SMIL 2.0 Implementation Overview

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In August 2001, the World Wide Web Consortium (W3C) released version 2.0 of Synchronized Multimedia Integration Language, or SMIL (pronounced "smile"). SMIL 2.0's purpose is bringing state-of-the-art interactive multimedia to the Web. As such, it is a non-proprietary, standardized format encoded in XML that is woven into the W3C's XML-based family of cooperative and interdependent languages. SMIL 2.0 builds on the basic foundation started three years ago by SMIL 1.0, bringing Web-based multimedia up-to-date with the latest developments in multimedia research. The result is a specification that is 15 times as large as that for the first version. SMIL 2.0 makes its features available for a wider variety of Web formats by being a *meta-language*: it defines how multimedia constructs can be written into any XML format for Web presentation. This results in a family of SMIL 2.0 formats. The members of this family include:

- *SMIL Profile* — the flagship of SMIL 2.0 formats
- *SMIL Basic* — SMIL Profile subset for mobile devices
- *SMIL 1.0* — forward-compatible to SMIL Profile
- *XHTML+SMIL* — timing applied to Web pages
- *SVG* — graphics animated with SMIL timing

Like most W3C Recommendations, SMIL 2.0 is being released with strong industrial support. We'll go over the tools that are now available for each member of the SMIL family. Keep in mind, however, that "now" is changing very fast — this writing is as of early December, 2001. More tools may be available as you read this.

SMIL 1.0

In June 1997, the W3C released version 1.0 of SMIL. SMIL 1.0 warmed the Web up to multimedia by introducing the bare essentials for it. It captures in one format the basic foundation for multimedia on the Web.The format has since enjoyed quiet but wide-spread implementation and use. It remains viable in the SMIL 2.0 era by remaining playable on SMIL 2.0 Profile players. The specification for SMIL 1.0 is available at http://www.w3.org/TR/REC-smil/.

Most of SMIL 1.0's silent success was as the behind-the-scenes synchronization format for RealNetworks's *RealPlayer*. RealPlayer is among the primary media browsers on the Web, having been distributed to 200,000,000 desktops world-wide. This means that at least this many SMIL 1.0 browsers now exist on the Web. The media sites linked to by its maker, Real-Networks, have distributed many SMIL 1.0 presentations for use with the player. As a result, SMIL 1.0 presentations have,

and for some time will continue to have, a strong presence on the Web. These RealNetworks-related SMIL documents are typically carried in the ".rm" stream, thus not detectable as SMIL to the user. However, RealPlayer can also load SMIL files directly for playback. Compared to other SMIL players, the focus of RealPlayer is its ability to receive large amounts of bandwidth- and processing-intensive media and play them back in perfect synchronization, without the hiccups and glitches that are so hard to avoid in multimedia playback. The RealPlayer can be downloaded free-of-charge from http://www.real.com/products/player/.

SMIL wide-spread adoption got another big push when Apple put support for SMIL 1.0 in *QuickTime*, starting with version 4.1. In addition to playing SMIL 1.0 presentations, QuickTime also processes its own extension constructs to the format. These extensions only control details of how the presentation is handled by QuickTime player controls, instead of defining the presentation itself. This enables SMIL presentations with QuickTime extensions to play as specified on other SMIL 1.0 browsers. QuickTime is available at http://www.apple.com/quicktime/. Its extensions to SMIL are described at http://www.apple.com/quicktime/authoring/qtsmil.html.

There is also a variety of other SMIL 1.0 players, usually made by research labs. The most sited of these "alternative" SMIL 1.0 players is *Soja* by the Helio organization, available at http://www.helio.org/products/smil/. Sojo is programmed in Java and can be plugged in to other Web browsers, making for fast software download and easy transition between HTML and SMIL presentations. The remaining alterative SMIL 1.0 players come from research labs. *Schmunzel*, by Salzburg Research and Sun Microsystems, is available at http://www.salzburgresearch.at/suntrec/schmunzel/. *S2M2* by the U.S National Institute of Standards and Technology (NIST) is available at http://smil.nist.gov/player/. *HPAS* by Compaq Research is available at http://www.research.compaq.com/SRC/HPAS/.

