters to host channels, transcoded streams, and playout systems in virtual infrastructure and deliver them to DPOs over secure IP links. Cloud distribution provides scalability, redundancy, and global reach without heavy physical infrastructure. DPOs can pull or receive channels from cloud-based playout, enabling flexible disaster recovery, multi-site distribution, and rapid deployment. This model is increasingly adopted due to its cost efficiency and operational agility.

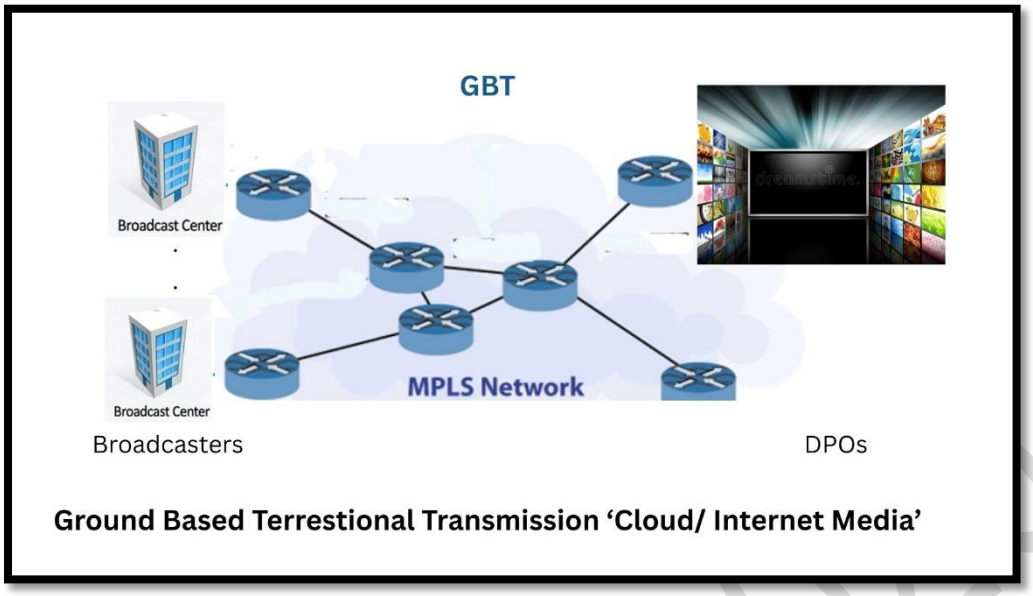

Figure 7: System Overview of Ground-Based Broadcasting (Cloud)

A. Cloud Access Interfaces

- Secure Internet or private fiber access
- VPN / Direct Connect

B. Cloud Network Interfaces

- Virtual private networks (VPC/VNet)
- CDN-based delivery
- Cloud interconnects

C. Service-Level Cloud Interfaces

- Virtual playout channels
- MPEG-TS / HLS / DASH
- SMPTE ST-2110 gateways
- Disaster recovery feeds

(Enables scalable, location-independent channel distribution.)

1.3 TEC Standard for products:

The interfaces with the use of specific technology are mentioned in the respective Standards issued by the TEC. Technology wise interfaces can be used for the provisioning of the Interfaces for terrestrial communication of Broadcasting channel ~~System~~ to DPOs.

Product Type Used	SL. No.	Technology	TEC GR Number

OFC	1.	Armoured Optical Fibre Cable for Direct Burial (U/G) (Amendment No. 1 dated 29.06.04)	TEC 85010:2003
	2.	Self Supporting Metal Free Aerial Optical Fibre Cable (For Hilly & Rural Area)	TEC 85020:2018
	3.	Non Zero Dispersion Shifted Single Mode Metal Free Optical Fibre Cable (G.655 C Fibre)	TEC 85050:2015
	4.	Self-Supporting Metal Free Aerial Optical Fibre Cable (For Urban areas)	TEC 85090:2018
	5.	Metal Free Optical Fibre Cable with Double HDPE Sheath for underground duct application (Type-I & Type-II)	TEC 85240:2023
	6.	OFC last mile connectivity	TEC 85200:2022
Microwave	1.	Local Multipoint Distribution system in 26 GHz Frequency band	TEC 36020:2016
	2.	Local Multipoint Distribution system in 28 GHz Frequency Band	TEC 36030:2016
	3.	Hybrid Microwave Radio Equipment (15, 18 and 23GHz)	TEC 36050:2022
	4.	Millimeter Wave (E-Band) Microwave Equipment	TEC 36060:2022
Cellular	1.	gNodeB	TEC 21060:2022
Wi-Fi	1.	Radio Modems in Unlicensed (2.4/5 GHz) Band	TEC 38050:2023
Cloud/ Internet	1.	Cloud Infrastructure	TEC 50000:2025

