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IPCablecom 1.5 Part 17: Audio Server Protocol

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1 INTRODUCTION

1.1 Purpose

This specification describes the architecture and protocols that are required for playing announcements in voice-over-IP (VoIP) IP-Cablecom networks, and is issued to facilitate design and field-testing leading to the manufacture and interoperability of conforming hardware and software by multiple vendors. The will be referred to as the IP-Cablecom Audio Server Specification.

Announcements are typically needed for calls that do not complete. Additionally, they may be used to provide enhanced information services to the caller (e.g., calling card, N11 services). 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 signaled in a standard manner for all supported call features and use case scenarios.

This specification defines a set of signaling protocols that are used to provide announcement services within a cable network. For one of these protocols, this specification defines two new event packages:

- A Base Audio Package
- An Advanced Audio Package

1.2 Scope

IPCablecom is a set of protocols developed to deliver enhanced communications services using packetized data transmission technology to a consumer's home over the cable network. The "IPCablecom Architecture Framework" is the starting point for understanding IPCablecom Interface Specifications, Technical reports, and other IPCablecom documents.

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

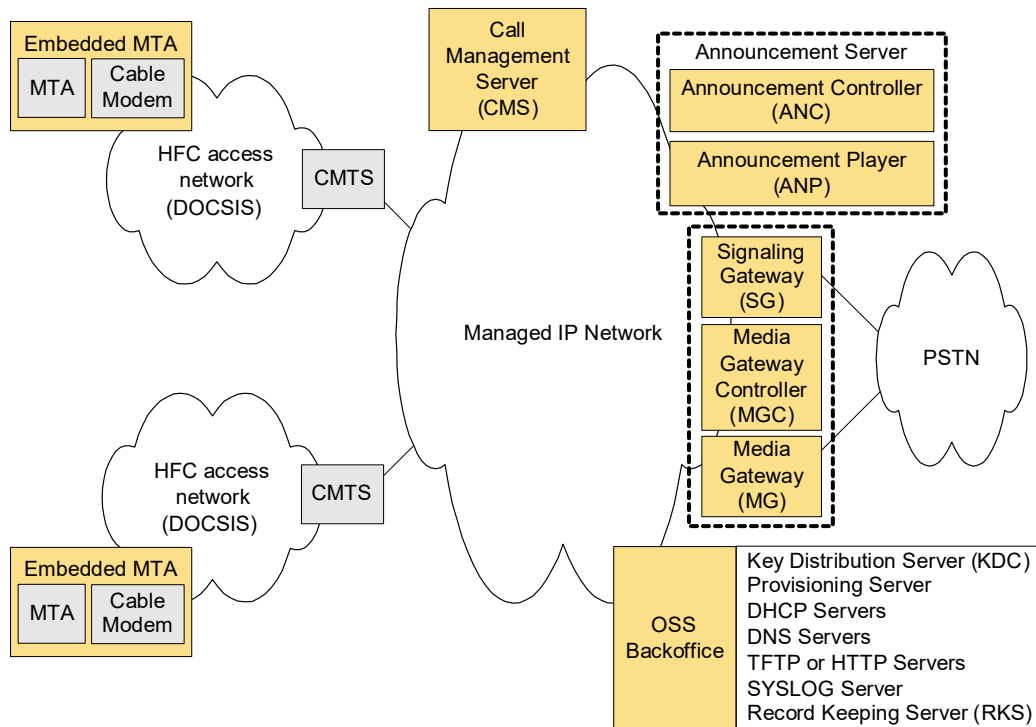


Figure 1. IPCablecom Network Component Reference Model

Announcement Servers, also known as Audio 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.

1.3 Specification Language

1.4 Requirements and Conventions

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

“MUST”	This word or the adjective “REQUIRED” means that the item is an absolute requirement of this specification.
“MUST NOT”	This phrase means that the item is an absolute prohibition of this specification.
“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 behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior 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.

The legal/regulatory classification of IP-based voice communications provided over cable networks and otherwise, and the legal/regulatory obligations, if any, borne by providers of such voice communications, are not yet fully defined by appropriate legal and regulatory authorities. Nothing in this specification is addressed to, or intended to affect, those issues. In particular, while this document uses standard terms such as "call," "call signaling," "telephony," etc., it will be evident from this document that while an IPCablecom network performs activities analogous to these PSTN functions, the manner by which it does so differs considerably from the manner in which they are performed in the PSTN by telecommunications carriers. These differences may be significant for legal/regulatory purposes.

2 REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision, and while parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version

2.1 Normative References

In order to claim compliance with this standard, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this standard. Intellectual property rights may be required to implement these references.

