

TECHNICAL REPORT



**Cable networks for television signals, sound signals and interactive services –
Part 201: A study of IPTV systems with examples and applications for optical
broadcast services**

Document Preview

[IEC TR 60728-201:2024](https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024)

<https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024>





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

International Standards
standards.iteh.ai
Document Preview

[IEC TR 60728-201:2024](https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024)

<https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024>

TECHNICAL REPORT



**Cable networks for television signals, sound signals and interactive services –
Part 201: A study of IPTV systems with examples and applications for optical
broadcast services**

Document Preview

[IEC TR 60728-201:2024](https://standards.iteh.ai/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024)

<https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.160.01; 33.160.99; 33.180.10

ISBN 978-2-8322-8167-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
3.1 Terms and definitions.....	8
3.2 Abbreviated terms.....	10
4 Toward IPTV services.....	11
4.1 Service scenario	11
4.1.1 General	11
4.1.2 IP unicast distribution technology	12
4.1.3 IP multicast distribution technology.....	12
4.1.4 Migration to ALL IP FTTH NETWORK.....	13
4.1.5 Step 1.....	13
4.1.6 Step 2.....	14
4.2 Quality assurance	14
4.2.1 General	14
4.2.2 Carrier's network quality assurance	15
4.2.3 Customer premises' network quality assurance.....	16
4.2.4 QoE for Progressive Download and DASH.....	17
5 Technologies for supporting service	17
5.1 IPTV Protocols.....	17
5.1.1 Classification based on video streaming system configuration	17
5.1.2 First-mile streaming protocol	18
5.1.3 Last-mile streaming protocol.....	19
5.2 ABR and M-ABR	20
5.2.1 ABR (adaptive bit rate)	20
5.2.2 M-ABR (multicast adaptive bit rate)	21
5.3 MPEG-DASH	22
5.4 DRM and CENC.....	23
5.4.1 DRM	23
5.4.2 CENC	24
5.4.3 Watermark.....	26
5.5 Virtualization.....	26
5.5.1 vCPE (virtual customer premises equipment).....	26
5.5.2 Next generation STB (trend in the Japan cable industry)	27
5.5.3 Virtual STB (cloud supported CPE).....	27
5.5.4 Network virtualization technology and vCPE	28
5.6 Proof of concept experiments of video broadcasting through IP streaming	29
5.6.1 Verification experiments on IP streaming of 4K broadcast.....	29
5.6.2 Advanced broadcasting system using broadband (M-ABR validation)	29
5.6.3 Low latency streaming technology for live streaming (CMAF validation).....	30
6 Migration to IP over FTTH	31
6.1 General.....	31
6.2 Grand Design toward All IP services	32
6.3 HFC (hybrid fibre coaxial) system	32
6.4 Strategies to All IP from HFCs	33

6.5	Completion of All IP Migration from HFC around 2025	34
6.6	FTTH (up to 10G) system configuration.....	34
6.7	FTTH (up to 100G) system configuration.....	35
6.8	Migration strategies to all IP from FTTH.....	36
6.9	Completion of All IP migration from FTTH around 2030.....	37
Annex A (informative) ATSC 3.0 Broadcast System		38
A.1	General.....	38
A.2	Overview of the ATSC 3.0 system.....	38
A.3	System specification	38
A.3.1	General	38
A.3.2	Description of the ATSC 3.0 standard	39
A.3.3	Emergency messaging.....	42
A.3.4	Accessibility.....	42
A.3.5	Personalization.....	43
A.4	Receiver protocol stack.....	43
A.5	Convergence of broadcast and broadband services	43
Annex B (informative) NHK Plus: Simultaneous streaming of broadcast signal through internet.....		45
B.1	General.....	45
B.2	Overview of system specification	45
B.3	On-demand service.....	45
B.4	Video Masking	46
B.5	Overview of streaming technology.....	46
B.6	Overview of streaming facility	47
B.7	Overview of streaming platform.....	48
Annex C (informative) Cable 4K IP.....		50
C.1	General.....	50
C.2	Abstract of service	50
C.2.1	General	50
C.2.2	Number of subscribers.....	50
C.3	Concept of Cable 4K IP platform	50
C.4	IP distribution.....	51
Annex D (informative) Optical TV.....		52
D.1	General.....	52
D.1.1	Overview	52
D.1.2	Services	52
D.1.3	Subscribers	52
D.1.4	Technical features	52
D.1.5	An example of Specification.....	52
D.2	Requirements	52
D.2.1	Service requirements.....	52
D.2.2	IPTV system model.....	53
D.3	Customer premises' network	54
D.3.1	Equipment logical connection	54
Annex E (informative) DVB-I		55
E.1	General.....	55
E.2	DVB-I components and interfaces	55
E.3	Conceptual model of a DVB-I client.....	56