1.4 Standard for Interface:

Based on the used technology and required bandwidth, Telecom Service Providers (TSP) may provide one or more type of interface(s) following the Essential Requirements [ER No. TEC23732304] of TEC having characteristics as per the standard of the parameters as mentioned against respective parameter tabulated below:

S. No.	Type of interface	Parameter	Standard Name/ Value
1.	1 G Optical Ethernet	Average Launch power for 1 GE Opt	IEEE 802.3z Cl.38. Annex-H
		Receiver Sensitivity 1 GE Opt	IEEE 802.3z Cl.38. Annex-H
		Wavelength for 1 GE Opt	IEEE 802.3z Cl.38. Annex-H
2.	10/ 100/ 1000 BASE-T Ethernet	Link Speed and Auto-negotiation Test GE	IEEE 802.3. Annex-H
3.	10/100 BASE-T Ethernet	Link Speed and Auto-negotiation Test FE	IEEE 802.3 Annex-H
4.	10 BASE-T Ethernet	Link Speed	IEEE 802.3 Annex-H
5.	10 G Optical Ethernet	Receiver Sensitivity 10 GE Opt	IEEE 802.3ae Cl.52. Annex-H
		Wavelength for 10 GE Opt	IEEE 802.3ae Cl.52. Annex-H
		Average Launch power for 10 GE Opt	IEEE 802.3ae Cl.52. Annex-H
6.	100 G Optical Ethernet	Average Launch power for 100 GE Opt	IEEE 802.3ba Cl.86-88. Annex-H
		Receiver Sensitivity 100 GE Opt	IEEE 802.3ba Cl.86-88. Annex-H
		Wavelength for 100 GE Opt	IEEE 802.3ba Cl.86-88. Annex-H
7.	140 Mbps - E4	Input Jitter Tolerance for 140 Mbps Int	G.823. Annex-I
		Input Return Loss for 140 Mbps Int	G.703 ETSI TBR-4 Cl. 9.3.1. Annex-I
		Nominal Bit Rate with Tolerance 140 Mbps Int	ITU-T G.703 ETSI TBR-4 Cl. 9.2.3. Annex-I
		Output Jitter for 140 Mbps Int	G.823. Annex-I
		Pulse Mask for 140 Mbps Int	G.703 ETSI TBR-4 Cl. 9.2.1. Annex-I
8.	2 Mbps - E1	Input Jitter Tolerance for 2 Mbps Int	ITU-T G.823 / ETSI TBR-4. Annex-I
		Input Return Loss for 2 Mbps Int	ITU-T G.703 / ETSI TBR-4 Cl. 9.3.1. Annex-I
		Nominal Bit Rate with Tolerance for 2 Mbps Int	ITU-T G.703 / ETSI TBR-4 Cl. 9.2.3. Annex-I
		Output Jitter for 2 Mbps Int	ITU-T G.823 / ETSI

