Requirements of Fragment Identification

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Abstract: The task of creating specific references rests on specifications that qualify how parts of resources can be addressed. The lack of standards for fragment identifiers has lead to the problem that links, metadata and references merely point to whole resources. Although it is suggested that fragment identification is specified with a media type's MIME type registration, there are few formats that provide a fragment identification scheme. Furthermore formats that specify fragment identification schemes have not agreed on a common set of requirements.

In this paper we present an overview of the current status of interoperable fragment definitions, point out promising activities that promote interoperable fragment definitions and suggest strategies to promote uniform fragment identifiers. Additionally a set of requirements is defined and described to ease the development of fragment identification standards.

Key Words: fragment identifier, URI, media access, metadata
Category: H.3.3, H.3.5, H.5.1, H.5.4

1 Introduction

Hypertext links are recognized as one of the primary driving forces of the Web and the simplicity of creating links is one aspect for the success of the hypertext Web [Jacobs 04]. Following a link, we are used to navigate directly to the linked information resource, or even to a specific part of the resource. But not all media types define how to address a specific part of a resource with a fragment identifier - FID. For instance, if one would like to link to a selected part of a movie, there is no approved, application and format independent way to do so. But Navigating directly to a specific part of a resource is only one possible application of fragment identifiers. Fragment identifiers can also be used to include a specific part of a resource in another document or to add links or metadata to parts of resources that do not support this internally. The vocabulary required to define the fragments is thereby moved from the metadata or annotation schema to the language that defines the fragment identifier [Geurts 05]. This improves interoperability and usability. Navigation, transclusion and external references are different applications of FID and all have their own specific requirements. By giving an overview on the current status and presenting a set of requirements, this paper promotes uniform fragment identification.

1.1 Fragment Identification on the Web

Fragments can be used to refer to parts of resources on the client-side. This may either be a secondary resource identified by reference to the primary resource or a defined view on the primary resource [Berners-Lee 05]. Fragment identifiers allow authors to reference aspects of existing resources independent of the resource provider. This is possible, because the fragment identifier is separated from the URI - Uniform Resource Identifier before the resource is requested from the server. After the resource has been retrieved the identified fragment is processed by the user agent.

A Web browser or user agent that follows a link to a HTML - Hypertext Markup Language document identified by a URI knows how to interpret the optional fragment identifier, because it is declared in the MIME[1] media type 'text/html'[2]. So if a fragment is declared, the browser will render the whole page and scroll to the identified element. Although it is recommended that a MIME media type registration should contain information on fragment identifiers [Freed 05], there are only few media types that provide fragment identifier specifications. Web formats like HTML, SMIL - Synchronized Multimedia Integration Language and SVG - Scalable Vector Graphics use anchors or named elements to specify link targets that can be used by FID. Although this is sufficient for navigating, it is insufficient for transclusion and external references. Especially multimedia document types are missing clear semantic and syntactic description of fragment identifiers [Ossenbruggen 04, Nack 05, Arndt 07]. The recently published standard MPEG-21 FID[ISO 06] and proposals like temporal URI[Pfeiffer 05] and text/plain FID [Wilde 05] prove that developers need a unified way to address fragments in diverse formats.

A lively discussion is held upon the fact, that content negotiation of the http protocol and fragments don't go well together. In section 3.5 of [Berners-Lee 05] a fragment identifier is described as a component of a URI that allows *indirect* identification of a secondary resource by reference to a primary resource. The secondary resource is the fragment and the primary resource is identified by the URI without the fragment identifier. That is where a possible problem arises when using content negotiation of the http protocol [Fielding 99]. This mechanism selects an appropriate response format of an URI. If a fragment identifier is used with an URI using content negotiation, the fragment identifier has to be consistent across all formats that may be retrieved from that URI. This is well known [Berners-Lee 97] and no agreement has been found how to overcome this potential pitfall. The most simple solution is to avoid combining fragment identifiers and content negotiation.

[1] RFC 2046: Multipurpose Internet Mail Extensions Part Two: Media Types [Freed 96]
[2] RFC 2854: The 'text/html' Media Type [Connolly 00]

After an overview of the status of fragment identification, a set of requirements are presented. Based on these requirements, suggestions how to add fragment identifications to a wide range of common multimedia types are given.