- [1] ANSI/SCTE 165-03 2016, IP_Cablecom 1.5 Part 3: Network-Based Call Signaling Protocol.
- [2] IETF RFC 3435, Media Gateway Control Protocol (MGCP), January, 2003.
- [3] ANSI/SCTE 165-02 2016, IP_Cablecom 1.5 Part 2: Audio/Video Codecs.
- [4] ANSI/SCTE 165-10 2009, IP_Cablecom 1.5 Part 10: Security.

2.2 Informative References

The following documents may provide valuable information to the reader but are not required when complying with this standard.

- [5] ANSI/SCTE 165-01 2019, IP_Cablecom 1.5 Part 1: Architecture Framework Technical Report.
- [6] ANSI/SCTE 165-12 2016, IP_Cablecom 1.5 Part 12: PSTN Gateway Call Signaling Protocol Specification.
- [7] ANSI/SCTE 165-09 2019, IP_Cablecom 1.5 Part 9: Event Messages.
- [8] IETF RFC 2396, Uniform Resource Identifiers (URI): Generic Syntax, August 1998.
- [9] IETF RFC 2234, Augmented BNF for Syntax Specifications: ABNF, November 1997.
- [10] ISO 639-2, Code For The Representation Of Names Of Languages, 1998.
- [11] ISO 4217, Codes for the Representation of Currencies and Funds, 2001.
- [12] ISO 8601, Representation of Dates and Times, 2000.
- [13] Sun Microsystems, Java Speech Grammar Format Specification, [JSGF], Copyright 1998-99.
- [14] Hunt, McGlashan, Speech Recognition Grammar Specification for the W3C Speech Interface Framework, [W3C], March 2004.

3 TERMS AND DEFINITIONS

IP_Cablecom specifications use the following terms:

**Announcement
Server**

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.

4 ABBREVIATIONS AND ACRONYMS

IPCablecom specifications use the following abbreviations.

ASP	Audio Server Protocol
CMS	Call Management Server.
CMTS	Cable Modem Termination System.
DNS	Domain Name Service.
DTMF	Dual-tone Multi Frequency (tones).
E-MTA	Embedded MTA. A single node that contains both an MTA and a cable modem.
IANA	Internet Assigned Numbered Authority. See www.ietf.org for details.
IVR	Interactive Voice Response system.
MEGACO	Media Gateway Control IETF working group. See www.ietf.org for details.
MGCP	Media Gateway Control Protocol. Protocol follow-on to SGCP. Refer to IETF 3435.
MIB	Management Information Base.
MP	Media Player
MPC	Media Player Controller
MTA	Multimedia Terminal Adapter.
NCS	Network Call Signaling.
PDU	Protocol Data Unit.
PSTN	Public Switched Telephone Network.
QCIF	Quarter Common Intermediate Format.
QoS	Quality of Service. Guarantees network bandwidth and availability for applications.
SDP	Session Description Protocol.
SFID	Service Flow ID. A 32-bit integer assigned by the CMTS to each DOCSIS Service Flow defined within a DOCSIS RF MAC domain. SFIDs are considered to be in either the upstream direction (USFID) or downstream direction (DSFID). Upstream Service Flow IDs and Downstream Service Flow IDs are allocated from the same SFID number space.
S-MTA	Standalone MTA. A single node that contains an MTA and a non-DOCSIS MAC (e.g., ethernet).
TGCP	Trunking Gateway Control Protocol
TN	Telephone Number.
URI	Universal Resource Identifier
VoIP	Voice-over-IP.

5 TECHNICAL OVERVIEW

The IPCablecom Audio Server Specification defines a suite of signaling protocols for providing announcement and media services in an IPCablecom network. This section of the document:

- 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, as described in the IPCablecom Architecture Technical Report [5], and
- Describes the signaling and media interfaces in the IPCablecom Audio Server Specification.

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.

5.1.1 Call Destination

The Audio Server Specification must define how announcements are provided for IPCablecom on-net to off-net and on-net to on-net calls¹.

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 [3].

5.1.3 Security

Audio MUST be signaled and played in a secure manner. Media Player Controllers and Media Players MUST support the security protocols defined in the IPCablecom Security specification [4].

5.1.4 Operational Support Systems

Media Player Controllers MUST support the IPCablecom billing and event message protocols as defined in [7], as applicable to the applications they support. No requirement has 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. See [1] and [6] for details.

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."

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 also may be played from the IPCablecom Media Gateway (MG).

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 dialed, 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 dialed, 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*. Wildcards (\$, *) 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. In this case the naming would look like *aud/<card number>/<port number>@audio-server-3.whatever.net*

5.3 Interfaces

The IPCablecom Audio Server Specification defines a set of interfaces between the components responsible for providing audio services. The following figure illustrates the interfaces between these components. Only where an interface is exposed is it expected to meet IPCablecom specification requirements.