E.4	Service discovery.....	57
E.5	Content guide metadata.....	58
Annex F (informative)	SAT>IP.....	59
F.1	General.....	59
F.2	Network topology.....	59
F.3	IP adapter/IP multiswitch.....	60
F.4	IP-based SMATV/multi-dwelling units.....	60
F.5	Protocol specification.....	61
	Bibliography.....	63
	Figure 1 – IP unicast distribution.....	12
	Figure 2 – IP multicast distribution.....	12
	Figure 3 – Step 0.....	13
	Figure 4 – Step 1.....	14
	Figure 5 – Step 2.....	14
	Figure 6 – Carrier's network and home network.....	15
	Figure 7 – Applicable point to assure carrier's network quality.....	16
	Figure 8 – Applicable point to assure customer premises' network quality.....	16
	Figure 9 – Example of a video streaming system configuration.....	18
	Figure 10 – Different kinds of streaming solutions.....	19
	Figure 11 – Latency associated with the protocols.....	19
	Figure 12 – Sharing multiple protocols using CMAF.....	20
	Figure 13 – Aspect of Just-in time ABR.....	21
	Figure 14 – Aspect of M-ABR.....	22
	Figure 15 – Architecture of MPEG-DASH.....	23
	Figure 16 – Construction of MPD.....	23
	Figure 17 – DRM processing.....	24
	Figure 18 – Content encryption by DRM.....	25
	Figure 19 – Aspect of ISO BMFF and CENC.....	25
	Figure 20 – An attack detection system by WM.....	26
	Figure 21 – Concept of virtual CPE.....	27
	Figure 22 – Concept of virtual STB.....	28
	Figure 23 – VoD streaming (vSTB).....	28
	Figure 24 – Cloud storage (vNAS).....	29
	Figure 25 – Experimental setup used for IP streaming of 4K broadcast.....	29
	Figure 26 – Experimental setup for advanced broadcasting system using broadband (M-ABR validation).....	30
	Figure 27 – Verification experiments on low latency live streaming (CMAF verification).....	30
	Figure 28 – Types of IPTV.....	31
	Figure 29 – HFC system topology.....	32
	Figure 30 – HFC system topology 2.....	33
	Figure 31 – HFC system topology 3.....	33
	Figure 32 – Migration strategies to All IP from HFC system.....	34
	Figure 33 – Completion of All IP migration from HFC around 2025.....	34
	Figure 34 – FTTH system topology 1 (EPON system).....	35

