

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

J.175

(11/2005)

SERIES J: CABLE NETWORKS AND TRANSMISSION
OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

IPCablecom

Audio server protocol

ITU-T Recommendation J.175



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ITU-T Recommendation J.175

Audio server protocol

Summary

This Recommendation describes the architecture and protocols that are required for playing announcements in Voice-over-IP (VoIP) IP-Cablecom networks. Announcements are typically needed for calls that do not complete. Additionally, they may be used to provide enhanced information services to the caller. Different carrier service feature sets require different announcement sets and announcement formats.

Announcements can be as basic as fixed-content announcements (e.g., all circuits busy) or as complex as those provided by intelligent IVR (Interactive Voice Response) systems. The IP-Cablecom service model requires that all announcements be provisioned and signalled in a standard manner for all supported call features and use case scenarios.

Source

ITU-T Recommendation J.175 was approved on 29 November 2005 by ITU-T Study Group 9 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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Audio server protocol

1 Scope

This Recommendation describes the architecture and protocols that are required for playing announcements in Voice-over-IP (VoIP) IP-Cablecom networks. Announcements are typically needed for calls that do not complete. Additionally, they may be used to provide enhanced information services to the caller. Different carrier service feature sets require different announcement sets and announcement formats.

Announcements can be as basic as fixed-content announcements (e.g., all circuits busy) or as complex as those provided by intelligent Interactive Voice Response (IVR) systems. The IP-Cablecom service model requires that all announcements be provisioned and signalled in a standard manner for all supported call features and use case scenarios.

This Recommendation defines a set of signalling protocols that are used to provide announcement services within a cable network. For one of these protocols – the IP-Cablecom Network Call Signalling (NCS) protocol (ITU-T Rec. J.162) – this Recommendation defines two new event packages:

- a Base Audio Package;
- an Advanced Audio Package.

NOTE – There may be cases where audio server implementations are based on protocols other than that specified in this Recommendation. If other protocols are implemented, those implementations MUST adhere to IP-Cablecom-specified architectural and functional requirements, such as security and Quality of Service (QoS), and the required features/capabilities to support interoperability. A variety of such protocols exists, including protocols such as INAP, ITU-T Rec. H.248 and others.

2 References

2.1 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- ITU-T Recommendation J.161 (2001), *Audio codec requirements for the provision of bidirectional audio service over cable television networks using cable modems*.
- ITU-T Recommendation J.162 (2005), *Network call signalling protocol for the delivery of time-critical services over cable television networks using cable modems*.
- ITU-T Recommendation J.170 (2005), *IP-Cablecom security specification*.
- ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*.
- IETF RFC 2396 (1998), *Uniform Resource Identifiers (URI): Generic Syntax*.

2.2 Informative references

- ITU-T Recommendation J.160 (2005), *Architectural framework for the delivery of time-critical services over cable television networks using cable modems*.
- ITU-T Recommendation J.163 (2005), *Dynamic quality of service for the provision of real-time services over cable television networks using cable modems*.
- ITU-T Recommendation J.171.x series (2005), *IPCablecom trunking gateway control protocol (TGCP)*.
- *Hunt, McGlashan, Speech Recognition Grammar Specification for the W3C Speech Interface Framework, [W3C], March 2004.*
- IETF RFC 2234 (1997), *Augmented BNF for Syntax Specifications: ABNF*.
- IETF RFC 3435 (2003), *Media Gateway Control Protocol (MGCP)*.
- ISO 4217:2001, *Codes for the representation of currencies and funds*.
- ISO 8601:2004, *Data elements and interchange formats – Information interchange – Representation of dates and times*.
- *Sun Microsystems, Java Speech Grammar Format Specification, [JSGF], Copyright 1998-99.*

3 Terms and conventions

3.1 Terms

This Recommendation defines the following term:

3.1.1 announcement servers: Also known as Audio Servers, Announcement Servers are network components that manage and play informational tones and messages in response to events that occur in the network. Most announcements are media streams that originate from servers in the network. Some simple tones and short announcements can also reside at the MTA and in the MG.

3.2 Conventions

If this Recommendation is implemented, the keywords "MUST" and "SHALL" as well as "REQUIRED" are to be interpreted as indicating a mandatory aspect of this Recommendation.

The keywords indicating a certain level of significance of particular requirements that are used throughout this Recommendation are summarized below.