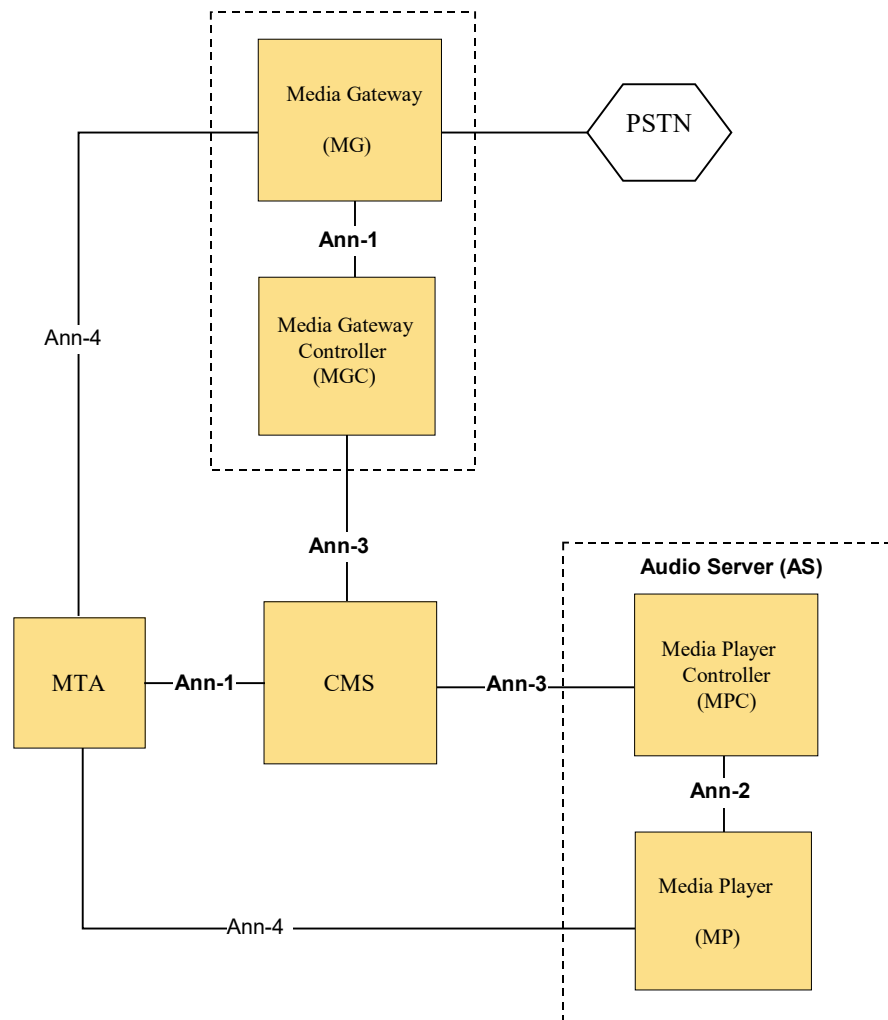


Figure 2. IPCablecom Audio Server Components and Interfaces

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. The table below illustrates the storage requirements for such announcements. The example uses an average announcement time of 10 seconds.

Table 1. 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 and will need to be worked jointly with the IPCablecom architecture, security, and provisioning teams.

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 [2], using URI (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 the table below is a list of some announcements that MAY be supported in the MTA. The first column contains wording that may be used.

Table 2. Sample Announcements

Sample Announcement	Name
Your call cannot be completed as dialed. 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 dialed. Please read the instruction card or call your operator for assistance.	Assisted Dialing
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 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 and will need to be worked jointly with the IPCablecom architecture, security, and provisioning teams.

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 a 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 the 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 re-sending 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 where ever 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 pre-defined language selector) and are instead defined by the provisioner. A provisioner could define one or more of the following selector types: language, accent, gender, accent, 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 AudioServer 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 section of this document.

7.2.2 Segment Identifiers

Provisioned segments and segments recorded at runtime are identified by URIs as defined in RFC 2396, [8] 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://localhost 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. The following table shows some of the possibilities.

Table 3. 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, 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>."

