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Requirements for Internet Media Guides
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Abstract

This memo specifies requirements for a framework and protocols for
accessing and updating Internet Media Guide (IMG) information for
media-on-demand and multicast applications. These requirements are
designed to guide choice and development of IMG protocols for

efficient and scalable delivery.

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1 Introduction

1.1 Background and Motivation

   For some ten years, multicast-based (multimedia) conferences
   (including IETF WG sessions) as well as broadcasts of
   lectures/seminars, concerts, and other events have been used in the
   Internet, more precisely, on the MBONE. Schedules and descriptions
   for such multimedia sessions as well as the transport addresses,
   codecs, and their parameters have been described using SDP [2] as a
   rudimentary (but as of then largely sufficient) means. Dissemination
   of the descriptions has been performed using the Session Announcement
   Protocol (SAP) [3] and tools such as SD [4] or SDR [5]; descriptions
   have also been put up on web pages, sent by electronic mail, etc.

   Recently, interest has grown to expand -- or better: to generalize --
   the applicability of these kinds of session descriptions.
   Descriptions are becoming more elaborate in terms of included
   metadata; more generic regarding the types of media sessions; and
   possibly also support other transports than just IP (e.g. legacy TV
   channel addresses). This peers well with the DVB (Digital Video
   Broadcasting) [6] Organization's increased activities towards
   IP-based communications over satellite, cable, and terrestrial radio
   networks, also considering IP as the basis for TV broadcasts and
   further services. The program/content descriptions are referred to as
   Internet Media Guides (IMGs) and can be viewed as a generalization of
   Electronic Program Guides (EPGs) and multimedia session descriptions.

   An Internet Media Guide (IMG) has a structured collection of
   multimedia session descriptions expressed using SDP, SDPng [7] or
   some similar session description format. This is used to describe a
   set of multimedia services (e.g. television program schedules,
   content delivery schedules) but may also refer to other networked
   resources including web pages. IMGs provide the envelope for metadata
   formats and session descriptions defined elsewhere with the aim of
   facilitating structuring, versioning, referencing, distributing, and
   maintaining (caching, updating) such information.

   The IMG metadata may be delivered to a potentially large audience,
   who use it to join a subset of the sessions described, and who may
   need to be notified of changes to this information. Hence, a
   framework for distributing IMG metadata in various different ways is
   needed to accommodate the needs of different audiences: For
   traditional broadcast-style scenarios, multicast-based (push)
   distribution of IMG metadata needs to be supported. Where no
   multicast is available, unicast-based push is required, too.
   Furthermore, IMG metadata may need to be retrieved interactively,
   similar to web pages (e.g. after rebooting a system or when a user is

browsing after network connectivity has been re-established).
Finally, IMG metadata may be updated as time elapses because content
described in the guide may be changed: for example, the airtime of an
event such as a concert or sports event may change, possibly
affecting the airtime of subsequent media. This may be done by
polling the IMG sender as well as by asynchronous change
notifications.

Furthermore, any Internet host can be a sender of content and thus an
IMG sender. Some of the content sources and sinks may only be
connected to the Internet sporadically. Also, a single human user may
use many different devices to access metadata. Thus, we envision that
IMG metadata can be sent and received by, among others, by cellular
phones, PDA (Personal Digital Assistant), personal computer,
streaming video server, set-top box, video camera, and DVR (Digital
Video Recorder) and that they be carried across arbitrary types of
link layers, including bandwidth-constrained mobile networks.
However, generally we expect IMG Senders to be well-connected hosts.

Finally, with many potential senders and receivers, different types
of networks, and presumably numerous service providers, IMG metadata
may need to be combined, split, filtered, augmented, modified, etc.,
on their way from the sender(s) to the receiver(s) to provide the
ultimate user with a suitable selection of multimedia services
according to her preferences, subscriptions, location, context (e.g.
devices, access networks), etc.

1.2 Scope of This Document

This document defines requirements that Internet Media Guide
mechanisms must satisfy in order to deliver IMG metadata to a
potentially large audience. Since IMGs can describe many kinds of
multimedia content, IMG methods are generally applicable to several
scenarios.