"MUST"	This word or the adjective "REQUIRED" means that the item is an absolute requirement of this Recommendation.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this Recommendation.
"SHOULD"	This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

"MAY" This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

ASP	Audio Server Protocol
CMS	Call Management Server
CMTS	Cable Modem Termination System
DNS	Domain Name System
DTMF	Dual Tone Multi-Frequency
E-MTA	Embedded MTA
H.248	An ITU-T/IETF protocol for media gateway control. Also known as MEGACO. See www.itu.int .
IANA	Internet Assigned Numbers Authority
IVR	Interactive Voice Response
MEGACO	An IETF/ITU-T protocol for media gateway control. Also known as ITU-T Rec. H.248. See www.ietf.org for details.
MGCP	Media Gateway Control Protocol
MIB	Management Information Base
MP	Media Player
MPC	Media Player Controller
MTA	Media Terminal Adapter
NCS	Network-based Call Signalling
PSTN	Public Switched Telephone Network
RTP	Real-Time Protocol
SDP	Session Description Protocol
SID	Service ID. A 14-bit number assigned by a CMTS to identify an upstream virtual circuit. Each SID separately requests and is granted the right to use upstream bandwidth.
SNMP	Simple Network Management Protocol
S-MTA	Stand-alone MTA – a single node which contains an MTA and a non-J.112 MAC (e.g., Ethernet).
TGCP	Trunking Gateway Control Protocol
TN	Telephone Number
URI	Universal Resource Identifier
VoIP	Voice-over-IP

5 Technical overview

This Recommendation defines a suite of signalling protocols for providing announcement and media services in an IPCablecom network. This clause:

- defines the architectural requirements for providing IPCablecom announcement and media services;
- defines and categorizes announcement and media types;
- defines the components and their roles in the IPCablecom audio server architecture; and
- describes the signalling and media interfaces.

5.1 Architectural requirements

The architectural requirements and assumptions for providing audio and media services for an IPCablecom network are listed below. These requirements are based upon the specifications and technical reports that define the IPCablecom architecture.

The reference architecture for the IPCablecom network is shown in Figure 1.

