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## IANA Registration of Enumservices for Voice and Video Messaging

### Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

### Abstract

This document registers the Enumservice named "vmmsg", which is used to facilitate the real-time routing of voice, video, and unified communications to a messaging system. This vmmsg Enumservice registers three Enumservice types: "voicemsg", "videomsg", and "unifmsg". Each type also registers the subtypes "sip", "sips", "http", and "https", as well as the subtype "tel" for the "voicemsg" type.

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## 1. Introduction

ENUM (E.164 Number Mapping, RFC 3761 [1]) is a technology that transforms E.164 numbers (the International Public Telecommunication Numbering Plan, ITU-T Recommendation E.164 [2]) into domain names and then uses DNS (Domain Name System, RFC 1034 [3]) delegation through NS records and Naming Authority Pointer (NAPTR) records (Dynamic Delegation Discovery System (DDDS) Part Three: The Domain Name System (DNS) Database, RFC 3403 [4]) to look up what services are available for a specific domain name.

This document registers Enumservices according to the guidelines given in RFC 3761 [1] to be used for provisioning in the services field of a NAPTR [4] resource record to indicate the types of functionality associated with an end point and/or telephone number. The registration is defined within the DDDS (Dynamic Delegation Discovery System [4][5][6][7][8]) hierarchy, for use with the "E2U" DDDS Application defined in RFC 3761.

Voice messaging systems are used widely with telephony and voice communication services. The need for a voice messaging service type has become clear in order to provide certain applications with direct access to various voice messaging services (for example, voicemail), most typically via the use of SIP.

The authors considered the use of Voice Profile for Internet Mail (VPIM) [14] but found that VPIM was best suited to the non-real-time and non-session-based routing of a voice message once it had been deposited into a voice messaging system. Thus, VPIM was a good solution for the non-real-time and non-session-based routing of voice messages between and within domains, but it did not enable real-time interaction with a voice messaging system.

Thus, a need has been identified for this voice messaging service type that would enable, for example, some of the use cases listed in this section.

Video messaging systems, sometimes called visual voice messaging systems, are beginning to be used with real-time communication services. The need for a video messaging service type has become clear in order to provide certain applications with direct access to various video messaging services, most typically via the use of SIP. Thus, a need has been identified for this video messaging service type that would enable, for example, some of the use cases listed in this section.

Finally, several service providers and software developers have indicated that their system for voice messaging and video messaging either have been or soon will be unified into a single system. As such, they desired to have the option of using an Enumservice type that represents a subscriber's mailbox as being a so-called unified messaging repository. Thus, a need has been identified for this unified voice and video messaging service type that would enable, for example, some of the use cases listed in this section.

### 1.1. Selected Use Cases for Illustrative Purposes

The following is a partial, non-exclusive list of use cases that the vmsg Enumservice could address:

- \* A called party is busy or does not answer a call. A client or server then determines that a messaging service should be used and sends the calling party's session to such a service. The client or server needs to be able to determine which server to direct this real-time session to, whether that is within or outside of the called party's domain.
- \* Similar to the above use case, a real-time session is attempted to a messaging system, but that system is currently unavailable. Since multiple service type records may be returned by the original ENUM query, the client or server could then attempt to initiate a session with one or more backup messaging servers in a manner that is transparent to the calling party and that supports better overall availability of a messaging service.
- \* Similar to the above use case, this service type could be used to balance load across multiple messaging servers, whether those are in the same or in different physical locations.
- \* A user with an account on a messaging service needs to connect to the messaging service in order to retrieve messages. They initiate a real-time session, and an ENUM query is performed to discover the messaging server that holds its mailbox.
- \* In the process of invoking and supporting a real-time, automated and interactive session with a user, whether for message deposit or retrieval, VoiceXML files are referenced and utilized, via either HTTP or HTTPS. Multiple VoiceXML servers could be associated with a user and returned via ENUM query, for the purposes of load balancing, for example.

## 1.2. Consideration of Other Existing Enumservices

The authors considered whether this service type could simply use the SIP Enumservice type [19], but found that it does not satisfy their voice messaging requirements, particularly given the non-SIP URI subtypes specified herein. Even with sub-types for SIP URIs, however, there are challenges to using the SIP Enumservice type. For example, a request for access to such a service could be extended to the requesting SIP client, or User Agent Client (UAC), rather than relying upon the local policy of a SIP server, or User Agent Server (UAS), which means that special routing logic within a UAS cannot be relied upon to solve this problem. More importantly, however, the authors have found that without this service type, a UAC or UAS will be presented with multiple SIP URIs, with no ability other than in non-standards-based routing rules or application logic to recognize which one is related to a voice messaging, video messaging, or unified voice and video messaging service.