SMIL Profile

The SMIL 2.0 Language Profile, or SMIL Profile for short, distinguishes itself from other SMIL family member by including virtually all of the new SMIL 2.0 constructs in one XML language. As such, it is the most powerful SMIL format in terms of multimedia integration and synchronization. It is the most straightforward progression from SMIL 1.0 — a single format

for integrating the media of other formats into a presentation, but this time with no holds barred. SMIL 1.0 is, in fact, a proper subset of the Profile, making the full legacy of SMIL 1.0 presentations playable on Profile browsers. SMIL Basic is also a Profile subset, thus SMIL Profile players are also SMIL Basic and SMIL 1.0 players. The SMIL 2.0 Profile was released by the W3C as part of the SMIL 2.0 Recommendation itself. The specification for the SMIL 2.0 Profile is available at http://www.w3.org/TR/smil20/smil20-profile.html.

RealNetworks moves to remain the dominant SMIL player implementer with the beta release of its *RealOne* platform, which plays presentations written in the SMIL 2.0 Profile. As of this writing, a Player Preview version of RealOne can be downloaded free-of-charge off the Web for use during the current pre-beta trial period from http://www.realnetworks.com/solutions/ecosystem/realone.html. This beta version is not a complete implementation of the SMIL 2.0 Profile, but the official full release of the system can be expected to be more complete.

While *GRiNS*, by Oratrix, is best know as an authoring system for SMIL 1.0, and now SMIL 2.0, it also distributed as a player-only version. Both the SMIL 1.0 and SMIL 2.0 versions of the GRiNS player are the most complete implementations of SMIL available. GRiNS's focus is the robust playback of a wide variety of SMIL features in complex documents, with the trade-off that RealPlayer and QuickTime provide more precise synchronization for the simple types of SMIL 1.0 video-with-audio presentations that currently dominate the market. The GRiNS Player for SMIL 2.0 can be downloaded and purchased, with a several week free-of-charge trial period, from http://www.oratrix.com/GRiNS/.

SMIL Basic

While state-of-the-art multimedia has gotten more complex, some of the most important computers in our lives are now quite simple. Multimedia is becoming increasingly communicated through the low-bandwidth medium of radio waves to tiny computers in the palms of our hands. These mobile environments can't play the multimedia desktop computers can, so they need a standardized format for multimedia made just for them. SMIL Basic provides just that: a lean subset of the SMIL 2.0 Profile, with only the SMIL constructs that are appropriate for mobile environments. Like the SMIL Profile, SMIL Basic was released by the W3C as part of the SMIL 2.0 Recommendation itself. The specification for the SMIL Basic is available at http://www.w3.org/TR/smil20/smil-basic.html.

The emerging framework for distributed mobile multimedia is current being arranged by the *3GPP* (Third Generation Partnership Project), a consortium of mobile device developers. 3GPP has chosen SMIL Basic as the format for multimedia communicated to and presented on the upcoming generation of mobile systems. This 3GPP infrastructure is a work in progress, and thus no implementations have been made. But when the 3GPP specifications are released, we can expect partner companies to develop conforming mobile devices, which will have SMIL Basic players built in. Then we can also expect

SMIL Basic multimedia presentations intended for mobile users and their needs to be put on the Web and on mobile communication networks. More information about the 3GPP can be obtained at http://www.3gpp.org/.

X-Smiles is among the most interesting of the currently emerging SMIL implementations. Under development by the Helsinki University of Technology, this Java-encoded browser aims to play several XML-defined languages on one browser for mobile devices. The current version of X-Smiles plays SMIL Basic, but they aim to implement the rest of the SMIL Profile as well. It also plays SVG and XSL-FO, and it processes XSLT as well. X-Smiles can be downloaded free-of-charge from http://www.x-smiles.org/.

Media-based SMIL

SMIL 1.0, the SMIL 2.0 Profile and SMIL Basic are all *native* SMIL in that they define no displayed media themselves — they instead refer entirely to external media files in other formats. With a few minor exceptions, native SMIL can only orchestrate the presentation of whole media files, or temporal clips of them. It cannot, for example, time the display of a word or paragraph of text different from the rest of the text in a document.