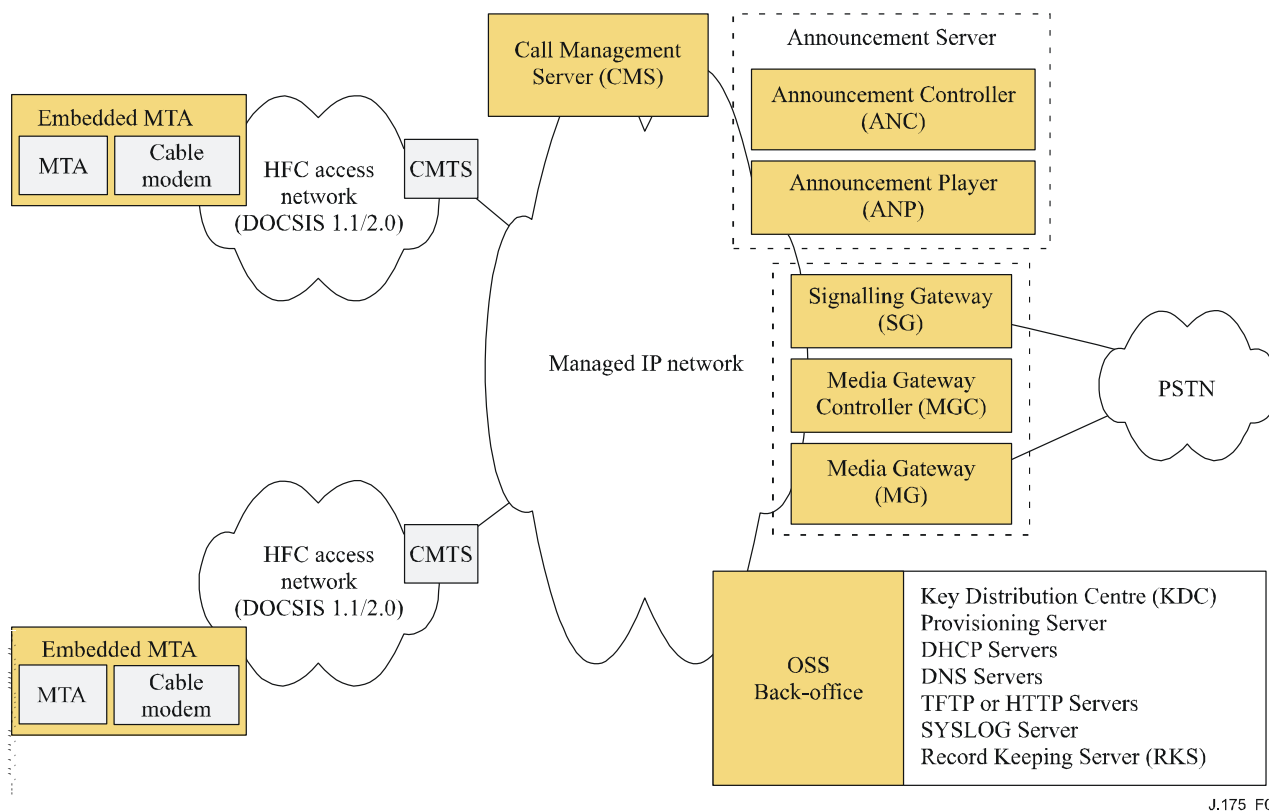


Figure 1/J.175 – IPCablecom network component reference model

5.1.1 Call destination

This Recommendation defines how announcements are provided for IPCablecom on-net to off-net and on-net to on-net calls¹.

¹ Announcements for off-net to on-net calls will usually be handled by the PSTN as a result of SS7 clearing messages. However, when appropriate, they may also be played from the IPCablecom Media Gateway (MG).

5.1.2 Media formats

A Media Player **MUST** be able to generate the required announcements in any of the code formats required by the IPCablecom Codecs specification (see ITU-T Rec. J.161).

5.1.3 Security

Audio **MUST** be signalled and played in a secure manner. Security protocols defined in the IPCablecom security specification (see ITU-T Rec. J.170) **MUST** be supportable in this Recommendation.

5.1.4 Operational support systems

Audio servers may be required to support the IPCablecom billing and event message protocols as defined in ITU-T Rec. J.164. At the current time, no requirement had been identified for support of event reporting by the Media Player.

5.2 Announcement definitions

Announcements can be divided into four distinct categories: tones, fixed-content, variable content, and interactive announcements.

5.2.1 Tones

Includes tones such as reorder, busy, and ringback.

5.2.2 Fixed-content announcements

Fixed-content announcements consist of audio messages with fixed-content that require no user interaction. For example, "Your call did not go through. Please hang up and try your call again".

5.2.3 Variable-content announcements

Variable-content announcements are messages that contain a customizing parameter(s) yet require no user interaction. For example, "The number you have dialled, 321-9876, has been changed. The new number is 321-6789".

5.2.4 Interactive announcements

Interactive announcements are announcements that require user interaction, DTMF (Dual Tone Multi-Frequency) or IVR. For example, "The number you have dialled, 541-321-9876, has been changed. The new number is 541-321-6789. To be connected to the new number, at a cost of thirty-five cents, please press 1".

5.2.5 Naming conventions for endpoint identifiers

A flat name space for endpoints is used, with audio ports indicated by the prefix *aud* and the port number, e.g., *aud/12@audio-server-3.whatever.net*. Wild cards (\$, *) **MAY** be used in place of the port numbers in accordance with standard NCS rules for wild card use.

Systems that support announcements only (i.e., no digit collection, no recording, and no speech recognition ability) **MAY** use the prefix *ann* instead of *aud*.

Some systems may use one additional level in the naming scheme to support the identification of specific cards, e.g., *aud/<card number>/<port number>@audio-server-3.whatever.net*.

5.3 Interface specifications

This Recommendation defines a set of interfaces between the components responsible for providing audio services. Figure 2 illustrates the interfaces between these components. Only where an interface is exposed is it expected to meet IPCablecom specification requirements.