In considering wide applicability, this document provides the problem
statement and existing mechanisms in this area. Then several use case
scenarios for IMGs are explained including descriptions of how IMG
metadata and IMG delivery mechanisms contribute to these scenarios.
Following this, this document provides general requirements that are
independent of any transport layer mechanism and application, such as
delivery properties, reliability and IMG descriptions.

This document reflects investigating work on delivery mechanisms for
IMGs and generalizing work on session announcement and initiation
protocols, especially in the field of the MMUSIC working group (SAP,
SIP [8], SDP).

2 Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [1].

2.1 New Terms

> Internet Media Guide (IMG): IMG is a generic term to describe the formation, delivery and use of IMG metadata. The definition of the IMG is intentionally left imprecise.

> IMG Element: The smallest atomic element of metadata that can be transmitted separately by IMG operations and referenced individually from other IMG elements.

> IMG Metadata: A set of metadata consisting of one or more IMG elements. IMG metadata describes the features of multimedia content used to enable selection of and access to media sessions containing content. For example, metadata may consist of the URI, title, airtime, bandwidth needed, file size, text summary, genre and access restrictions.

> IMG Delivery: The process of exchanging IMG metadata both in terms of large scale and atomic data transfers.

> IMG Sender: An IMG sender is a logical entity that sends IMG metadata to one or more IMG receivers.

> IMG Receiver: An IMG receiver is a logical entity that receives IMG metadata from an IMG sender.

> IMG Transceiver: An IMG transceiver combines an IMG receiver and sender. It may modify received IMG metadata or merge IMG metadata received from a several different IMG senders.

> IMG Operation: An atomic operation of an IMG transport protocol, used between IMG sender(s) and IMG receiver(s) for the delivery of IMG metadata and for the control of IMG sender(s)/receiver(s).

> IMG Transport Protocol: A protocol that transports IMG metadata from an IMG sender to IMG receiver(s).

> IMG Transport Session: An association between an IMG sender and one or more IMG receivers within the scope of an IMG transport protocol. An IMG transport session involves a time bound series of IMG transport protocol interactions

that provide delivery of IMG metadata from the IMG sender
to the IMG receiver(s).

3 Problem Statement

As we enumerate the requirements for IMGs, it will become clear that
they are not fully addressed by the existing protocols. The Framework
for the Usage of Internet Media Guides [9] talks about these issues
in more detail.

The MMUSIC working group has long been investigating content, media
and service information delivery mechanisms and protocols, and has
itself produces Session Announcement Protocol (SAP), Session
Description Protocol (SDP), and the Session Initiation Protocol
(SIP). SDP is capable of describing multimedia sessions (i.e.
content in a wider sense) by means of limited descriptive information
intended for human perception plus transport, scheduling information,
and codecs and addresses for setting up media sessions. SIP and SAP
are protocols to distribute these session descriptions.

However, we perceive a lack of a standard solution for scalable IMG
delivery mechanism in the number of receivers with consistency of IMG
metadata between an IMG sender and IMG receiver for both
bi-directional and unidirectional transport. With increased service
dynamics and complexity, there is an increased requirement for
updates to these content descriptions.

HTTP [10] is a well known information retrieval protocol using
bi-directional transport and widely used to deliver web-based
content descriptions to many hosts. However, it has well recognized
limitations of scalability in the number of HTTP clients since it
relies on the polling mechanism to keep information consistent
between the server and client.

SAP [3] is an announcement protocol that distributes session
descriptions via multicast. It does not support prioritization or
fine-grained metadata selection and update notifications, as it
places restrictions on metadata payload size and always sends the
whole metadata. It requires a wide-area multicast infrastructure for
it to be deployable beyond a local area network.

SIP [8] and SIP-specific event notification [11] can be used to
notify subscribers of the update of IMG metadata for bi-directional
transport. However, it is necessary for SIP Event to define an event
package as a standard protocol for each specific application
including IMGs.

We also perceive a lack of standard solution for flexible content

   descriptions to support a multitude of application-specific metadata
   and associated data models with differing amount of detail and
   different target audiences.