Figure 35 – FTTH system topology 2 (EPON system).....	35
Figure 36 – 100G-EPON system configuration	36
Figure 37 – NG-PON2 system configuration.....	36
Figure 38 – Migration strategies to All IP from FTTH system.....	37
Figure 39 – Completion of All IP Migration from FTTH around 2030.....	37
Figure A.1 – Layered architecture used in ATSC 3.0 system.....	38
Figure A.2 – ATSC 3.0 standards set and structure.....	39
Figure A.3 – General physical layer frame structure.....	40
Figure A.4 – Audio watermark system architecture.....	40
Figure A.5 – An example of watermarked video frame.....	41
Figure A.6 – Example of AEA signal flow	42
Figure A.7 – ATSC 3.0 receiver protocol stack model	43
Figure A.8 – ATSC 3.0 Hybrid Delivery Architecture.....	44
Figure B.1 – Overview of on-demand service	46
Figure B.2 – Video masking to block the uncopyrighted contents	46
Figure B.3 – Technologies used for adaptive streaming	47
Figure B.4 – System configuration used for the NHK plus streaming service.....	48
Figure B.5 – Streaming platform used for the streaming service.....	49
Figure C.1 – Concept of Cable 4K IP	50
Figure D.1 – IPTV service chain.....	53
Figure D.2 – IPTV system model.....	54
Figure D.3 – Equipment logical connection in customer premises	54
Figure E.1 – Simplified example DVB-I components and interfaces.....	56
Figure E.2 – Conceptual model of a DVB-I client.....	57
Figure E.3 – Relationships between service list entry point, service list, service and LCN table	58
Figure F.1 – SAT>IP protocol between server and client.....	59
Figure F.2 – SAT>IP Network Topology	60
Figure F.3 – IP Adapter / Multiswitch and In-Home Digital Network	60
Figure F.4 – An example of IP based SMATV by SAT>IP.....	61
Figure F.5 – SAT>IP Protocol Stack.....	61
Figure F.6 – SAT>IP protocol containing UPnP protocol stack	62
Table 1 – Average throughput.....	17
Table 2 – Protocols supporting low latency	18
Table 3 – Expected transmission capacity to serve video service over ALL IP network	31
Table 4 – Grand design toward all IP services	32
Table 5 – Wavelength and maximum speed of PON system.....	35
Table A.1 – PHY layer parameters	39
Table B.1 – NHK Plus specification overview	45
Table B.2 – NHK Plus system overview	48
Table C.1 – Abstract characteristics of Cable 4K IP platform.....	51
Table D.1 – Specification of Optical TV (example)	52

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –**

**Part 201: A study of IPTV systems with examples and applications for
optical broadcast services**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TR 60728-201 has been prepared by technical area 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
100/4073/DTR	100/4103/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60728 series, published under the general title *Cable networks for television signals, sound signals and interactive services*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ITeH Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC TR 60728-201:2024](https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024)

<https://standards.iteh.ai/catalog/standards/iec/de9d1c05-c323-424c-88a6-1c6355a17491/iec-tr-60728-201-2024>

CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

Part 201: A study of IPTV systems with examples and applications for optical broadcast services

1 Scope

This part of IEC 60728 describes the technical background of IPTV systems and commercially available products related to audio, video and multimedia systems and equipment to enable cable operators and customers to understand current IPTV systems that include application, middleware, network, equipment and terminal devices. This document is to encourage all TA5 experts to develop new IS related to IPTV system over optical broadcast network. This Technical Report examines the mechanisms of IPTV systems developed by major standards development organizations (SDOs) and known national regulations. This document concludes with observations and recommendations for the potential future technical standards development activities especially for TA5 under the scope of TC 100.

The purpose of this TR is to give cable operators an appropriate way how to adopt IPTV services with current FTTH system recognizing that optical system is the best solution for the effective transmission of 4K and 8K video signals. This TR gives an overall but essential information on current IPTV systems to cable operators; however, too much detailed information is omitted due to the limitation of document size. The author of this document recommends the cable operator who plans to develop IPTV services to study the original international standards shown in this document. It also describes a migration from the HFC to FTTH system for effective introduction to IPTV services.

DOCSIS 4.0 can be considered on HFC as an alternative way to provide 10Gbps service. If bandwidth and other constraints (without Amp, etc.) are cleared, the IPTV service described in this document can of course be provided.

In addition to present international standards and recommendations, this document describes some major technology supporting IPTV services such as unicast, multicast, ABR (Adapting Bit Rate) and MPEG-DASH. The experiment of 4K and 8K video transmission over IP, virtual STB are also described.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

**3.1.1
multicast**

transmission of the same message to a group of receivers, identified by their group address

Note 1 to entry: The term "multicast" is used even if the group includes all receivers.

[SOURCE: IEC 61375-1:2012, 3.1.34]

**3.1.2
unicast**

transmission of message to a receiver

Note 1 to entry: The term "unicast" is used in IPTV like broadcast

**3.1.3
forward error correction
FEC**

addition of redundant information (parity bits) to the data at the transmitter side so that the receiver side then uses the redundant information to detect and correct errors

**3.1.4
adaptive bit rate
ABR**

technology that automatically switches the bit rate value according to the communication quality and device resolution in streaming distribution using the Internet

**3.1.5
error correction**

error control with a view to correcting some types of messages recognized as erroneous

Note 1 to entry: Error correction makes use of either an error correcting code or an error detecting code or a loop checking with, in the last two cases, automatic repetition of the signals recognized as being erroneous.