S. No.	Type of interface	Parameter	Standard Name/ Value
			TBR-4. Annex-I
		Pulse Mask for 2 Mbps Int	ITU-T G.703 / ETSI TBR-4 Cl. 9.2.1. Annex-I
9.	200 G Optical Ethernet	Average Launch Power for 200 GE Opt	IEEE 802.3cn Cl 121 Cl 122
10.	25 G Optical Ethernet	Average Launch Power for 25 GE Opt	IEEE 802.3 - 2018 Cl. 114
		Receiver Sensitivity for 25 GE Opt	IEEE 802.3 - 2018 Cl. 114
		Wavelength for 25 GE Opt	IEEE 802.3 - 2018 Cl. 114
11.	34 Mbps - E3	Input Jitter Tolerance for 34 Mbps Int	ITU-T G.823. Annex-I
		Input Return Loss for 34 Mbps Int	ITU-T G.703. Annex-I
		Nominal Bit Rate with Tolerance for 34 Mbps Int	ITU-T G.703 Annex-I
		Output Jitter for 34 Mbps Int	ITU-T G.823. Annex-I
		Pulse Mask for 34 Mbps Int	ITU-T G.703. Annex-I
12.	40 G Optical Ethernet	Average Launch power for 40 GE Opt	IEEE 802.3ba Cl. 86 87. Annex-H
		Receiver Sensitivity 40 GE Opt	IEEE 802.3ba Cl. 86 87. Annex-H
		Wavelength for 40 GE Opt	IEEE 802.3ba Cl. 86 87. Annex-H
13.	400 G Optical Ethernet	Average Launch Power for 400 GE Opt	IEEE 802.3cn Cl 122 Cl 124
		Receiver Sensitivity for 400 GE Opt	IEEE 802.3cn Cl 122 Cl 124
		Wavelength for 400 GE Opt	IEEE 802.3cn Cl 122 Cl 124
14.	45 Mbps	DC power	ITU-T G.703. Annex-I
		Input Jitter Tolerance for 45 Mbps Int	ITU-T G.824. Annex-I
		Nominal Bit Rate with Tolerance for 45 Mbps Int	ITU-T G.703 Annex-I
		Output Jitter for 45 Mbps Int	ITU-T G.824 Annex-I
		Pulse Mask for 45 Mbps Int	ITU-T G.703. Annex-I
15.	50G Ethernet Optical	Average Launch Power for 50 GE Opt	IEEE 802.3cn
		Receiver Sensitivity for 50 GE Opt	IEEE 802.3cn
		Wavelength for 50 GE Opt	IEEE 802.3cn
16.	8 Mbps - E2	Input Jitter Tolerance for 8 Mbps Int	ITU-T G.823. Annex-I
		Input Return Loss for 8 Mbps Int	ITU-T G.703. Annex-I
		Nominal Bit Rate with Tolerance for 8 Mbps Int	ITU-T G.703 Annex-I
		Output Jitter for 8 Mbps Int	ITU-T G.823. Annex-I
		Pulse Mask for 8 Mbps Int	ITU-T G.703. Annex-I
17.	Fast Ethernet Optical	Average Launch power for FE Opt	IEEE 802.3u. Annex-H
		Receiver Sensitivity for FE Opt	IEEE 802.3u. Annex-H
		Wavelength for FE Opt	IEEE 802.3u. Annex-H
18.	Gigabit Ethernet	Link Speed and Autonegotiation Test GE	IEEE 802.3. Annex-H

S. No.	Type of interface	Parameter	Standard Name/ Value
	Electrical		
18A	SDI (Video with Embedded Audio)	Parameter: SD-SDI Standard: SMPTE 259M (480i/576i) Parameter: HD-SDI Standard: SMPTE 292M, (720p/1080i) Parameter: 3G-SDI Standard: SMPTE 424M, (1080p60) Parameter: 12G-SDI Standard: SMPTE ST 2082, (4K60p and up to 8K.)	270 Mbps 1.485 Gbps Gbps 12 Gbps
19.	HDMI 2	Bandwidth HDMI 2	Up to 18 Gbps
		Multi-dimensional Immersive Audio Experience	Up to 32 Audio channels
		Video resolution HDMI 2	Up to 4K at the rate 50-60 (2160p)
20.	RF Video	RF Video Output Bandwidth	52 + 870 MHz. - 870 MHz. Annex-J2
		RF Video Output Level	BmV. Annex-J2
21.	RF Video (IN)	RF Input	IEC 60169-24 F-type female
22.	STM-1 Electrical	Input Jitter Tolerance STM-1 Electrical	ITU-T G.825. Annex-K
		Input Return Loss for STM-1 Electrical	ITU-T G.703. Annex-K
		Nominal Bit Rate with Tolerance STM-1 Electrical Int	ITU-T G.703. Annex-K
		Output Jitter for STM-1 Electrical Int	ITU-T G.825. Annex-K
		Pulse Mask for STM-1 Electrical Int	ITU-T G.703. Annex-K
23.	STM-1 Optical	Input Jitter Tolerance for STM-1 Opt	ITU-T G.825. Annex-K
		Mean Launched Power for STM-1 Opt Int	ITU-T G.957. Annex-K
		Nominal Bit Rate with Tolerance STM-1 Opt Int	ITU-T G.957. Annex-K
		Operating Wavelength Range for STM-1 Opt Int	ITU-T G.957. Annex-K
		Output Jitter for STM-1 Opt Int	ITU-T G.783 G.825 Annex-K
		Receiver Overload for STM-1 Opt Int	ITU-T G.957. Annex-K
		Receiver Sensitivity for STM-1 Opt Int	ITU-T G.957. Annex-K
24.	STM-16 Optical	Input Jitter Tolerance for STM-16 Opt	G.825. Annex-K
		Mean Launched Power for STM-16 Opt Int	ITU-T G.957. Annex-K
		Nominal Bit Rate with Tolerance STM-16 Opt Int	ITU-T G.957. Annex-K
		Operating Wavelength Range for STM-16 Opt Int	ITU-T G.957. Annex-K
		Output Jitter for STM-16 Opt Int	ITU-T G.783. Annex-K
		Receiver Overload for STM-16 Opt Int	ITU-T G.957. Annex-K