   SDP [2] has a text-encoded syntax to specify multimedia sessions for
   announcements and invitations. It is primarily intended to describe
   client capability requirements and enable client application
   selection. Although SDP is extensible, it has limitations such as
   structured extensibility and capability to reference properties of a
   multimedia session from the description of another session.

   These are mostly overcome by the XML-based SDPng [7], which is
   intended for both two-way negotiation and also unidirectional
   delivery. Since SDPng addresses multiparty multimedia conferences, it
   is necessary to extend the XML schema in order to describe general
   multimedia content.

4 Use Cases Requiring IMGs

4.1 Connectivity-based Use Cases

4.1.1 IP Datacast to a Wireless Receiver

   IP Datacast is the delivery of IP-based services over broadcast
   radio. Internet content delivery is therefore unidirectional in this
   case. However, there can be significant benefits from being able to
   provide rich media one-to-many services to such receivers.

   There are two main classes of receiver in this use case: fixed
   mains-powered; and mobile battery-powered. Both of these are affected
   by radio phenomena and so robust, or error-resilient, delivery is
   important. Carouselled metadata transfer (cyclically repeated with
   fixed bandwidth) provides a base level of robustness for an IP
   datacast based announcement system, although the design of
   carouselled transfer should enable battery-powered receivers to go
   through periods of sleep to extend their operational time between
   charges. Insertion of Forward Error Correction (FEC) data into
   metadata announcements improves error resilience, and reordering
   (interleaving) data blocks further increases tolerance to burst
   errors.

   To enable receivers to more accurately specify the metadata they
   are interested in, the unidirectional delivery may be distributed
   between several logical channels. This is so that a receiver needs
   only access the channels of interest and thus can reduce the amount
   of time, storage and CPU resources needed for processing the IP
   data. Also, hierarchical channels enable receivers to subscribe to
   a, possibly well known, root multicast channel/group and

   progressively access only those additional channels based on
   metadata in parent channels.

   In some cases the receiver may have multiple access interfaces adding
   bi-directional communications capability. This enables a multitude of
   options, but most importantly it enables NACK based reliability and
   the individual retrieval of missed or not-multicasted sets of
   metadata.

   Thus, essential IMG features in this case include: robust
   unidirectional delivery (with optional levels of reliability
   including "plug-in FEC" supported by a transport layer protocol)
   which implies easily identifiable segmentation of delivery data to
   enable FEC, carousel, interleaving and other schemes possible;
   effective identification of metadata sets (probably uniquely) to
   enable more efficient use of multicast and unicast retrieval over
   multiple access systems regardless of the parts of metadata and
   application specific extensions in use; prioritization of metadata,
   which can (for instance) be achieved by spreading it between channels
   and allocating/distributing bandwidth accordingly.

   Furthermore, some cases require IMG metadata authentication and some
   group security/encryption and supporting security message exchanges
   (out of band from the IMG multicast sessions).

4.1.2 Regular Fixed Dial-up Internet Connection

   Dial-up connections tend to be reasonably slow (<56kbps in any case)
   and thus large data transfers are less feasible, especially during an
   active application session (such as a file transfer described by IMG
   metadata). They can also be intermittent, especially if a user is
   paying for the connected time, or connected through a less reliable
   exchange. Thus this favors locally stored IMG metadata over web-based
   browsing, especially where parts of the metadata change infrequently.
   There may be no service provider preference over unicast and
   multicast transport for small and medium numbers of users as the
   last-mile dial-up connection limits per-user congestion, and a user
   may prefer the more reliable option (unicast unless reliable
   multicast is provided).

4.1.3 Broadband Always-on Fixed Internet Connection

   Typically bandwidth is less of an issue to a broadband user and
   unicast transport, such as using query-response methods, may be
   typical for a PC user. If a system were only used in this context,
   with content providers, ISPs and users having no other requirements,
   then web-based browsing may be equally suitable. However, broadband
   users sharing a local area network, especially wireless, may benefit

more from local storage features than on-line browsing, especially if
they have intermittent Internet access.