[SOURCE: IEC 60050-702:2017, 702-07-42]

**3.1.6
api
API**

specification or interface to use OS functions from a software application's program interface

**3.1.7
bit error ratio
BER**

error ratio for a binary signal

[SOURCE: IEC 60050-704:1993, 704-18-04]

**3.1.8
service provider
SP**

organization that provides services to users and other providers

Note 1 to entry: The services may be, for instance, those of an Internet access provider, of a content provider or information provider, of a forum server, or of a server of a private message handling system, or content hosting.

**3.1.9
cloud service**

one or more capabilities offered via cloud computing invoked using a defined interface

[SOURCE: ISO/IEC 20924:2021, 3.1.8]

3.1.10

application

software designed to fulfil a particular purpose

[SOURCE: ISO/IEC 20924:2021, 3.1.2]

3.1.11

optical fibre

waveguide shaped as a filament, made of dielectric materials for guiding optical waves

[SOURCE: IEC 60050-151:2019, 151-12-35]

3.1.12

quality of service

collective effect of service performances which determine the degree of satisfaction of a user of the service

Note 1 to entry: These characteristic performances can, for example, relate to: transmission quality, dial-tone delay, failures, fault frequency and duration.

[SOURCE: IEC 60050-715:1996, 715-07-14]

3.1.13

media presentation description

MPD

provides sufficient information for a DASH client for adaptive streaming of the content by downloading the media segments from a HTTP server

Note 1 to entry: Content described in layer basis in MPD.

3.1.14

digital rights management

DRM

generic term to protect content right of digital data by controlling and limiting its usage or copying

Note 1 to entry: A watermark is a kind of DRM in a broad sense.

3.1.15

content delivery network

CDN

network for delivering web content efficiently over internet

3.1.16

watermark

WM

embedding technology of related information into video or audio data that cannot be detected by humans

Note 1 to entry: Embedded information can be detected by exclusive software.

3.2 Abbreviated terms

ABR	adaptive bit rate	AEA	advanced emergency information
AES	advanced encryption standard	API	application programming interface
ARQ	automatic repeat request	BMFF	baseline media file format
BNG	broadband network gateway	CENC	common encryption scheme
CAS	conditional access system	CDN	content distribution network
CM	cable modem	CMAF	common media application format

CMTS	cable modem termination system	CTE	chunked transfer encoding
CP	content provider	DHCP	dynamic host configuration protocol
DOCSIS	data over cable service interface specification	DRM	digital rights management
DVR	digital video recorder	eMTA	embedded media terminal adapter
FEC	forward error correction	HDTV	high-definition television
HD	high definition	HFC	hybrid fibre coaxial
HTML	hypertext mark-up language	HTTP	hypertext transfer protocol
IGMP	Internet group management protocol	IP	internet protocol
IPER	IP packet error ratio	IPDV	IP packet delay variation
IPLR	IP packet loss ratio	IPTD	IP packet transfer delay
IPv4	internet protocol version 4	IPv6	internet protocol version 6
ITU-T	international telecommunication union – telecommunication sector	KID	key identifier
LAN	local area network	LLID	local link identifier
M-ABR	multicast adaptive bitrate	MLD	multicast listener discovery
MPD	media presentation description	NAT	network address translation
OLU	optical line unit	ONU	optical network unit
PON	passive optical network	QoE	quality of experience
QoS	quality of service	RIST	reliable internet Stream transport
RTMP	real-time messaging protocol	RTP	real-time transport protocol
RTSP	real-time streaming protocol	SI	service information
SMS	subscriber management system	SP	service provider
SRT	secure reliable transport	STB	set-top box
TCP	transmission control protocol	TD	terminal device
TS	transport stream	TTML	timed text mark-up language
TTS	time stamped TS	UDP	user datagram protocol
UHD	ultra-high definition	vCPE	virtual customer premises equipment
vNAS	virtual network attached server	VoD	video on demand
WM	watermark	web VTT	web video text track
webRTC	web real-time communication	Zixi ¹ (SDVP)	Zixi (software- defined video platform)

4 Toward IPTV services

4.1 Service scenario

4.1.1 General

In recent years, as transmission line progresses to the FTTH, large amount of data transfer becomes available. In terms of TV contents, it is highly expected that high-definition digital video signal such as 4K UHD and 8K SHD can be transmitted through all IP network in keeping with high-quality and low-cost services regardless of long distance and signal impairment.