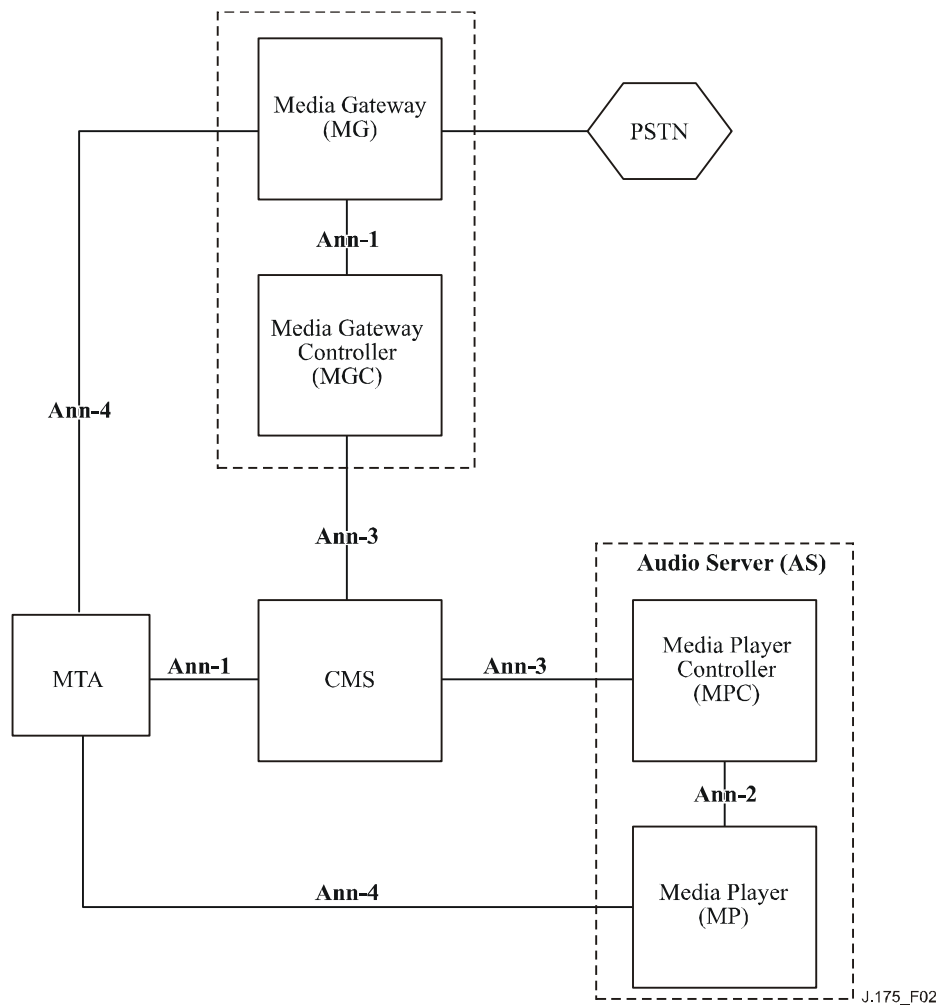


Figure 2/J.175 – IP-Cablecom audio server components and interfaces

6 Ann-1 interface: CMS-MTA and MGC-MG

The CMS-MTA and MGC-MG announcement interfaces are implemented by the Legacy Audio Package of the NCS/TGCP protocol, which provides the playback of tones and fixed-content announcements to the end-users.

6.1 CMS-MTA interface

Each MTA in the network MAY store a predefined set of simple announcements locally. When an announcement is needed, the CMS will decide if it should instruct the MTA to play a local announcement or set up a connection between the MTA and a Network MP and have the announcement played over the network. Playing simple announcements from the MTA saves network resources.

The MTA MAY store announcements in either static or dynamic memory. If announcements are stored in dynamic memory, then the announcements will not be available until the MTA has accessed them from the network.

These simple announcements will require only a small amount of storage on the MTA. Table 1 illustrates the storage requirements for such announcements. The example uses an average announcement time of 10 seconds.

Table 1/J.175 – MP storage

Number of announcements	Announcement length (seconds)	Encoding bytes/second	Bytes required
11	10	2000 (G.728)	220 K
11	10	8000 (PCMU/PCMA)	880 K

MTAs require the ability to be updated dynamically with announcements so that the same MTA can move from service provider to service provider without requiring complete firmware upgrades. This capability is for further study.

6.1.1 Announcement list

The MTA MAY store and play a defined set of announcements for common network situations. These announcements may be played using the Announcement Server Package defined in RFC 3435, *Media Gateway Control Protocol*, using URIs (Universal Resource Identifiers) to identify the announcements. Cached versions of all announcement URIs SHOULD be refreshed every time the MTA connects to the network. Other methods of propagating new announcements to MTAs, for instance, while the MTA remains in service, are for further study. The second column of Table 2 is a list of some announcements that MAY be supported in the MTA. The first column contains wording that MAY be used.