2 Current Status

This part gives an overview of current standards and projects that define fragment identifiers.

HTML, SMIL and SVG support named fragment identifiers. Additionally the fragment identifier of SVG allows to specify a desired view of the document.

XML - Extensible Markup Language files can use the XPointer Framework [Grosso 03] as a basis for fragment identifiers. XML based formats should define their own fragment identifiers. Although one might assume that fragment identification is similar to HTML this is incorrect [Jacobs 04].

Adobe has defined a set of open parameters that can be used as fragment identifiers [Taft 04]. The parameters can be used to define a highlight, to jump to a named destination or page, to search in the document and to define view options. Also it is possible to enable and disable specific controlls for the user like the tool bar, status bar, message bar, navigation panes and scroll bar.

Fragment Identification of MPEG Resources - MPEG-21 FID - is defined in Part 17 of the MPEG-21 framework. It supports all MPEG resources and can be used to address parts of any resource whose MIME type is one of: audio/mpeg, video/mpeg, video/mp4, audio/mp4, application/mp4, application/mp21 and video/MPEG4-visual. It is based on the XPointer Framework and adds temporal, spatial and spatio-temporal axis, logical units, byte ranges, masks for videos and items and tracks of ISO Base Media Files [ISO 06, WG 05].

The two following specifications for fragment identifiers are not standards, but represent the ongoing effort to establish interoperable fragment identifiers for various media types.

The Internet-Draft *Specifying time intervals in URI queries and fragments of time-based Web resources* - Temporal URI - addresses the problem of fragment identification for temporal offsets and time intervals in time-based Web resources. Although it was originally developed to support specific resources (Annodex, CMML2) it can be used with all information resources that relate to a timeline of events [Pfeiffer 05] .

With fragment identifiers from the Internet-Draft *URI Fragment Identifiers for the text/plain Media Type* - text/plain FID - positions, ranges and query results can be addressed. Additionally a hash value can be used to check if a fragment is still valid [Wilde 05].

3 Requirements of Fragment Identifiers

Based on our research on fragment identification and previous work[Rutledge 01, Wilde 05, Pfeiffer 05, ISO 06] a comprehensive set of requirements for fragment identification is presented.

3.1 Source of Fragment Definition

A fragment can either be defined in the destination resource, in a separate location or inside the fragment identifier. In the first case, the author of the resource has to specify the fragments before they can be used; a prominent example is HTML. Other standards like XPointer support addressing into the internal structures of documents without having to modify it.

3.2 Fragment Identification Type

Three main fragment identification types can be distinguished: measured, nominal and structured.

Measured fragments provide dimension specific metrics to identify fragments. Usual dimensions are spatial, temporal and spatio-temporal. The metrics rely on semantics of the dimension and are inherent to the resource. In most cases measured fragment identification is coding format independent.

Nominal fragments use given names or ids within the destination document. The semantic of the fragment is defined by the media type. While HTML and SMIL only support fragments to be used as link targets, SVG allows to define views.

Structured fragments use the physical or logical structure of a resource type to identify a fragment. Queries are another way to identify structural fragments. The specification of text/plain FID [Wilde 05] shows how to use regular expressions to identify fragments in text files. The XPointer Framework has been defined as a basis to identify fragments in XML documents based on various properties, such as element types, attribute values, character content and relative position.

Depending on the resource type and its semantics, fragment identification can be measured, nominal, structured or any meaningful combination of these fragment types. A prominent example of a fragment identifier using structured, nominal and measured fragments is the MPEG-21 FID. MPEG-21 FID is an ISO standard that is based on the XPointer framework and defines fragment identifiers with respect to media semantics of MPEG resources.

3.3 Fragment Presentation

If easy distinction between fragment and context has to be provided to the user, a reasonable solution is highlighting the fragment with a given style. In order to have coherent presentations of the same fragment across user agents, presentation behavior has to be specified with the fragment identifier. Style attributes of the highlight can be defined as part of the fragment or within the destination resource. In CSS3 - Cascading Style Sheets Level 3 the pseudo class target can be used to define style of the link destination [Celik 04].