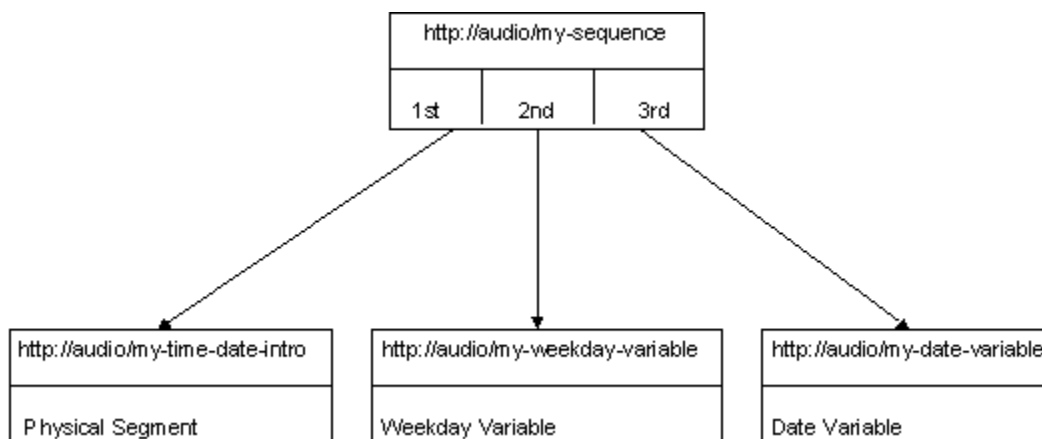


Figure 3. Sequence Example

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 pre-defined selector, "lang", and would use define 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 also could 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 English has been set as the default selector value.

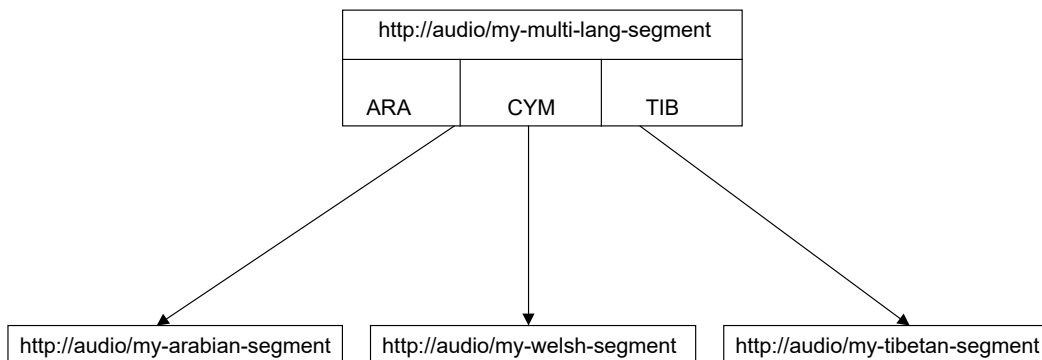


Figure 4. Set Example

7.2.7 Set With Nested Sequence Example

In this example, 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."

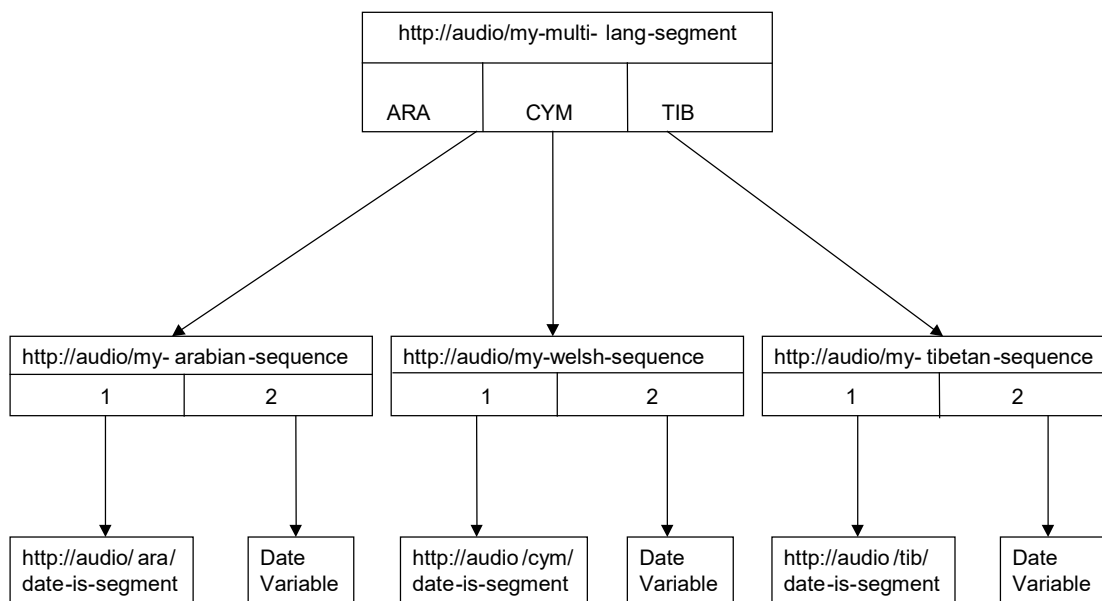


Figure 5. Set With Nested Sequence Example

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 re-prompting during data collection.

Package Name: BAU

7.3.2 Events

Table 4. Events

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

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.