¹ Zixi Software Defined Video Platform is the trade name of a product supplied by Zixi, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

IP distribution technologies for broadcast contents are classified as IP unicast and IP multicast. IP unicast distribution technology which is distributed from one-to-one on the timing decided by receiver and IP multicast distribution technology which is distributed from one-to-N on the timing decided by service providers.

This subclause introduces two IP distribution technologies and describes migration from current RF distribution to all IP distribution via FTTH networks.

4.1.2 IP unicast distribution technology

IP unicast is the distribution technology for distributing just the required data of contents from the contents distribution centre to each subscriber; refer to Figure 1.

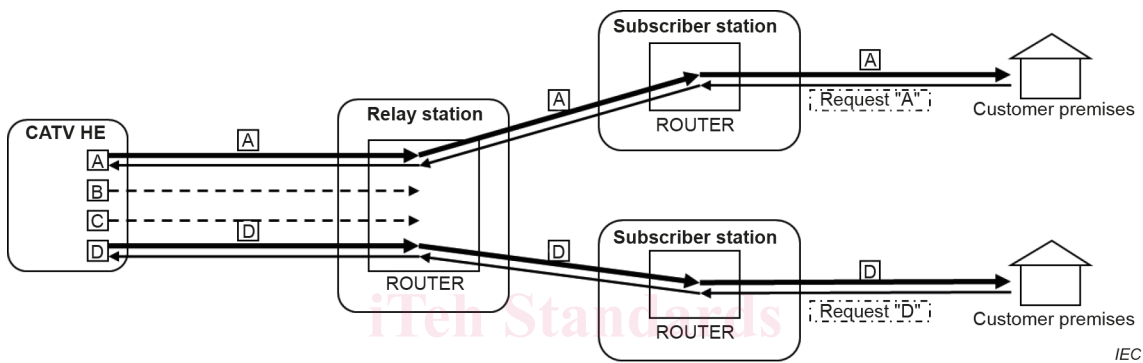


Figure 1 – IP unicast distribution

IP unicast distribution can take requirement of contents and transmission data rate for devices, such as mobile terminals or TV monitors, because the distribution from servers is independent of the user terminals. For this reason, the IP unicast distribution technique is mainly used for IP VOD which is watched separately by each user.

However, IP unicast distribution has disadvantages; it needs to send content to requiring client individually and the more clients there are, the more traffic becomes congested.

4.1.3 IP multicast distribution technology

IP multicast means a simultaneous distribution of the same content among a registered group. (Refer to Figure 2)

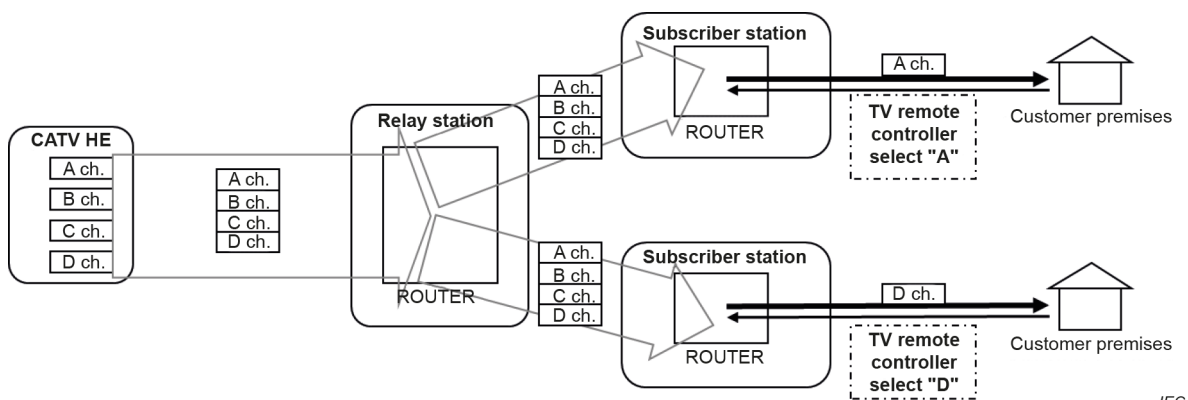


Figure 2 – IP multicast distribution