Some services on broadband, such as live media broadcasting, benefit
from multicast transport for streaming media because of scalability.
In the cases where multicast transport is already available, it is
convenient for a sender and receiver to retrieve IMG metadata over
multicast transport. Thus, broadband users may be forced to retrieve
IMG metadata over multicast if backbone operators require this to
keep system-wide bandwidth usage feasible.

4.2 Content-orientated Use Cases

IMGs will be able to support a very wide range of use cases for
enabling content/media delivery. The following few sections just
touch the surface of what is possible and are intended to provide an
understanding of the scope and type of IMG usage. Many more examples
may be relevant, for instance those detailed in [12]. There are
several unique features of IMGs that set them apart from related
application areas such as SLP based service location discovery, LDAP
based indexing services and search engines such as Google. Features
unique to IMGs include:

> o IMG metadata is generally time-related

> o There are timeliness requirements in the delivery of IMG
>   metadata

> o IMG metadata may be updated as time elapses or when an event
>   arises

4.2.1 TV and Radio Program Delivery

A sender of audio/video streaming content can use the IMG metadata to
describe the scheduling and other properties of audio/video sessions
and events within those sessions, such as individual TV and radio
programs and segments within those programs. IMG metadata describing
audio/video streaming content could be represented in a format
similar to that of a TV guide in newspapers, or an Electronic Program
Guide available on digital TV receivers.

TV and radio programs can be selected for reception either manually
by the end-user or automatically based on the content descriptions
and the preferences of the user. The received TV and radio content
can be either presented in real time or recorded for later
consumption. There may be changes in the scheduling of a TV or a
radio program, possibly affecting the transmission times of
subsequent programs. IMG metadata can be used to notify receivers of

such changes, enabling users to be prompted or recording times to be
adjusted.

4.2.2 **Media Coverage of a Live Event**

The media coverage of a live event such as a rock concert or a sports
event is a special case of regular TV/radio programming. There may be
unexpected changes in the scheduling of live event, or the event may
be unscheduled to start with (such as breaking news). In addition to
audio/video streams, textual information relevant to the event (e.g.
statistics of the players during a football match) may be sent to
user terminals. Different transport modes or even different access
technologies can be used for the different media: for example, a
unidirectional datacast transport could be used for the audio/video
streams and an interactive cellular connection for the textual data.
IMG metadata should enable terminals to discover the availability of
different media used to cover a live event.

4.2.3 **Distance Learning**

IMG metadata could describe compound sessions or services enabling
several alternative interaction modes between the participants. For
example, the combination of one-to-many media streaming, unicast
messaging and download of presentation material could be useful for
distance learning.

4.2.4 **Multiplayer Gaming**

Multiplayer games are an example of real time multiparty
communication sessions that could be advertised using IMGs. A gaming
session could be advertised either by a dedicated server, or by the
terminals of individual users. A user could use IMGs to learn of
active multiplayer gaming sessions, or advertise the users interest
in establishing such a session.

4.2.5 **File Distribution**

IMGs support the communication of file delivery session properties,
enabling the scheduled delivery or synchronization of files between a
number of hosts. The received IMG metadata could be subsequently used
by any application (also outside the scope of IMGs), for example to
download a file with a software update. IMG metadata can provide a
description to each file in a file delivery session, assisting users
or receiving software in selecting individual files for reception.

For example, when a content provider wants to distribute a large
amount of data in file format to thousands clients, the content
provider can use IMG metadata to schedule the delivery effectively.

Since IMG metadata can describe time-related data for each receiver,
the content provider can schedule delivery time for each receiver.
This can save network bandwidth and delivery capacity of senders. In
addition, IMG metadata can be used to consistency check, and thus
synchronize, a set of files between a sender host and receiver host,
when those files change as time elapses.

4.2.6 Coming-release and Pre-released Content

IMG metadata can be used to describe items of content before the
details of their final release are known. A user may be interested
in coming content (a new movie or software title where some aspects
of the content description are known in advance) and so subscribe
to an information service which notifies the user of changes to
metadata describing that content. Thus, as the coming release, or
pre-releases, (such as movie trailers or software demos) become
available the IMG metadata changes and the user is notified of this
change. For example, the user could see an announcement of a movie
that will be released sometime in the next few months, and
configure the user's terminal to receive and record any trailers or
promotional material as they become available.