Table 2/J.175 – Sample announcements

Sample announcement	Name
Your call cannot be completed as dialled. Please check the number and dial again.	Vacant Code
You must first dial a one or zero when calling this number. Please hang up and try your call again.	Dial One or Zero
You must first dial a one when calling this number. Please hang up and try your call again.	Dial One First
It is not necessary to dial a one when calling this number. Please hang up and try your call again.	No Dial One
If you'd like to make a call, please hang up and try again. If you need help, hang up and dial the operator.	No Digits
Your call cannot be completed as dialled. Please read the instruction card or call your operator for assistance.	Assisted Dialling
Your call did not go through. Please try your call again.	Reorder
All circuits are busy now. Please try your call later.	No Circuit
Due to facility trouble in the area you are calling, your call cannot be completed at this time. Please try your call later.	Domestic Facility
The party you are calling has declined to receive this call. Please try your call again with caller ID enabled.	Unidentified Call Reject
Thank you for using [carrier's name].	Branding

6.2 MGC-MG interface

The MG announcement interface (Ann-1) allows for the MGC to request the MG to play fixed-content announcements to PSTN end-users. The MGC/MG announcement interface package does not specify any standard announcements to be stored locally in the MG. All announcements are provisioned dynamically and are referenced accordingly.

This MG announcement provisioning capability is for further study.

7 Ann-2 interface: MPC-MP

7.1 Introduction

An MP (Media Player) is a shared resource in the IPCablecom network that can be instructed to provide media services to an end-user or terminal. These services include streaming fixed-content, variable-content and interactive announcements to IPCablecom subscribers. For example, the MP is responsible for playing prompts and collecting digits when charging a call to a calling card.

The MP is controlled by an external element, the MPC (Media Player Controller). The MPC-MP interface defines two new NCS announcement packages used to control the Media Player. The Base Audio Package provides a standard set of IVR functions such as Play, PlayCollect, and PlayRecord. The Advanced Audio Package is a superset of the Base Audio Package and provides additional capabilities.

The MP is responsible for managing its own resources. When accepting a request, the MP MUST make sure that the required resources are available before accepting a request. When a single session involves multiple requests to the Media Player, the MP may experience a shortage of resources preventing it from accepting one given request belonging to that session. In this case, the MP user (i.e., the MPC) is responsible for resending the request or terminating the end-user session elegantly.

7.2 Audio Package concepts

The Base and Advanced Audio Packages support both simple and complex audio structures. A simple audio structure might be a single announcement such as "Welcome to Bell South's Automated Directory Assistance Service". A more complex audio structure might consist of an announcement followed by voice variable followed by another announcement, for example "There are thirty-seven minutes remaining on your prepaid calling card", where "There are" is a prompt, the number of minutes is a voice variable, and "minutes remaining on your prepaid calling card" is another prompt.

It is also possible to define complex audio structures that are qualified by user-defined selectors such as language, audio file format, gender, accent, customer, or voice talent. For instance, if the above example were qualified by language and accent selectors, it would be possible to play "There are thirty-seven minutes remaining on your prepaid calling card" in English spoken with a southern accent or in English spoken with a mid-western accent, providing that the audio to support this had been provisioned.

There are two methods of specifying complex audio. The first is to directly reference the individual components. This requires a complete description of each component to be specified via the protocol. The second method is to provision the components on the audio server as a single entity and to export a reference to that entity to the call agent. In this case, only the reference (plus any dynamic data required, such as a variable data) is passed via the protocol, and no specification of individual components is necessary.

These packages provide significant functionality, most of which is controlled via protocol parameters. Most parameters are optional, and wherever possible default to reasonable values. An audio application that references to complex provisioned audio structures can specify audio events using a minimum of syntax by taking advantage of parameter optionality and parameter defaults.

7.2.1 Understanding audio segments

An audio segment is a reference that resolves to one or more audio recordings. There are four types of audio segments:

Physical: A physical segment is the simplest type of segment, a single recording. The recording could be a single word, such as "one", or an extended block of speech, such as "Our office is closed at this time. Please call back during normal business hours". Every physical segment is assigned a unique URI (Universal Resource Identifier) which among other things can be a hierarchical name, or a simple name or number.

Sequence: A sequence is a provisioned ordered list of audio segments. Every sequence is assigned a unique URI. A sequence can contain any of the four segment types (physical segments, other sequences, sets, and variables). On playback, a sequence identifier is resolved to an ordered list of physical segments which are played in order.

Set: A set is a provisioned collection of semantically related audio segments and an associated selector. Each set is assigned a unique URI. A set can contain physical segments, sequences, other sets, or variables. At runtime, the value of the selector is used to determine which element of the set is played.

Individual selector types are not defined in the syntax (except for the predefined language selector) and are instead defined by the provisioner. A provisioner could define one or more of the following selector types: language, accent, gender, customer, or day of the week. For each selector type, the provisioner must define a range of valid values. The provisioner may also choose to define a default value. At runtime, if a selector value is not supplied, the default value is used.

