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P. Blatherwick (Editor)
Nortel Networks
R. Bell
Cisco Systems
P. Holland
Circa Communications
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Megaco IP Phone Media Gateway Application Profile

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Abstract

This document specifies a particular application of the Megaco/H.248 Protocol for control of Internet telephones and similar appliances: the Megaco IP Phone Media Gateway. The telephone itself is a Media Gateway (MG), controlled by the Megaco/H.248 Protocol, with application control intelligence located in the Media Gateway Controller (MGC). To achieve a high degree of interoperability and design efficiency in such end-user devices, a consistent architectural approach, a particular organization of Terminations and Packages, and a Protocol Profile are described. The approach makes use of existing Protocol features and user interface related Packages, and is thus a straight-forward application of the Megaco/H.248 Protocol.

1. Introduction

This document represents the current view from the TIA working group on VoIP (Voice over IP) telephone specification [1], TIA TR-41.3.4, with the intent of using this as part of its "whole device" specification as an optional method of device control.

Industry feedback has made it clear that interoperability and acoustic performance of Internet telephones is key to the rapid and extensive commercialization of these products. To facilitate this, the TIA has established working group TR-41.3.4 to develop a standard

for VoIP telephones. The TR-41.3.4 working group has included the "whole device" within the scope of the standard, so a full range of requirements including acoustic performance, protocols, methods for powering and safety are provided. Where possible, the requirements are based on existing standards, which are included by reference.

The TIA TR-41.3.4 working group has also recognized that its proposed standard must enable creative application of the equipment, encourage the development of new capabilities and allow for high levels of product customization. To achieve this, peer to peer architectures that are based on protocols such as H.323 or SIP and master/slave architectures such as Megaco/H.248 Protocol are both necessary and complementary.

In support of the Megaco/H.248 Protocol development effort, the TR-41.3.4 working group has considered product enabling issues and requirements, and has developed an approach to use the Megaco/H.248 Protocol for Internet telephone device control. This document represents the working group's current view.

This document covers the general requirements of the Megaco IP Phone application (section 3), architectural approach and MG organization (section 4), details of specific Termination types used and Packages supported by each (section 5), and the Megaco IP Phone Protocol Profile (section 6).

2. Conventions

The keywords MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL, when they appear in this document, are to be interpreted as described in RFC 2119 [5].

3. General Requirements

The following general requirements were identified to drive the Megaco IP Phone design [1]:

1. The Megaco IP Phone must meet the basic needs of the business user from day one;
2. Provide a path for rapid expansion to support sophisticated business telephony features;
3. Flexibility to allow for a very wide range of telephones and similar devices to be defined, from very simple to very feature rich;
4. Simple, minimal design;

5. Allow device cost to be appropriate to capabilities provided;
6. Packages and Termination types must have characteristics that enable reliability;
7. The IP Phone MG shall meet the appropriate Megaco/H.248 Protocol requirements as provided in the Megaco Requirements document [2] and be a straight-forward application of the Megaco/H.248 Protocol [3].

4. Architecture Description

The following subsections describe the general design approach and organization of the Megaco IP Phone MG.

4.1. Design Approach

Design intent of the Megaco IP Phone is to keep it determinedly simple while providing required support for fully featured business telephones and the flexibility to allow for a very wide range of telephone configurations and similar appliances.

The approach to achieve this goal is to provide a very simple and direct master/slave control model in which very little feature intelligence is required in the end device. This design intent matches the Megaco/H.248 Protocol approach well.

It is important to note that additional functionality, built-in feature capability or system-specific optimization can easily be provided, at the option of the implementer, by defining additional Termination types, Event/Signal Packages, or providing built-in application capability. This document defines the minimal design only.

4.2. General Structure

As shown in Figure 1 below, the Megaco IP Phone is organized as a Media Gateway (MG) that consists of a User Interface Termination and a set of Audio Transducer Terminations.

Several - potentially thousands - of Megaco IP Phone MGs may be controlled by a single Media Gateway Controller (MGC). This is distinguished from the organization between traditional analog or PBX telephones behind an IP network, where the MGC would control an MG which in turn controls the collection of telephone devices in question. In the case of a Megaco IP Phone MG, the MG directly

implements the media terminations like handset, handsfree and headset, as well as the user interface. In this case, the Megaco IP Phone itself is the MG.