5 Requirements

5.1 General Requirements

5.1.1 Independence of IMG Operations from IMG Metadata

REQ GEN-1: Carrying different kinds of IMG metadata format in the IMG
message body MUST be allowed.

REQ GEN-2: Delivery mechanisms SHOULD support many different
applications' specific metadata formats to keep the system
interoperable with existing applications.

This provides flexibility in selecting/designing IMG transport
protocol suited to various scenarios.

5.1.2 Multiple IMG Senders

REQ GEN-3: IMG receivers MUST be allowed to communicate with any
number of IMG senders simultaneously.

This might lead to receiving redundant IMG metadata describing the
same items, however it enables the IMG receiver access to more IMG
metadata than may be available from a single IMG sender. This also
provides flexibility for the IMG transport protocols and does not
preclude a mechanism to solve inconsistency among IMG metadata due to

multiple IMG senders. This document assumes a typical IMG environment
will involve many more IMG receivers than IMG senders and that IMG
senders are continually connected for the duration of interest
(rather than intermittently connected).

5.1.3 Modularity

REQ GEN-4: The IMG delivery mechanisms MUST allow the combination of
several IMG Operations.

This is for the purpose of extending functionality (e.g. several or
one protocol(s) to provide all the needed operations). Applications
can select an appropriate operation set to fulfill their purpose.

5.2 Delivery Properties

This section describes general performance requirements based on the
assumption that the range of IMG usage shall be important. However,
it may be noted that requirements of delivery properties may vary
based on the usage scenario, and thus some limited use
implementations place less importance on some requirements.

For example, it is clear that a multicast transport may provide more
scalable delivery than a unicast transport, however scalability
requirements do not preclude the unicast transport mechanisms. In
this sense, scalability is always important for the protocols
irrespective of transport mechanisms.

5.2.1 Scalability

REQ DEL-1: The IMG system MUST be scalable to large numbers of
messages, so as to allow design and use of delivery mechanisms that
will not fail in delivering up-to-date information under huge numbers
of transactions and massive quantities of IMG metadata.

REQ DEL-2: IMGs SHOULD provide a method to prevent an IMG sender from
sending unnecessary IMG metadata that have been stored or deleted in
IMG receivers.

REQ DEL-3: The protocol MUST be scalable to very large audience sizes
requiring IMG delivery.

5.2.2 Support for Intermittent Connectivity

REQ DEL-4: The system MUST enable IMG receivers with intermittent
access to network resources (connectivity) to receive and adequately
maintain sufficient IMG metadata.

This allows intermittent access to save power where there is no need
to keep communications links powered-up while they are sitting idle.
For instance, in this situation periodic bursts of notifies, or a
fast cycling update carousel, allows hosts to wake up for short
periods of time and still be kept up-to-date. This can be beneficial
for IMG receivers with sporadic connections to the fixed Internet,
but is critical in the battery-powered wireless Internet.

The implication of intermittent connectivity is that immediate
distribution of changes becomes infeasible and so managing data
consistency should be focused on the timely delivery of data.

5.2.3 Congestion Control

REQ DEL-5: Internet-friendly congestion control MUST be provided for
use on the public Internet.

REQ DEL-6: An IMG entity SHOULD invalidate the IMG metadata item when
an IMG metadata item has lifetime information and its lifetime is
over. This will lessen the need for notifications of updates from the
IMG sender to the IMG receiver to invalidate the item and may enable
lesser congestion.

5.2.4 Sender and Receiver Driven Delivery

REQ DEL-7: The system MUST be flexible in choosing sender-driven,
receiver-driven or both delivery schemes.

Sender-driven delivery achieves high scalability without interaction
between the IMG sender and receiver. This avoids keeping track of a
delivery state for every IMG receiver.