The SMIL family language *XHTML+SMIL*, on the other hand, mixes SMIL constructs directly in with HTML constructs into a single XML format. This enables the fine-tuned synchronization of fragments of text documents not possible with native SMIL and referenced external media. The playing of XHTML+SMIL is best suited for multimedia presentations with heavy use of text within one predominantly text-based layout, and less dependence on other more time-intensive media. Providing PowerPoint-like presentations is an oft-cited example use of the format, though this emerging SMIL format can do much more as well. XHTML+SMIL is an ongoing effort within the W3C. W3C Working Drafts of the format have been released. The current Working Draft of the XHTML+SMIL specification is available at http://www.w3.org/TR/XHTMLplusSMIL/.

XHTML+SMIL enjoys very wide distribution through its support in *Internet Explorer*. Microsoft has implemented the latest W3C Working Draft of XHTML+SMIL in Explorer, giving the profile a good head start on the Web. Internet Explorer can be downloaded free-of-charge from http://www.microsoft.com/windows/ie/. Information on Internet Explorer's use of XHTML+SMIL is available at http://msdn.microsoft.com/library/en-us/dntime/html/htmltime.asp.

XHTML+SMIL isn't the only media-based SMIL format. SMIL 2.0 constructs have also been mixed into the W3C Recommendation for graphics, *SVG* (Scalable Vector Graphics). These SMIL constructs enable the displayed SVG constructs to move with the passage of time, providing animated graphics for the Web. SVG is a W3C Recommendation. Its specification is available at http://www.w3.org/TR/SVG/.

Adobe's *SVG Viewer* plays SVG with SMIL-defined animation, and can be downloaded free-of-charge from http://www.adobe.com/svg/viewer/install/. SVG Viewer can

be a plug-in for other browsers, allowing SVG, both static and animated, to be incorporated into HTML and SMIL displays. There is a wide variety of other SVG players, but currently none of them support SMIL animation.

SMIL GUI Editors

Of course it isn't enough to play SMIL — it must be created as well. Creating and maintaining large multimedia presentations is a difficult task because the structure of authored multimedia is more complex than that of text. The management of timing and adaptivity in multimedia is particular complex. To make this job easier, a number of SMIL editors are available with graphical user interfaces providing user-friendly control of the creation of multimedia structure.

The industrial-strength power tool for SMIL 2.0 authoring is *GRiNS*. GR*i*NS provides graphic user interfaces for viewing and editing the spatial and often intricate temporal structure of SMIL 2.0 presentations. The authoring environment also provides integration and playback of individual media components and portions of SMIL presentations. Like its player counterpart, GR*i*NS is a relatively complete SMIL 2.0 implementation. It can output code in SMIL Profile and XHTML+SMIL. GR*i*NS's previewer can play SMIL Profile, Basic, 1.0 and animated SVG. Like most power tools, GR*i*NS is useful for the more expert authors of larger presentations, but has a higher learning curve. Simpler alternatives for SMIL 2.0 may come along as current SMIL 1.0 editors get upgraded. The GR*i*NS editor can be downloaded and purchased, with a several week free-of-charge trial period, from http://www.oratrix.com/GRiNS/.

In the three years since SMIL 1.0 was released, several editors became available for it. Since the market for SMIL came mostly from RealPlayer, most editors generate SMIL 1.0 tailored for it. These typically offer a template-based authoring environment, with graphic user interfaces to some of the key SMIL constructs. They don't offer all the features of GR*i*NS, but some users find them easier to learn, and they are, of course, less expensive. A comparative review of some of these browsers is available at http://smw.internet.com/smil/reviews/.

Fluition is among the SMIL 1.0 editors most promoted in the Western media. Purchases and free trial downloads of Fluition can be arranged at http://www.fluition.com/. London-based *Smibase* recently released its like-named product: a SMIL 1.0 creation maker with a focus on assisting streaming media servers. Purchase of Smibase can be arranged at http://www.smibase.com/. In France, Aurora is developing an open-source SMIL 1.0 editor *SmilMe*, described at http://www.smilme.com/. SMIL 1.0 editors are also emerging on the Asian market. Korean-based SMIL Media offers *EZer SMIL 1.0*, which has a Web page at http://www.smilmedia.com/. DoCoMo Systems in Japan offers, *SMILEditor*, with a free trial download available from http://www.docomo-sys.co.jp/prod/soft/smil2.html.