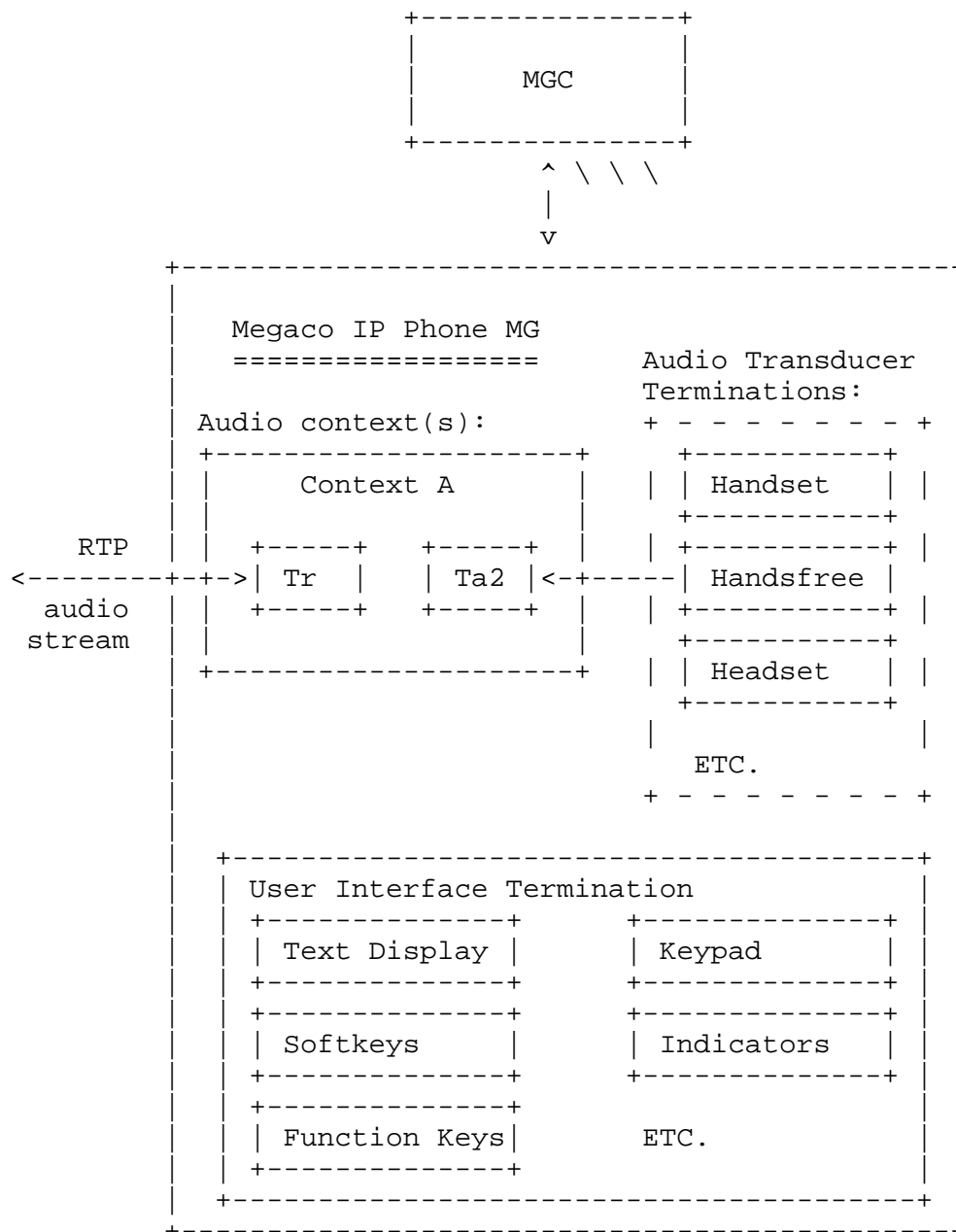


Figure 1: Megaco IP Phone Termination / Package Model

4.3. Termination / Package Organization

As shown in Figure 1, each Audio Transducer Termination represents an individually controllable audio input/output element of the telephone device, such as Handset, Handsfree, Headset, etc. By separating each audio element as a distinct Termination, more flexible applications can be easily implemented, such as paging, group listening, and so on. Since this is actually only the logical view of the device, represented by protocol, it is also quite possible to simplify representation of the device by hiding all available audio input/outputs behind a single Audio Transducer Termination, for example the Handset, and implement control of multiple real input/outputs locally inside the device.