In contrast, the receiver-driven delivery provides on-demand delivery
for IMG receivers. Since an IMG sender's complete IMG metadata may be
a very large amount of data, the IMG receiver needs to be able to
access the guide when convenient (e.g. when sufficient network
bandwidth is available to the IMG receiver).

5.3 Customized IMGs

REQ CUS-1: The system MUST allow delivery of customized IMG metadata.

The IMG receiver may require a subset of all the IMG metadata
available according to their preferences (type of content, media
description, appropriate age group, etc.) and configuration.

The IMG receiver might send its preferences in the IMG operations
which can specify user specific IMG metadata to be delivered. These

preferences could consist of filtering rules. When receiving these
messages, the IMG sender might respond with appropriate messages
carrying a subset of IMG metadata which matches the IMG receiver's
preferences.

This mechanism can reduce the amount of IMG metadata delivered from
the IMG sender to IMG receiver, and consequently it can save the
resource consumption on the IMG entities and networks. It is
typically useful in unicast cases and also beneficial in multicast
cases where an IMG sender distributes the same IMG metadata to
interested IMG receivers at the same time.

For multicast and unicast cases where the IMG sender does not provide
customized IMG metadata, the IMG receiver could receive all IMG
metadata transmitted (on its joined channels). However, it may select
and filter the IMG metadata to get customized IMG metadata by its
preferences, and thus drop unwanted metadata immediately upon
reception.

Customized metadata might be achieved by changing the IMG
descriptions sent and IMG receivers and/or changing the delivery
properties (channels used).

Note, customization and scalability are only somewhat exclusive.
Systems providing an IMG receiver to an IMG sender request-based
customization, will be generally less scalable to massive IMG
receiver populations than those without this return signaling
technique. Thus, customization, as with any feature which affects
scalability, should be carefully designed for the intended
application, and it may not be possible that a one-size-fits-all
solution for customization would meet the scalability requirements
for all applications and deployment cases.

5.4 Reliability

5.4.1 Managing Consistency

IMG metadata tends to change as time elapses, as new content is
added, the old IMG metadata stored in the IMG receiver becomes
unavailable and the parameters of the existing IMG metadata are
changed.

REQ REL-1: The system MUST manage IMG metadata consistency.

The IMG sender can either simply make updates available
(unsynchronized) or IMG sender and receiver can interact to keep
their copies of the IMG metadata synchronized.

In the unsynchronized model, the IMG sender does not know whether a particular IMG receiver has an up-to-date copy of the IMG metadata.

In the synchronized model, updating a cached copy of the IMG metadata is necessary to control consistency when the IMG sender or receiver could not communicate for a while. In this case, the IMG sender or receiver may need to confirm its consistency by IMG operations.

REQ REL-2: Since IMG metadata can change at any time, IMG receivers SHOULD be notified of such changes.

Fulfilling this requirements needs to be compatible with the scalability requirements for the number of IMG receivers and the consistency of metadata.

Depending on the size of the guide, the interested party may want to defer retrieving the actual information. The change notification should be addressed to a logical user (or user group), rather than a host, since users may change devices.

Note that depending on the deployment environment and application specifics, the level of acceptable inconsistency varies. Thus, this document does not define inconsistency as specific time and state differences between IMG metadata stored in an IMG sender and IMG metadata stored in an IMG receiver.

In general, the consistency of metadata for a content and media is more important immediately prior to and during the media's session(s). Hosts which forward (or otherwise resend) metadata may be less tolerant to inconsistencies as delivering out of date data is both misleading and bandwidth inefficient.

5.4.2 Reliable Message Exchange

REQ REL-4: An IMG transport protocol MUST support reliable message exchange.

The extent to which this could result in 100% error free delivery to 100% of IMG receivers is a statistical characteristic of the protocols used. Usage of reliable IMG delivery mechanisms is expected to depend on the extent to which underlying networks provide reliability and, conversely, introduce errors. Note, some deployments of IMG transport protocols may not aim to provide perfect reception to all IMG receivers in all possible cases.

5.5 IMG Descriptions

REQ DES-1: IMG metadata MUST be interoperable over any IMG transport

protocol, such that an application receiving the same metadata over
any one (or more) of several network connections and/or IMG transport
protocols will interpret the metadata in exactly the same way. (This
also relates to the 'Independence of IMG Operations from IMG
Metadata' requirements.)