## 2. Distribution of Data

The authors believe that it is more likely that these records will be distributed on a purely private basis, but they may also be distributed in public ENUM trees. Distribution of this NAPTR data could be either (a) on a private basis within a service provider's internal network, (b) on a private basis between one or more parties using a variety of security mechanisms to prohibit general public access, or (c) openly available.

## 3. Security Considerations

DNS, as used by ENUM, is a global, distributed database. Should implementers of this specification use `el64.arpa` or any other publicly available domain as the tree for maintaining voicemsg Enumservice data, this information would be visible to anyone anonymously. While this is not qualitatively different from publication in a Telephone Directory, it does open or ease access to such data without any indication that such data has been accessed or by whom it has been accessed.

Such data harvesting by third parties is often used to generate lists of targets for unsolicited information. Thus, a third party could use this to generate a list that it can use to make unsolicited telemarketing phone calls, or so-called SPAM over Internet Telephony (SPIT). Many countries have do-not-call registries or other legal or regulatory mechanisms in place to deal with such abuses.

As noted earlier, carriers, service providers, and other users may simply choose not to publish such information in the public e164.arpa tree, but may instead simply publish this in their internal ENUM routing database that is only able to be queried by trusted elements of their network and/or partner networks, such as softswitches and SIP proxy servers. They may also choose to publish such information in a carrier-only branch of the e164.arpa tree, should one be created.

Although an E.164 telephone number does not appear to reveal as much identity information about a user as a name in the format sip:username@hostname or email:username@hostname, the information is still publicly available; thus, there is still the risk of unwanted communication.

An analysis of threats specific to the dependence of ENUM on the DNS and the applicability of DNSSEC [16] to this is provided in RFC 3761 [1]. A thorough analysis of threats to the DNS itself is covered in RFC 3833 [17].

#### 4. ENUM Service Registration for voicemsg

##### 4.1. Registration for "voicemsg" with Subtype "sip"

Enumservice Name: "voicemsg"

Enumservice Type: "voicemsg"

Enumservice Subtypes: "sip"

URI Schemes: 'sip:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a voice communication session to a voice messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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Any other information the author deems interesting:

Implementers should review a non-exclusive list of examples below in Section 7.

#### 4.2. Registration for "voicemsg" with Subtype "sips"

Enumservice Name: "voicemsg"

Enumservice Type: "voicemsg"

Enumservice Subtypes: "sips"

URI Schemes: 'sips:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a voice communication session to a voice messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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#### 4.3. Registration for "voicemsg" with Subtype "tel"

Enumservice Name: "voicemsg"

Enumservice Type: "voicemsg"

Enumservice Subtype: "tel"

URI Schemes: 'tel:'

#### Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a voice communication session to a voice messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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#### 4.4. Registration for "voicemail" with Subtype "http"

Enumservice Name: "voicemail"

Enumservice Type: "voicemail"

Enumservice Subtype: "http"

URI Schemes: 'http:'

#### Functional Specification:

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'http:' [11] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even voice message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON



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**4.5. Registration for "voicemsg" with Subtype "https"**

Enumservice Name: "voicemsg"

Enumservice Type: "voicemsg"

Enumservice Subtype: "https"

URI Schemes: 'https:'

**Functional Specification:**

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information, which can be contacted using TLS or the Secure Socket Layer protocol.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'https:' [12] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even voice message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON

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## 5. ENUM Service Registration for videomsg

### 5.1. Registration for "videomsg" with Subtype "sip"

Enumservice Name: "videomsg"

Enumservice Type: "videomsg"

Enumservice Subtypes: "sip"

URI Schemes: 'sip:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a video communication session to a video messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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### 5.2. Registration for "videomsg" with Subtype "sips"

Enumservice Name: "videomsg"

Enumservice Type: "videomsg"

Enumservice Subtypes: "sips"

URI Schemes: 'sips:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a video communication session to a video messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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### 5.3. Registration for "videomsg" with Subtype "http"

Enumservice Name: "videomsg"

Enumservice Type: "videomsg"

Enumservice Subtype: "http"

URI Schemes: 'http:'

Functional Specification:

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'http:' [11] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even video message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON

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#### 5.4. Registration for "videomsg" with Subtype "https"

Enumservice Name: "videomsg"