Another presentation dependent fragment that can to be defined is the view of a resource. Formats like SVG and PDF define attributes in their fragment identifiers that allow adjustments of the region that is displayed.

3.4 Fragment Context Removal

In order to improve reuse of existing resources, an author may crop or clip resources thereby creating a fragment. Using a fragment identifier one can also create a portion of the original resource. This implies that the fragment is separated from the context. The context of a fragment is a portion of a resource, that is not a fragment [Rutledge 01]. As discussed in [Rutledge 01] a unified fragment identification would introduce unification, consistency and simplicity to Web fragmenting.

The author of the FID should be able to control whether context has to be removed. By definition, context removal of URI fragments is done by the client. Although it is obvious that server side context removal is more efficient in terms of network traffic, this behavior guarantees, that fragment identification is independent from the provider of the resource.

3.5 Fragment Robustness

Since resources may change, means to improve robustness should be added to fragment identification. An example how this can be done by adding a hash sum is available in [Wilde 05]. The hash sums are used to check if a resource has changed.

4 Evaluation of the current status

All fragment identification formats presented in this paper except XPointer are evaluated with respect to the identified requirements. XPointer does not specify appropriate semantics for fragment identification of specific XML-based data formats [Jacobs 04].

4.1 Fragment Definition and Identification

MPEG-21 FID is the most expressive language and can be extended to support other pointer schemes. In contrast to the open framework of MPEG-21 FID all other formats are focused on specific formats. The text/plain FID format provides a complete set of identifiers for resources with the media type text/plain. Temporal URI defines ways to address temporal fragments similar to MPEG-21 FID. HMTL, SMIL and SVG use nominal fragments for identification, with the limitation, that only elements that have been given names can be used as fragments.

4.2 Fragment Presentation

None of the fragment identification formats support the definition of style to be used by user agents that present a fragment. HTML and SVG documents may use the CSS3 Hyperlink Presentation Module to specify the presentation properties of hyperlinks, but currently CSS3 is still a working draft.

4.3 Fragment Context Removal

HTML, SMIL, PDF, MPEG-21 FID and text/plain FID do not specify context removal behavior. SVG allows to define client side context removal using view parameters.

Temporal URI uses a query (?) instead of a fragment (#) to support server side context removal. A temporal query supports server-side context removal with the limitation that the server has to be capable of resolving a Temporal URI query. Temporal queries have the same addressing scheme as fragments which allows the author to easily choose between client and server side processing of the fragment identification.

4.4 Fragment Robustness

Fragment robustness is only considered by text/plain FID.

5 Recommendations

In the authors opinion MPEG-21 FID is a promising step towards unified fragment identification for multimedia resources. MPEG-21 FID is a comprehensive standard for fragment identification and has the potential to act as basis for unified fragment identifier specifications, particularly for multimedia resources. It supports all MPEG resources, can be used for almost all audiovisual multimedia resources and has means to add support for other resources.

Just because MPEG-21 FID is very expressive and provides universal schemes for a whole domain, it may have problems becoming widely-used. Without openly available fragment identification processors it is far easier to define proprietary schemes. Feasible tools and support for developers must be the first step towards unified fragment identification. In addition a core profile of fragment identifiers for common use cases and defining mappings for unsupported identifiers outside the core profile can simplify adaptation. Having syntax and semantics that are not directly compatible with other Web technologies may be another disadvantage within the Web community. Furthermore, special requirements like robustness and presentation have not been specified in the MPEG-21 FID. Although it is possible to add them, it is still necessary to agree on a specification to become a standard that ensures interoperability.

6 Conclusions

The need for unification, consistency and simplicity of fragment identifications is obvious, but during the evolvement of the Web little effort has been taken to provide useful fragment identifiers for commonly used formats. This is especially true for formats that were originally not designed for the Web or were not meant to be accessed in a flexible way by referring to parts of the resource.

The requirements identified in this paper will help to improve future fragment identifier specifications in terms of extend, interoperability and expressiveness. Together with efforts that have been taken in several projects and standards [WG 05, Pfeiffer 05, Wilde 05] to provide uniform fragment identifiers it forms the basis for a brisk step towards unified fragment identification.

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