Variable: A voice variable represents a single semantic concept (such as date or number) and dynamically produces the appropriate speech based on information supplied at runtime. Each provisioned voice variable is assigned a unique URI. For example, if an application needs to play a date, rather than telling the audio server to play each individual component of the date (e.g., "March" "twenty" "second" "nineteen" "ninety" "nine"), it can specify a voice variable of type date with value "19990322". The variable then assembles and plays the component audio needed to speak the date. Specification of variables is considered in more detail in a later clause of this Recommendation.

7.2.2 Segment identifiers

Provisioned segments and segments recorded at runtime are identified by URIs as defined in RFC 2396, Uniform Resource Identifiers: Generic Syntax.

A URI can be a simple name or it can be a URL. Three URL schemes are allowed: the file:scheme, the ftp:scheme, and the http:scheme. The file:scheme is used for audio local to the Audio Server. The ftp:scheme is used for audio remote to the Audio Server. The http:scheme can be used for audio local to the Audio Server using the http://local host convention or audio remote to the Audio Server. All audio references that require parameters encoded in the URL (e.g., set selectors) MUST use the http:scheme. Table 3 shows some of the possibilities.

Table 3/J.175 – Example URIs

Reference to local audio (flat file): S: pa(an=file://welcome)
Reference to local audio (flat file): S: pa(an=file://12354)
Reference to local audio: S: pa(an=file://audio/xyztel/welcome)
Reference to remote audio: S: pa(an=http://audio/xyztel/welcome)

7.2.3 Segment life

Physical segments may be provisioned or they may be recorded during the course of a call. A physical segment recorded during the course of a call can be either transient or persistent. A transient physical segment lasts only for the duration of the call during which it was recorded. A persistent physical segment lasts beyond the duration of the call during which it was recorded.

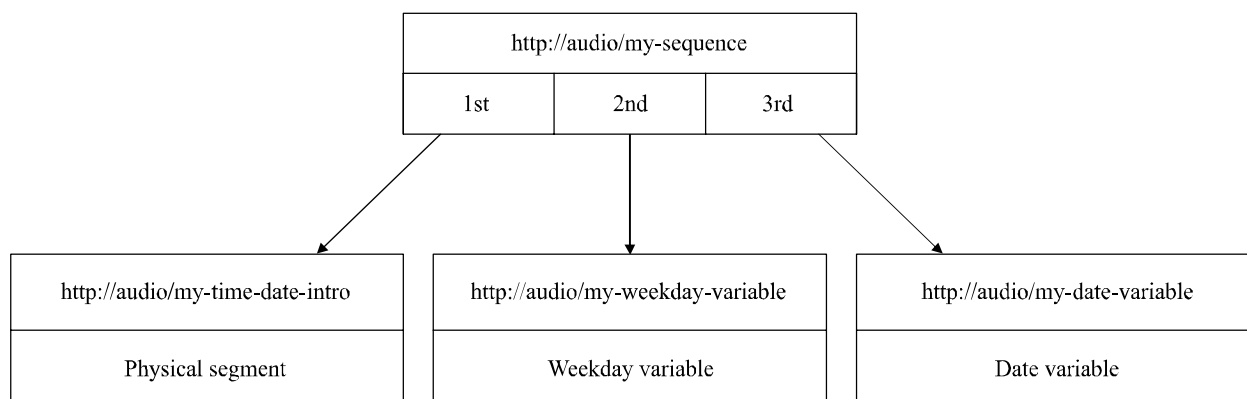
7.2.4 Nested sets and sequences

Nested definition of both sets and sequences is allowed, i.e., it is legal to define a set of sets or a sequence of sequences. In addition, audio structures may also be specified by intermixing sets and sequences, and it is possible to specify a set of sequences or a sequence containing one or more set elements. Direct or transitive definition of a set or segment in terms of itself is not allowed.

Nesting of sets and sequences should be restricted to two or three levels.

7.2.5 Sequence example

In the following example, in Figure 3, a provisioner has provisioned one physical segment and two variable segments and has provisioned a sequence, `http://mysegment`, which is an ordered list of the three segments. The sequence when played speaks the following: "Today's date is <weekday> <date>".