REQ DES-2: IMG delivery MUST enable the carriage of any format of
application-specific metadata.

Thus, the system will support the description of many kinds of
multimedia content, without the need for a single homogenous metadata
syntax for all uses (which would be infeasible anyway). This is
essential for environments using IMG systems to support many kinds of
multimedia content and to achieve wide applicability.

REQ DES-3: Whereas specific applications relying on IMGs will need to
select one or more specific application-specific metadata formats
(standard, syntax, etc.), the IMG system MUST be independent of this
(it may be aware, but it will operate in the same way for all).

Thus, a metadata transfer envelope format, that is uniform across all
different application-specific IMG metadata formats, is needed. The
envelope would reference (point to) or carry (as payload) some
application-specific metadata, and the envelope would support the
maintenance of the application-specific metadata, which may also
serve the metadata relationships determined by the data model(s)
used. The envelope would not need to be aware of the data model(s) in
use.

REQ DES-4: IMG metadata MUST be structured to enable fragmentation
for efficient delivery.

This is intended to ensure that and IMG sender with more than a
trivial knowledge of metadata is able to deliver only part of its
(and the global) complete IMG metadata knowledge. (For instance, a
trivial quantity of knowledge could be a single SDP description.) In
general, the resolution of this fragmentation will be very much
dependent on the optimal delivery of a deployment, although some
metadata syntaxes will inherently effect the sensible lower limit for
a single element/fragment.

REQ DES-5: A metadata transfer envelope MUST be defined to include
essential parameters.

Examples of essential parameters are those that allow the metadata in
question to be uniquely identified and updated by new versions of the
same metadata.

   REQ DES-6: It SHALL be possible to deduce the metadata format via the
   metadata transfer envelope.

   REQ DES-7: IMG senders SHALL use a metadata transfer envelope for
   each IMG metadata transfer.

   Thus, it will even be possible to describe relationships between
   syntactically dissimilar application-specific formats within the same
   body of IMG metadata knowledge. (E.g. a data model could be
   instantiated using both SDP and SDPng.)

   REQ DES-8: IMG metadata SHOULD support the description of differences
   between update version and old version of IMG metadata when IMG
   delivery mechanism carries updated IMG metadata and those differences
   are considerably little. (E.g. by providing a 'delta' of the two
   versions. This also relates the delivery property requirements for
   congestion control in Section 5.2.3).

6 Security Considerations

   Internet Media Guides are used to convey information about multimedia
   resources from one or more IMG senders across one or intermediaries
   to one or more IMG receivers. IMG metadata may be pushed to the IMG
   receivers or interactively retrieved by them. IMGs provide metadata
   as well as scheduling and rendezvous information about multimedia
   resources, etc. and requests for IMG metadata may contain information
   about the requesting users.

   The information contained in IMG metadata as well as the operations
   related to IMGs should be secured to avoid forged information,
   misdirected users, spoofed IMG senders, etc. and to protect user
   privacy.

   The remainder of section addresses the security requirements for
   IMGs.

6.1 IMG Authentication and Integrity

   IMG metadata and its parts need to be protected against unauthorized
   altering/adding/deletion on the way. Their originator needs to be
   authenticated.

   REQ AUT-1: It MUST be possible to authenticate the originator of a
   set of IMG metadata.

   REQ AUT-2: It MUST be possible to authenticate the originator of a
   subpart of IMG metadata (e.g. a delta or a subset of the
   information).

REQ AUT-3: It MUST be possible to validate the integrity of IMG
metadata.

REQ AUT-4: It MUST be possible to validate the integrity of a subpart
of IMG metadata (e.g. a delta or a subset of the information).

REQ AUT-5: It MUST be possible to separate or combine individually
authenticated pieces of IMG metadata (e.g. in an IMG transceiver)
without invalidating the authentication.

REQ AUT-6: It MUST be possible to validate the integrity of an
individually authenticated piece of IMG metadata even after this
piece had been separated from other pieces of IMG metadata and
combined with other pieces to form new IMG metadata.