Enumservice Type: "videomsg"

Enumservice Subtype: "https"

URI Schemes: 'https:'

Functional Specification:

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information, which can be contacted using TLS or the Secure Socket Layer protocol.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'https:' [12] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even video message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON

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## 6. ENUM Service Registration for unifmsg

### 6.1. Registration for "unifmsg" with Subtype "sip"

Enumservice Name: "unifmsg"

Enumservice Type: "unifmsg"

Enumservice Subtypes: "sip"

URI Schemes: 'sip:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a unified communication session to a unified messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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### 6.2. Registration for "unifmsg" with Subtype "sips"

Enumservice Name: "unifmsg"

Enumservice Type: "unifmsg"

Enumservice Subtypes: "sips"

URI Schemes: 'sips:'

Functional Specification:

This Enumservice indicates that the remote resource identified can be addressed by the associated URI scheme in order to initiate a unified communication session to a unified messaging system.

Security Considerations: See Section 3.

Intended Usage: COMMON

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### 6.3. Registration for "unifmsg" with Subtype "http"

Enumservice Name: "unifmsg"

Enumservice Type: "unifmsg"

Enumservice Subtype: "http"

URI Schemes: 'http:'

Functional Specification:

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'http:' [11] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even video message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON

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#### 6.4. Registration for "unifmsg" with Subtype "https"

Enumservice Name: "unifmsg"

Enumservice Type: "unifmsg"

Enumservice Subtype: "https"

URI Schemes: 'https:'

Functional Specification:

This Enumservice indicates that the remote resource identified by the associated URI scheme is capable of being a source of information, which can be contacted using TLS or the Secure Socket Layer protocol.

Note that the kind of information retrieved can be manifold. Usually, contacting a resource by an 'https:' [12] URI provides a document. This document can contain references that will trigger the download of many different kinds of information, such as text, audio, video, executable code, or even video message files. Thus, one cannot be more specific about the kind of information expected when contacting the resource.

Security Considerations: See Section 3.

Intended Usage: COMMON

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## 7. Selected Examples for Illustrative Purposes

The following sub-sections document several examples that implementers may find informative. These examples shall in no way limit the various forms that this Enumservice may take.

### 7.1. Example Using a 'sip' URI

```
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 100 "u" "E2U+voicemsg:sip"  
"!^.*$!sip:12155550123@gw.example.com!".
```

In this example, a calling party has attempted a session that has gone unanswered after a certain period of time. The calling party's session is sent to the appropriate voice messaging server, a personalized greeting is played to the calling party, after which it records a voice message to the called party.

### 7.2. Example Using a 'tel' URI

```
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 100 "u" "E2U+voicemsg:tel"  
"!^.*$!tel:1-215-555-0123!".
```

In this example, a calling party has attempted a session that has gone unanswered after a certain period of time. The calling party's session is sent to the appropriate voice messaging server, a personalized greeting is played to the calling party, after which it records a voice message to the called party.

### 7.3. Example Using a Backreference

```
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 100 "u" "E2U+voicemsg:sip"  
"!(^.*)$!sip:\1@example.net!".
```

In this example, a backreference is used to reduce the size of the NAPTR record. The sip URI uses "\1", which would dynamically replace the expression with the TN, in this case +12155550123.



#### 7.4. Example Using a 'sip' URI without a Telephone Number

```
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 100 "u" "E2U+voicemsg:sip"  
"!^.*$!sip:johndoe@gw.example.com!".
```

In this example, a calling party has attempted a session that has gone unanswered after a certain period of time. The calling party's session is sent to the appropriate voice messaging server, a personalized greeting is played to the calling party, after which it records a voice message to the called party. The URI that this session is directed to does not include a telephone number, as this user has multiple service that are not particularly tied to telephone numbers whereby text, audio, video and other multimedia messages can be received and accessed.

#### 7.5. Example of Failover Using E2U+videomsg:sip

```
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 100 "u" "E2U+videomsg:sip"  
"!^.*$!sip:12155550123@gw1.example.com!".  
  
$ORIGIN 3.2.1.0.5.5.5.5.1.2.1.e164.arpa.  
NAPTR 10 200 "u" "E2U+videomsg:sip"  
"!^.*$!sip:12155550123@gw2.example.com!".
```

In this example, the preference indicates that gw1.example.com is used first (100), and if this is unreachable, then the next higher preference (200) is used and gw2.example.com is contacted. While out of scope for this document, a service provider could thus mirror or cluster a message store and fail from the primary to secondary using the DNS in an active-standby mode.