S. No.	Type of interface	Parameter	Standard Name/ Value
		Receiver Sensitivity for STM-16 Opt Int	ITU-T G.957. Annex-K
25.	STM-256 Optical	Input Jitter Tolerance for STM-256 Opt	ITU-T G.825. Annex-K
		Mean Launched Power for STM-256 Opt Int	ITU-T G.693. Annex-K
		Nominal Bit Rate with Tolerance STM-256 Opt Int	ITU-T G.693 Annex-K
		Operating Wavelength Range for STM-256 Opt Int	ITU-T G.693. Annex-K
		Output Jitter for STM-256 Opt Int	ITU-T G.783. Annex-K
		Receiver Overload for STM-256 Opt Int	ITU-T G.693. Annex-K
		Receiver Sensitivity for STM-256 Opt Int	ITU-T G.693. Annex-K
26.	STM-4 Optical	Input Jitter Tolerance for STM-4 Opt	ITU-T G.825. Annex-K
		Mean Launched Power for STM-4 Opt Int	ITU-T G.957. Annex-K
		Nominal Bit Rate with Tolerance STM-4 Opt Int	ITU-T G.957 Annex-K
		Operating Wavelength Range for STM-4 Opt Int	ITU-T G.957. Annex-K
		Output Jitter for STM-4 Opt Int	ITU-T G.783. Annex-K
		Receiver Overload for STM-4 Opt Int	ITU-T G.957. Annex-K
		Receiver Sensitivity for STM-4 Opt Int	ITU-T G.957. Annex-K
27.	STM-64 Optical	Input Jitter Tolerance for STM-64 Opt	ITU-T G.825. Annex-K
		Mean Launched Power for STM-64 Opt Int	ITU-T G.691. Annex-K
		Nominal Bit Rate with Tolerance STM-64 Opt Int	ITU-T G.707 Annex-K
		Operating Wavelength Range for STM-64 Opt Int	ITU-T G.691. Annex-K
		Output Jitter for STM-64 Opt Int	ITU-T G.783. Annex-K
		Receiver Overload for STM-64 Opt Int	ITU-T G.691. Annex-K
		Receiver Sensitivity for STM-64 Opt Int	ITU-T G.691. Annex-K
28.	WiFi	2.4 GHz WiFi Radio Conformance	ETSI EN 300 328 or FCC CFR47 pt 15.247 or FCC CFR47 pt 15.249. Annex-G3
		5 GHz WiFi Radio Conformance	ETSI EN 301 893 and or ETSI EN 302 502 or FCC CFR47 pt 15.407 or FCC CFR47 pt 15.249. Annex-G3
		EIRP for WiFi Interface	Latest NFAP and GSRs issued by DoT WPC. Annex-G2
		Frequency for WiFi equipment	DoT WPC GSR No. 45(E) 1048(E). Annex-

S. No.	Type of interface	Parameter	Standard Name/ Value
			G1

1.5 Interfaces for Monitoring and Control (NMS)

a) **Ethernet (1G/10G)** – SNMP, HTTP, SSH for equipment control

b) **RS-232 / RS-485** – Legacy transmitter control

c) **GPI/GPO** – Alarm & switching interfaces

d) **SNMP v2/v3** – Network management (mandatory in modern systems)

e) **NTP/PTP (IEEE-1588)** – Time synchronization

1.6 Interfaces for Content Processing & Playout

a) **MPEG-TS over IP (SMPTE 2022-2/7)** – Contribution & redundancy

b) **OTT formats (HLS, DASH)** – For hybrid broadcast-broadband (HbbTV support)

c) **MAM/CMS API Interfaces** – REST/JSON or SOAP

1.7 **Quality Requirements**

The manufacturer shall furnish the MTBF value. MTBF should meet the values specified in GR. The equipment shall be manufactured in accordance with international quality management system ISO 9001:2015 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system, followed by the manufacturer, would be required to be submitted.