All non-audio user interface elements are associated with the User Interface Termination. This special Termination supports Packages to implement all user interaction with the telephone user interface, including Function Keys, Indicators, the Dialpad, etc, as appropriate for the specific device capabilities (within constraints given in the section on User Interface Termination). The User Interface Termination cannot be placed in any Context. This grouping of user interface elements behind a well-know Termination greatly simplifies audits to determine actual device configuration, and reduces the number of Terminations involved in representing user interface.

In addition, TerminationID naming conventions are provided to identify specific Terminations within the Megaco IP Phone MG and group them into related sets. These conventions use a set of well known identifier names to specify the individual Terminations, for example the User Interface Termination ("ui"), the Handset Audio Transducer ("at/hs"), or the Handsfree Audio Transducer ("at/hf"). This specific naming is important in this application, especially for the Audio Transducer Terminations, since the real input/output elements to which they map on the physical device have very different functional significance to the end-user, yet they may be represented in the protocol using exactly the same sets of Packages. Naming conventions allow the controlling MGC to distinguish this end-user meaning without specific advance knowledge of physical device configuration and without the requirement to provide different Packages for each audio input/output type.

Using these same TerminationID naming conventions in combination with wildcards, the MGC application can target commands to groups of related Terminations, for example the collection of all Audio Transducer Terminations ("at/*"). This is especially useful during the discover phase, for example to efficiently Audit all available Audio Transducer Terminations, and to efficiently send commands to a set of related Terminations in a single command, for example to

simultaneously Subtract all Audio Transducer Terminations from a particular Context. Further information on TerminationID naming conventions and their use can be found under the sections on Control Interaction and Capability Discovery (next two subsections) and under Termination Types.

4.4. Control Interaction

To provide control of audio paths, Audio Transducer Terminations are manipulated using Contexts in the normal way, by sending Add, Move, Subtract and Modify commands addressed to the specific Terminations being manipulated. For example creating a Context (Context A) containing an RTP Termination (Tr) and a Handset Audio Transducer Termination (Ta1) creates a voice connection to/from the handset. Moving a Handsfree Audio Transducer Termination (Ta2) into the Context, and removing the Handset, sets up a handsfree conversation. This situation is shown in Figure 1. See the section on Audio Transducer Termination Types for further details on specific Package support requirements.

User input elements, such as Keypad or Function Keys, generate Events through Notify commands sent from the User Interface Termination of the Megaco IP Phone MG to the controlling MGC for handling. These Events are according to the specific set of Packages supported by the User Interface Termination of the device. See the section on User Interface Termination Type for further details on specific Package support requirements.

User output elements such as the Text Display or Indicators are controlled by Signals sent by the MGC, addressed to the User Interface Termination of the Megaco IP Phone MG, generally as part of a Modify command, using syntax defined in the corresponding Packages. Since the User Interface Termination cannot be part of any context, Add, Move and Subtract commands sent to it are not valid. See the section on User Interface Termination Type for further details on specific Package support requirements.

Some elements, for example Softkeys, have both user input and output aspects, so both react to Signals and generate Events as above.

The TerminationID naming conventions may be used to target commands to specific Terminations by well known name, for example to Add the Handsfree Audio Transducer Termination ("at/hf") to a Context. The naming conventions in combination with wildcards may be used to efficiently send commands to groups of related Terminations, for example to simultaneously Subtract all Audio Transducer Terminations ("at/*") from a particular Context.

4.5. Capability Discovery

At startup or service change, the Megaco IP Phone MG identifies itself to its controlling MGC as being a Megaco IP Phone class of device by use of the IPPhone Protocol Profile. This is the first and most important stage of capability discovery, and implicitly provides a great deal of the necessary information in a single step. Thereafter, the MGC can make a large number of assumptions regarding organization and behavior of the MG. See the section on IPPhone Protocol Profile for further details of ServiceChange operation.

Device capabilities, including the list of all Terminations and supported Packages for each, are queried through the AuditValue command. Wildcarded AuditValue commands targeted at the whole MG (i.e., addressed to ContextID=Null, TerminationID=ALL) return the list of all Terminations, including the User Interface Termination and all supported Audio Transducer Terminations. Since the returned TerminationIDs use well known identifier names, the MGC can derive the specific audio input/output elements available on the physical device, and their intended purpose. Further AuditValues commands on individual named Terminations provide further details of each, for example for the MGC to query user interface support Packages available on the User Interface Termination ("ui"). TerminationID naming conventions in combination with wildcards can be used with AuditValues commands to query specific Package support for the collection of all Audio Transducer Terminations ("at/*").