RealSlideshow Plus 2.0, RealNetworks' contribution to SMIL editing, provide a very user-friendly interface tailored for one simple but common task: SMIL 1.0 encoded slide-shows. RealSlideshow can be purchased and downloaded off the Web from http://www.realnetworks.com/products/slideshow/. A free-of-charge basic version of RealSlideshow is also available from the Web site.

Macromedia supports the authoring of SMIL multimedia presentation in some of its products. *Homesite* supports the validation of SMIL 1.0 content. *Flash* lets you publish a Flash movie as a RealPlayer file, which includes SMIL 1.0 code for synchronization. Information on both these products is available at http://www.macromedia.com/software/.

An interesting newcomer to the SMIL GUI editing scene is *SMILGen*, a RealNetworks product developed and distributed as free-of-charge and open source. It provides an XML-oriented GUI, facilitating creation of XML constructs in general, accounting for the possibilities and restrictions of individual DTDs and schemas, and with some SMIL 1.0- and 2.0-specific features built directly in. It is more general purpose than template-based SMIL 1.0 editors, but requires more XML and SMIL expertise. It doesn't have the intricate SMIL 2.0-specific interface that GR*i*NS has — but then, SMILGen is free-of-charge. SMILGen available from http://www.smilgen.org/.

SMIL Editing Accessories

In addition to the wide variety of GUI editors for SMIL, there are tools for handling other aspects of SMIL creation. American public television's National Center for Accessible Media (NCAM) has developed *MAGpie* for the creation of closed-captions and audio descriptions. These multimedia techniques are essential for making information accessible to the hearing- and sight-impaired. MAGpie makes it much easier to get the timing information from the media to which captions and descriptions are synchronized. MAGpie generates is captions and descriptions in SMIL 1.0 code. This code can either be a SMIL annotation of a single media, or contain SMIL-defined timing code that can be incorporated into a larger SMIL file. MAGpie can be can be downloaded free-of-charge from http://ncam.wgbh.org/webaccess/magpie/.

CWI in the Netherlands provides the *SMIL Syntax Validator*, accessible from http://www.cwi.nl/~media/symm/validator/. For those that write their SMIL code directly with text editors, the validation of this code with SMIL's DTD is essential. Tools like this help authors make sure the code they write conforms to SMIL. This validator checks code written for SMIL 1.0 and the SMIL Profile.

Another tool for the hand-coding inclined is the *Perly SMIL* perl module. This is a module of functions in the programing language Perl. With Perly SMIL, Perl hackers can more quickly write programs that generate SMIL output. Perly SMIL can be downloaded free-of-charge from http://www.webiphany.com/perlysmil/.

Summary and Conclusion

Though recently released, SMIL 2.0 has some important and potentially widely-distributed implementations for the different

facets of its use. The full-powered pure multimedia of the *SMIL 2.0 Profile* is supported in the anticipated Web media mainstay *RealOne*, the upcoming generation of Real-Networks's main media player. SMIL timing with text will make a large presence on Windows-based Web browsing through the support of *XHTML+SMIL* in current versions of *Internet Explorer.* SMIL timing with graphics in *SVG* is expected to have a dominant Web presence though the third SMIL industrial powerhouse *Adobe* and its graphics products. The *3GPP* has declared that upcoming mobile multimedia infrastructure, which it is defining, will use *SMIL Basic* for distributing presentations to cell phones and PDAs. Large-scale SMIL 2.0 maintenance is available through *GRiNS*, while several *template-based* editing systems are available for making smaller presentations. Other smaller-scale efforts are also underway for developing alternative tools for all these formats. An up-to-date list of SMIL implementations, along with other information in SMIL, can be obtained from the W3C Synchro-nized Multimedia Webpage at http://www.w3.org/ AudioVideo/.

Acknowledgments

Lloyd Rutledge is a researcher at CWI (Centrum voor Wiskunde en Informatica), the Dutch National Center for Mathematics and Computer Science. He has been involved in the development of the SMIL editor GRiNS by Oratrix, a spin-off of CWI. His research interests include emerging multimedia standards, semantic annotation of stored media and semi-automatic generation of multimedia presentations. He is currently writing the book "SMIL: Interactive Multimedia on the Web" with Dick C.A. Bulterman.