1.8 Environmental Requirements

The equipment shall conform to the requirements for Environment specified in TEC QA standards TEC 14016:2010 {QM-333, Issue- March, 2010} "Standard for Environmental testing of Telecommunication Equipment" or any other equivalent international standard, for operation, transportation and storage. The applicable tests shall be for environmental category "A" and category "B2" including vibration and corrosion (salt mist).

1.9 EMI/EMC Requirements

The equipment shall conform to Electromagnetic Compatibility (EMC) requirements to ensure it does not emit or suffer from unacceptable electromagnetic interference. A test certificate and report from an NABL/ TEC accredited laboratory shall be provided. The following EMC test results shall be furnished:

S. No.	Parameter	Latest Version of Applicable Standard	Test Level/ Requirement
1.	Radiated Emission Test – Broadcasting Equipment	CISPR 32:2015	
2.	Conducted Emission Test	CISPR 32:2015	
3.	Electrostatic Discharge (ESD) Immunity	IEC 61000- 4-2:2025	Contact discharge - Level 2 {± 4 kV}, or higher voltage; Performance Criteria B Air discharge - Level 3 {± 8 kV} or higher voltage; Performance Criteria B
4.	Electrostatic Fast Transient / Burst Immunity	IEC 61000- 4-4:2012	1 kV (AC/DC power lines), 0.5 kV (signal/control/data lines)
5.	Surge Immunity Test (Power Port)	IEC 61000- 4-5:2014	2kV (line to ground – power port) 1kV (line to line – power port)
6.	Radiated RF Electromagnetic Field Immunity	IEC 61000- 4-3:2020	3 V/m (80 MHz–1 GHz); 10 V/m (800–960 MHz & 1.4–6.0 GHz)
7.	RF Conducted Immunity (Signal/Power Ports)	IEC 61000- 4-6:2023	3 V (150 kHz–80 MHz)
8.	Immunity to Voltage Dips and Short Interruptions (AC Mains)	IEC 61000- 4-11:2020	30% for 500ms, 60% for 200ms, 100% for 5s/5000ms depending on class
9.	Immunity to Voltage Interruptions (DC Supply)	IEC 61000- 4-29:2025	Immunity to voltage dips & short interruption: Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. Voltage dip corresponding to 40% & 70% of supply for 100ms, 300ms and 1000 ms.

1.10Safety Requirements

In order to provide safeguard to users'/service persons from risk of injury or damage, the radio transmitting equipment shall conform to Safety Requirement mentioned in IS 10437: 2019/ IEC 60215: 2016 9 or the latest). The audio and other equipment shall conform to IS/IEC 62368-1:2018 (or the latest). The Audio/Video, Information and Communication Technology Equipment shall conform to IS/IEC 62368-1:2018 (or the latest).

1.11 Security Requirements

There should be password protection for accessing the configuration ports by Bluetooth pairing authentication or logging and access control for digital interfaces.

1.12.1 Access to management system shall be protected with multi-level passwords.

1.12.2 Management system shall have a Login Protection Security on all the System Access Ports.

1.12.3 Tracking of old passwords per account for preventing the user to enter same password twice.

1.12.4 All interfaces on the provisioning side shall be secured.

1.12.5 Security control standard ISO/IEC 27001 should be included as it is international standard for information security management system.

1.12.6 Rules under DPDP-Act (Digital Personal Data Protection) shall be applicable to LPFM Transmitter.

CHAPTER-2

2.1 Information for the procurer of product

Purchaser may decide upon features/components most suitable and appropriate for him wherever there are options to choose from, and mention the same while purchasing.