Since the structure of the Megaco IP Phone MG is well known in advance, by virtue of the IPPhone Protocol Profile, audits can be efficiently directed at discovering only what additional information is required by the MGC. Thus the MGC is able to efficiently and unambiguously discover both the specific user interface capabilities and the supported audio input/outputs of the Megaco IP Phone MG, without specific advance knowledge of physical device configuration. It is not necessary for the MGC to attempt to infer function from supported Packages within a random collection of Terminations, and a great deal of behavior common to all Megaco IP Phone MGs can simply be assumed. This pre-determined organization and behavior therefore greatly reduces design complexity of both MG and MGC, and greatly improves interoperability.

5. Termination Types

The Termination types defined for use in the Megaco IP Phone MG are:

- * User Interface (implements user interface);

- * Audio Transducer (implements audio input/output to the user, and potentially appears as several individual Terminations corresponding to individual audio input/outputs on the physical device);
- * RTP (transport of audio streams over IP).

These Termination types represent minimal capabilities to support fully featured business telephones. Additional Termination types can be defined to extend these capabilities.

The following subsections describe requirements and constraints on each type in further detail.

5.1. User Interface Termination Type

The User Interface Termination represents the Megaco IP Phone MG user interface elements. Megaco IP Phone MGs MUST support exactly one User Interface Termination.

TerminationID of the User Interface Termination MUST be "ui", used for both command addressing and command response return. ABNF text encoding for this MUST be as described in Megaco/H.248 Protocol Appendix B.1 [3].

Note: If ASN.1 binary encoding is used (OPTIONAL in this specification), TerminationID for the User Interface Termination MUST be encoded as described in Megaco/H.248 Protocol Appendix A.1 [3], with alphabetic characters of the identifier given above mapping to the equivalent octet string in the ASN.1 encoding.

The User Interface Termination cannot be part of any context, hence Add, Move and Subtract commands are invalid for this Termination.

The User Interface Termination MAY support the following Packages, defined in Megaco/H.248 Protocol H.248 Annex G: "User Interface Elements and Actions Packages" [4].

| Package | Name | Support in User Interface Termination |
|-----------------|------|---------------------------------------|
| Text Display | dis | OPTIONAL |
| Keypad | kp | OPTIONAL |
| Function Key | kf | OPTIONAL |
| Indicator | ind | OPTIONAL |
| Softkey | ks | OPTIONAL |
| Ancillary Input | anci | OPTIONAL |

Additional Packages not listed above MAY also be provided where these are defined to extend to additional user interface elements.

Note: The reasoning to make all Packages optional in the User Interface Termination is to allow maximum flexibility to create a very broad range of Internet telephones and similar devices. For example, anything from a simple hotel lobby phone (handset and hookswitch only), to conferencing units (handsfree unit and one or two buttons) to fully featured business telephones (display, rich set of keys and indicators, both handset and handsfree, etc) could be designed.

5.2. Audio Transducer Termination Types

The Audio Transducer Terminations are used to control audio input/output to/from the end user of the device. Megaco IP Phone MGs MUST support at least one Audio Transducer Termination, which MAY be chosen from the following well known types (with identifier name):

- * Handset ("hs") -- input/output,
- * Handsfree ("hf") -- input/output,
- * Headset ("ht") -- input/output,
- * Microphone ("mi") -- input only,
- * Speaker ("sp") -- output only.

TerminationIDs of the Audio Transducer Terminations MUST be of the form "at/<name>", where <name> is the 2 character identifier listed above, used for both command addressing and command response return. If more than one Audio Transducer Termination of a particular type is implemented, the TerminationIDs of each MUST be of the form "at/<name>/<num>", where <num> is a 2 digit index number in hexadecimal format beginning at 01. Examples of valid TerminationIDs include: "at/hs" (handset), "at/mi/02" (microphone 2), "at/*" (all audio input/outputs). ABNF text encoding for this MUST be as described in Megaco/H.248 Protocol Appendix B.1 [3].

Note: If ASN.1 binary encoding is used (OPTIONAL in this specification), TerminationIDs and wildcards MUST be encoded as described in Megaco/H.248 Protocol Appendix A.1 [3], with alphabetic characters of the identifiers given above mapping to octet sub-strings in the ASN.1 encoding and the '/' character not used.

Additional Audio Transducer Termination types MAY also be defined by the implementer, however well know identifier names for these are outside the scope of this specification.