### 8. Implementation Recommendations

#### 8.1. Call Processing When Multiple Records Are Returned

It is likely that both E2U+sip and E2U+voicemsg, E2U+videomsg, and/or E2U+unifmsg Enumservice type records will be returned for a given query. In this case, this could result in what is essentially E2U+sip records for real-time communications with an end user, while, for example, the E2U+voicemsg records will be used for real-time communications with a voice messaging service, when the called party is not available or does not wish to be disturbed. Therefore, the network element that receives the results of this ENUM query will need to know enough information in order to select the voicemsg service type, rather than the sip service type.

In addition, it is likely that multiple E2U+voicemsg, E2U+videomsg, and/or E2U+unifmsg Enumservice type records will be returned for a given query. In this case, multiple records may include order and preference to allow recursion or load balancing. Order could be used to designate a primary and a backup voice, video, or unified voice and video messaging service. Preference could be used to load balance across multiple voice, video, and/or unified voice and video messaging servers by weight, for example.

Finally, as with multiple records resulting from a typical ENUM query of the e164.arpa tree, it is up to the application using an ENUM resolver to determine which record(s) to use and which record(s) to ignore. Implementers should take this into consideration and build logic into their applications that can select appropriately from multiple records based on business, network, or other rules.

## 8.2. NAPTR Configuration Issues

Implementers may wish to consider using regular expressions in order to reduce the size of individual NAPTRs. This will have a significant effect on the overall size of the database involved.

## 9. IANA Considerations

This document registers the 'voicemsg' Enumservice type and the subtype "tel", "sip", "sips", "http", and "https" under the Enumservice registry described in the IANA considerations in RFC 3761. Details of this registration are provided in Section 4 of this document.

This document registers the 'videomsg' Enumservice type and the subtype "sip", "sips", "http", and "https" under the Enumservice registry described in the IANA considerations in RFC 3761. Details of this registration are provided in Section 5 of this document.

This document registers the 'unifmsg' Enumservice type and the subtype "sip", "sips", "http", and "https" under the Enumservice registry described in the IANA considerations in RFC 3761. Details of this registration are provided in Section 6 of this document.

## 10. Acknowledgements

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## 12. References

### 12.1. Normative References

- [1] Faltstrom, P. and M. Mealling, "The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM)", RFC 3761, April 2004.
- [2] ITU-T, "The International Public Telecommunication Numbering Plan", Recommendation E.164, May 1997.
- [3] Mockapetris, P., "Domain names - concepts and facilities", STD 13, RFC 1034, November 1987.
- [4] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part Three: The Domain Name System (DNS) Database", RFC 3403, October 2002.
- [5] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part One: The Comprehensive DDDS", RFC 3401, October 2002.
- [6] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part Two: The Algorithm", RFC 3402, October 2002.
- [7] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part Four: The Uniform Resource Identifiers (URI)", RFC 3404, October 2002.

- [8] Mealling, M., "Dynamic Delegation Discovery System (DDDS) Part Five: URI.ARPA Assignment Procedures", BCP 65, RFC 3405, October 2002.
- [9] Schulzrinne, H., "The tel URI for Telephone Numbers", RFC 3966, December 2004.
- [10] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M., and E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, June 2002.
- [11] Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999.
- [12] Rescorla, E., "HTTP Over TLS", RFC 2818, May 2000.

## 12.2. Informative References

- [13] Peterson, J., Liu, H., Yu, J., and B. Campbell, "Using E.164 numbers with the Session Initiation Protocol (SIP)", RFC 3824, June 2004.
- [14] Vaudreuil, G., "Voice Message Routing Service", RFC 4238, October 2005.
- [15] Brandner, R., Conroy, L., and R. Stastny, "IANA Registration for Enumservices email, fax, mms, ems, and sms", RFC 4355, January 2006.
- [16] Arends, R., Austein, R., Larson, M., Massey, D., and S. Rose, "Protocol Modifications for the DNS Security Extensions", RFC 4035, March 2005.
- [17] Atkins, D. and R. Austein, "Threat Analysis of the Domain Name System (DNS)", RFC 3833, August 2004.
- [18] Foster, M., McGarry, T., and J. Yu, "Number Portability in the Global Switched Telephone Network (GSTN): An Overview", RFC 3482, February 2003.
- [19] Peterson, J., "enumservice registration for Session Initiation Protocol (SIP) Addresses-of-Record", RFC 3764, April 2004.

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