J.175_F03

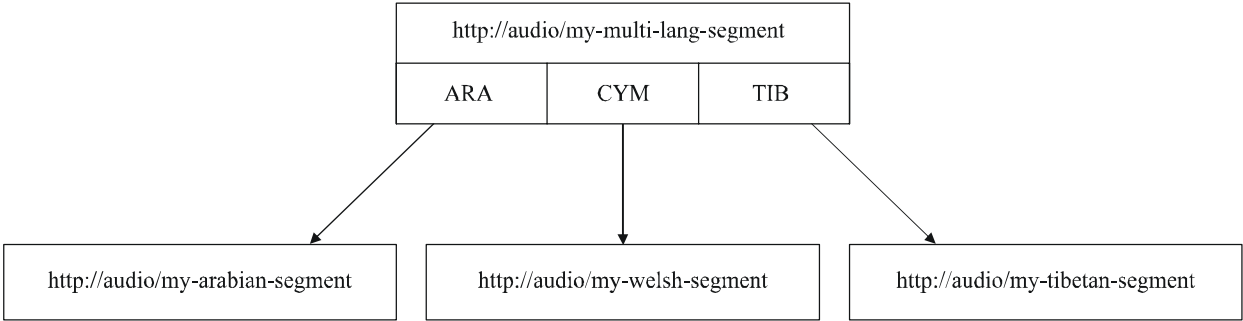
Figure 3/J.175 – Sequence example

7.2.6 Set example

To support an application which plays a particular piece of audio in either Arabic, Welsh, or Tibetan, a provisioner could define a set with the predefined selector, "lang", and would use three of the possible values for that selector, "ara", "cym", and "tib". The provisioner would provision three audio segments, one in each language, and would associate the Arabic segment with the "ara"

selector value, etc. The provisioner could also define a default value of the selector when no selector value is supplied, "ara" for instance. The entire set would be assigned a unique URI.

At runtime, a reference to the set with the selector set to "cym" would result in the Welsh version of the prompt being played. A reference to the set with no selector would result in the Arabic version of the prompt being played since Arabic has been set as the default selector value (see Figure 4).



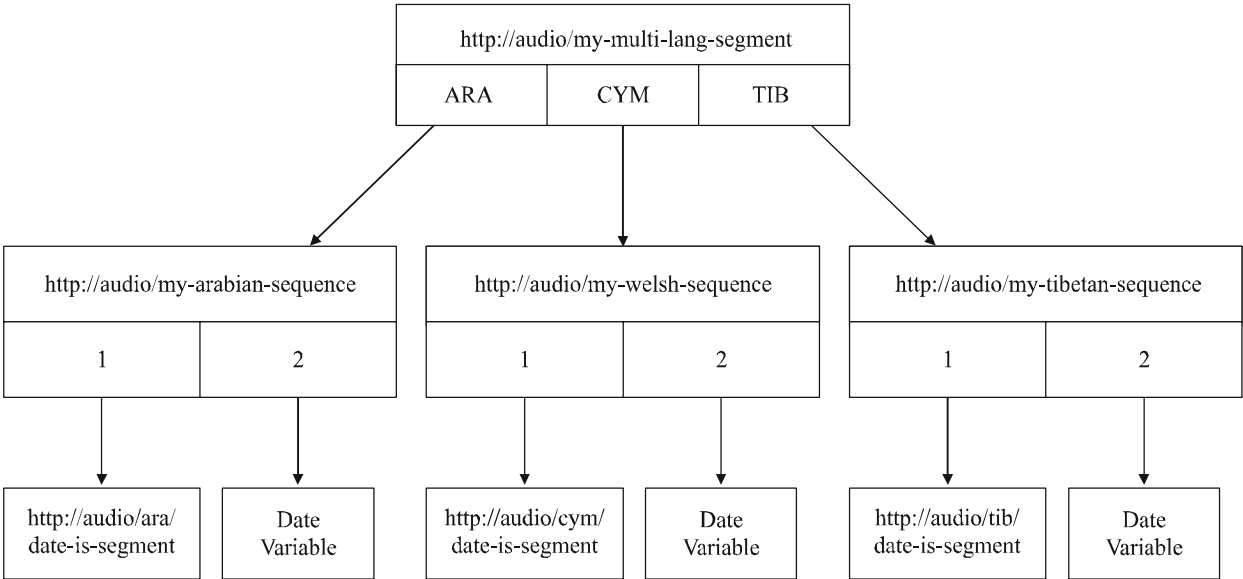
J.175_F04

Figure 4/J.175 – Set example

7.2.7 Set with nested sequence example

In this example, in Figure 5, the provisioner has provisioned three physical segments, one in Arabic, one in Welsh, and one in Tibetan, and the provisioner has also provisioned three date variables. Using these six segments the provisioner has provisioned three sequences, each consisting of a physical segment followed by a date variable. Finally, the provisioner has provisioned a set consisting of the three sequences and with language as the set selector.