REQ AUT-7: It MUST be possible to authenticate the originator of an
IMG operation.

REQ AUT-8: It MUST be possible to validate the integrity of any
contents of an IMG operation (e.g. the subscription or inquiry
information).

6.2 Privacy

Customized IMG metadata and IMG metadata delivered by notification to
individual users may reveal information about the habits and
preferences of a user and may thus deserve confidentiality
protection, even though the information itself is public.

REQ PRI-1: It MUST be possible to keep user requests to subscribe to
or retrieve certain (parts of) IMG metadata confidential.

REQ PRI-2: It MUST be possible to keep IMG metadata, pieces of IMG
metadata, or pointers to IMG metadata delivered to individual users
or groups of users confidential.

REQ PRI-3: It SHOULD be possible to ensure this confidentiality
end-to-end, that is, to prevent intermediaries (such as IMG
transceivers) from accessing the contained information.

6.3 Access Control for IMGs

Some IMG metadata may be freely available, while access to other IMG
metadata may be restricted to closed user groups (e.g. paying
subscribers). Also, different parts of IMG metadata may be protected
at different levels: e.g. metadata describing a media session may be
freely accessible while rendezvous information to actually access the
media session may require authorization.

REQ ACC-1: It MUST be possible to authorize user access to IMG
metadata.

REQ ACC-2: It MUST be possible to authorize access of users to pieces
of IMG metadata (delta information, subparts, pointers).

REQ ACC-3: It MUST be possible to require different authorization for
different parts of the same IMG metadata.

REQ ACC-4: It MUST be possible to access selected IMG metadata
anonymously.

REQ ACC-5: It MUST be possible for an IMG receiver to choose not to
receive (parts of) IMG metadata in order to avoid being identified by
the IMG sender.

REQ ACC-6: It SHOULD be possible for an IMG transceiver to select
suitable authorization methods which are compatible between both
IMG senders and IMG receivers it interacts with.

REQ ACC-7: It MAY be possible for IMG senders to require certain
authorization that cannot be modified by intermediaries.

6.4 Denial-of-Service attacks

Retrieving or distributing IMG metadata may require state in the IMG
senders, transceivers, and/or receivers for the respective IMG
transport sessions. Attackers may create large numbers of sessions
with any of the above IMG entities to disrupt regular operation.

REQ DOS-1: IMG operations SHOULD be authenticated.

REQ DOS-2: It SHOULD be possible to avoid DoS attacks that build up
session state in IMG entities to exhaust their resources.

REQ DOS-3: It SHOULD be possible to avoid DoS attacks that exhaust
resources of IMG entities by flooding them with IMG metadata.

As an example, two potential solutions which may be considered are
running an IMG entity in stateless mode or identification and
discarding of malicious packets by an IMG entity.

6.5 Replay Attacks

IMG metadata disseminated by an IMG sender or an IMG transceiver may
be updated, deleted, or lose validity over time for some other
reasons. Replaying outdated IMG metadata needs to be prevented.

Furthermore, replay attacks may also apply to IMG operations (rather than just their payload). Replaying operations also needs to be prevented.

REQ REP-1: IMG metadata MUST be protected against partial or full replacement of newer ("current") versions by older ones.

In a system with multiple senders it may not be feasible to prevent some senders delivering older versions of metadata than others - as a result of imperfect sender-sender data consistency. Thus, replay attacks and delivery of inconsistent data requires that an IMG receiver veryfies that the IMG metadata is valid and reliable by using some security mechanism(s) (e.g. authorization, authentication or integrity).

REQ REP-2: Mechanisms MUST be provided to mitigate replay attacks on the IMG operations.

The level of threat from replay attacks varies very much depending on system scale and how well defined or open it is. Thus mitigating replay attacks may lead to different solutions for different systems, independent of the basic delivery method and metadata definitions. A system with multiple senders presents a more challenging scenario for handling replay attacks. As an example, bundling metadata with a security mechanism is one potential solution.

7 IANA Considerations

This document does not request any IANA action.

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