ABBREVIATIONS

Abbreviation	Full Form
AAC	Advanced Audio Coding
AES	Audio Engineering Society
AES/EBU (AES3)	Audio Engineering Society / European Broadcasting Union Digital Audio Interface
AES10 (MADI)	Multichannel Audio Digital Interface
AES67	AES Standard for Audio-over-IP Interoperability
AM	Amplitude Modulation
AMSS	AM Signalling System
ASI	Asynchronous Serial Interface
ATSC	Advanced Television Systems Committee
BER	Bit Error Rate
CA	Conditional Access
CCTV	Closed-Circuit Television
CMS	Content Management System
COFDM	Coded Orthogonal Frequency-Division Multiplexing
DAB	Digital Audio Broadcasting
DAB+	Digital Audio Broadcasting Plus
DD	Doordarshan
DPO	Distribution Platform Operator
DRM	Digital Radio Mondiale
DTH	Direct-to-Home
DTT	Digital Terrestrial Television
E1	E1 Telecom Interface (2.048 Mbps)
ECM	Entitlement Control Message
EDI	ETI-over-IP Interface for DAB/DAB+
EMM	Entitlement Management Message
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EMC	Electromagnetic Compatibility
EWF	Emergency Warning Functionality
EWS	Emergency Warning System
ETI	Ensemble Transport Interface
FTP	File Transfer Protocol
FEC	Forward Error Correction

FM	Frequency Modulation
GB	Gigabyte (implied)
GBB	Ground-Based Broadcaster
GBT	Ground-Based Terrestrial (Transmission)
GHz	Gigahertz
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HD	High Definition
HDMI	High-Definition Multimedia Interface
HD-SDI	High-Definition Serial Digital Interface
HLS	HTTP Live Streaming
HITS	Headend-in-the-Sky
HTTP/HTTPS	Hypertext Transfer Protocol / Secure HTTP
IEC	International Electrotechnical Commission
IP	Internet Protocol
IPTV	Internet Protocol Television
IP-TS	MPEG Transport Stream over IP
ISDB-T	Integrated Services Digital Broadcasting — Terrestrial
ITU-R	International Telecommunication Union – Radiocommunication
ITU-T	International Telecommunication Union – Telecommunication Standardization
MADI	Multichannel Audio Digital Interface
MAM	Media Asset Management
MER	Modulation Error Ratio
MIB	Ministry of Information and Broadcasting
MIMO	Multiple-Input Multiple-Output (if referenced)
MIM	Media Input Module (context-based)
MPLS	Multi-Protocol Label Switching
MPEG-TS	Moving Picture Experts Group – Transport Stream
MSO	Multi-System Operator
MTCTE	Mandatory Testing & Certification of Telecom Equipment
NFS	Network File System
NMS	Network Management System
NOC	Network Operations Centre
NTP	Network Time Protocol
OFC	Optical Fibre Communication
OFDM	Orthogonal Frequency-Division Multiplexing
OTN	Optical Transport Network
OTU	Optical Transport Unit
OTT	Over-the-Top (Streaming Services)
PDH	Plesiochronous Digital Hierarchy
PES	Packetized Elementary Stream
PIP	Picture-in-Picture (if referenced)
PPS	Pulse Per Second
PTP	Precision Time Protocol (IEEE-1588)
QoS	Quality of Service
REST	Representational State Transfer
RDS	Radio Data System

RIST	Reliable Internet Stream Transport
RTECs	Regional Telecom Engineering Centres
RTP	Real-time Transport Protocol
RTMP	Real Time Messaging Protocol
RTSP	Real Time Streaming Protocol
RS-232	Serial Communication Standard
RS-485	Differential Serial Communication Standard
SD	Standard Definition
SDH	Synchronous Digital Hierarchy
SDI	Serial Digital Interface
SFN	Single Frequency Network
SFTP	SSH File Transfer Protocol
SIP	Session Initiation Protocol
SMPTE	Society of Motion Picture and Television Engineers
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SRT	Secure Reliable Transport
STM	Synchronous Transport Module
STB	Set-Top Box
TCP	Transmission Control Protocol
TEC	Telecommunication Engineering Centre
TS	Transport Stream
TV	Television
UDP	User Datagram Protocol
USB	Universal Serial Bus
UHF	Ultra High Frequency
VHF	Very High Frequency
VGA	Video Graphics Array
WDM	Wavelength Division Multiplexing
XML	Extensible Markup Language
xHE-AAC	Extended High Efficiency AAC

Template for submitting Comments or Feedback

[Comments on each section/sub section/table/figure etc. be stated in a fresh row. Information/comments should include reasons for comments and suggestions for

modified wordings of the clause]

Name of Commenter/Organisation:……..

S. No.	Section of the Draft Standard	Clause/Para/Table/ Figure No. of draft Standard	Comments/ Suggested Modified Wordings	Justification for proposed Change
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