All Audio Transducer type Terminations MUST support the following Packages, defined in Megaco/H.248 Protocol Annex E [3].

| Package | Name | Support in Audio Transducer Terminations |
|-------------------------------|------|--|
| Basic DTMF Generator | dg | REQUIRED |
| Call Progress Tones Generator | cg | REQUIRED |

Additional Packages not listed above MAY also be provided where applicable to audio input/output functions.

5.3. RTP Termination Type

Megaco IP Phone MGs MUST support at least one RTP Termination in order to support audio streams to/from the device, as defined in Megaco/H.248 Protocol Annex E.12 [3].

No special TerminationID naming convention is defined for RTP Terminations as part of this specification.

6. IPPhone Protocol Profile

The following subsections provide details of the IPPhone Protocol Profile, used between Megaco IP Phone MGs and their controlling MGCs. This includes implicit application-level agreements between the Megaco IP Phone MG and its controlling MGC on organization and behavior of the MG, types of Terminations used and the specific minimum Package support for each, and specific minimum selections on the transport and encoding methods used.

Use of a this Profile greatly simplifies assumptions necessary by the MGC regarding MG organization, thereby reducing complexity and cost of both MG and MGC, and improves interoperability for the specific Megaco IP Phone application. Since the Profile is specific to the

Megaco IP Phone MG, no other applications of Megaco/H.248 Protocol are affected.

It is important to note that the IPPhone Profile specifies minimum functionality only, for interoperability purposes. Additional Termination types, Package support, transport or encoding methods, or other capabilities MAY be added at the discretion of the implementer within the general structure described.

6.1. Profile Descriptor and Usage

Profile name: "IPPhone"
Version: 1

The Megaco/H.248 Protocol [3] describes startup and service change procedures in detail, including use of Profiles.

In brief, the above Profile name and version are supplied by the Megaco IP Phone MG on startup or at service change, in the ServiceChangeDescriptor parameter of the ServiceChange command, issued to the controlling MGC as part of the registration procedure. In response, the MGC may 1) accept control by acknowledging the Service Change, 2) pass control to a different MGC by replying with a new MGC to try, or 3) refuse control entirely by rejecting the Service Change. If MGC control is refused, the Megaco IP Phone MG may attempt registration with other MGCs in its list of MGCs to try.

Once a controlling MGC accepts the IPPhone Profile, both it and the Megaco IP Phone MG become bound by the Profile rules and constraints described in subsequent subsections as well as Megaco IP Phone Termination/Package organization and behavior rules described in previous sections of this document. Thereafter, any protocol use outside these rules is considered an error.

6.2 Termination Organization and Package Support

Termination organization, required Termination types, and the specific Packages supported by each MUST be as described in sections 4 - 5 of this document.

Note that additional Termination types and Package support MAY also be provided within the general structure described.

6.3. Transport

Megaco IP Phone MGs MUST support Application Layer Framing (ALF) over UDP transport, as specified in the Megaco/H.248 Protocol Appendix D.1 [3].

Note that this does not imply that the Megaco IP Phone MG cannot support other transport methods as well. TCP transport is OPTIONAL, but if used MUST conform to Megaco/H.248 Protocol Appendix D.2 [3].

6.4. Message Encoding

Megaco IP Phone MGs MUST support ABNF text encoding of the protocol, as specified in the Megaco/H.248 Protocol Appendix B [3].

Note that this does not imply that the Megaco IP Phone MG cannot support ASN.1 binary encoding as well. ASN.1 binary encoding is OPTIONAL, but if used MUST conform to Megaco/H.248 Protocol Appendix A [3].

7. Security Considerations

The Megaco IP Phone Media Gateway Application Profile adds no new security issues beyond those endemic to all applications of Megaco/H.248 Protocol [3].

8. References

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- [2] Greene, N., Ramalho, M. and B. Rosen, "Media Gateway Control Protocol Architecture and Requirements", RFC 2805, April 2000.
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9. Authors' Addresses

Peter Blatherwick (Editor)
Nortel Networks
P.O. Box 3511, Stn C
Ottawa, Ontario,
Canada K1Y 4H7

Phone: (613) 763-7539
 (613) 724-4726
EMail: blather@nortelnetworks.com
 peter.blatherwick@home.com

Bob Bell
Cisco Systems Inc.
576 S. Brentwood Ln.
Bountiful, UT 84010
USA

Phone: (801) 294-3034
EMail: rtbell@cisco.com

Phil Holland
Circa Communications Ltd.
1000 West 14th Street
North Vancouver, British Columbia,
Canada V7P 3P3

Phone: (604) 924-1742
EMail: phil.holland@circa.ca

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