At runtime, a reference to the set with the selector set to "ara" and a variable value of "20001015" would result in the following being played in Arabic: "Today's date is October 15th, 2000".



J.175_F05

Figure 5/J.175 – Set with nested sequence example

7.3 Base Audio Package

7.3.1 Abstract

This event package provides support for the standard IVR operations of PlayAnnouncement, PlayCollect, and PlayRecord. It supports direct references to simple audio as well as indirect references to simple and complex audio. It provides audio variables, control of audio interruptibility, digit buffer control, special key sequences, and support for reprompting during data collection.

Package Name: BAU

7.3.2 Events

See Table 4.

Table 4/J.175 – Events

Symbol	Definition	R	S	Duration
pa(parms)	PlayAnnouncement		TO	variable
pc(parms)	PlayCollect		TO	variable
pr(parms)	PlayRecord		TO	variable
ma(parms)	ManageAudio		BR	variable
oc	OperationComplete	x		
of(parms)	OperationFailed	x		

PlayAnnouncement: Plays an announcement in situations where there is no need for interaction with the user. Because there is no need to monitor the incoming media stream, this event is an efficient mechanism for treatments, informational announcements, etc.

PlayCollect: Plays a prompt and collects DTMF digits entered by a user. If no digits are entered or an invalid digit pattern is entered, the user may be reprompted and given another chance to enter a correct pattern of digits. The following digits are supported: 0-9, *, and #. By default, PlayCollect does not play an initial prompt, makes only one attempt to collect digits, and therefore functions as a simple Collect operation. Various special purpose keys, key sequences, and key sets can be defined for use during the PlayCollect operation.

PlayRecord: Plays a prompt and records user speech. If the user does not speak, the user may be reprompted and given another chance to record. By default, PlayRecord does not play an initial prompt, makes only one attempt to record, and therefore functions as a simple Record operation. The call agent may specify a URI to be associated with the recording or the call agent may ask the Audio Server to allocate a URI and return it to the call agent as part of the OperationComplete event. Digits entered by the user during a recording that are not defined as special key sequences are ignored and become part of the recording.

ManageAudio: Performs audio management operations on persistent audio which is typically not related to a current interaction with a user, e.g., "delete an audio segment" or "change volume for duration of connection".

OperationComplete: Detected upon the successful completion of a Play, PlayRecord, PlayCollect, or ManageAudio signal.

OperationFailed: Detected upon the failure of a Play, PlayRecord, PlayCollect, or ManageAudio signal.

7.3.3 Signal interactions

If an Audio Package signal is active on an endpoint and another signal of the same type is applied, the two signals including parameters and parameter values will be compared. If the signals are identical, the signal in progress will be allowed to continue and the new signal will be discarded. Because of this behaviour, the Advanced Audio Package may not interoperate well with some other packages such as the Line and Trunk packages.

7.3.4 Parameters

The PlayAnnouncement, PlayRecord, and PlayCollect events may each be qualified by a string of parameters, most of which are optional. Where appropriate, parameters default to reasonable values. If a required parameter is not supplied, an error is returned to the application.

These parameters are shown in Table 5:

Table 5/J.175 – Parameters

Symbol	Definition	pa	pc	pr	ma
an	announcement	O	F	F	F
ip	initial prompt	F	O	O	F
rp	reprompt	F	O	O	F
nd	no digits reprompt	F	O	F	F
ns	no speech reprompt	F	F	O	F
fa	failure announcement	F	O	O	F
sa	success announcement	F	O	O	F
off	Offset	O	O	O	F
ni	non-interruptible play	F	O	O	F
it	iterations	O	F	F	F
iv	interval	O	F	F	F
du	duration	O	F	F	F
sp	speed	O	O	O	F
vl	volume	O	O	O	F
cb	clear digit buffer	F	O	O	F
dm	digit map	F	O	O	F
fdt	first digit timer	F	O	F	F
idt	inter digit timer	F	O	O	F
edt	extra digit timer	F	O	F	F
prt	prespeech timer	F	F	O	F
pst	postspeech timer	F	F	O	F
rlt	recording length timer	F	F	M	F
rsk	restart key	F	O	O	F
rik	reinput key	F	O	O	F
rtk	return key	F	O	O	F
na	number of attempts	F	O	O	F
ap	append	F	F	O	F
rid	recording id	F	F	M	F