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Secure, XML-Based Presentation Slide Adaptation for Universal Access

Overview

The demonstrated tool is an XML-based system for securely adapting digital presentation slides for different output devices. The system involves encrypting content, but not structure, at the source end, and a service on an adaptation server, or as a pre-processing application on the client device. The adaptation engine takes advantage of the Microsoft Office OpenXML format used in the Microsoft PowerPoint 2007 presentation software. The slides, visual design elements, vector graphics, and text boxes are reduced in size so that they maintain the same layout positioning and relative size, but features such as object outlining and borders effectively become larger and more visible on small displays. Furthermore, when desired, text is removed from bulleted lists in order to make more effective use of screen real estate. Processing is performed using unencrypted metadata, while content remains encrypted.

Details

The secure slide adaptation system was implemented in Visual C#, using the .NET Framework 3.0 runtime components. An API is provided by Microsoft for interfacing with the ZIP-compressed container OpenXML file format. The adaptation process can be divided into two main operations: i) content adaptation and ii) layout and display adaptation. Content adaptation involves direct manipulation (reduction) of textual and visual content, whereas layout and display adaptation involves manipulation of the slide and content meta-data affecting how it is rendered in the presentation viewing software. The two input parameters accepted by the system are: down-scale factor (2^n), and the lowest bullet level (b), under which all other levels are discarded.

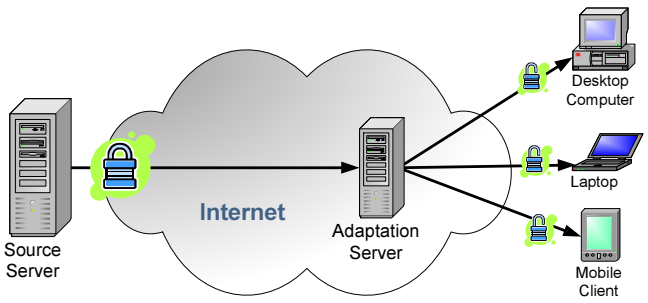

Figure 1: Network topology for secure presentation slide adaptation and distribution system.

All content is encrypted using a secret key-based stream cipher. Hence, the adaptation engine is not given direct access to the content, allowing processing to be implemented in a potentially untrusted domain. The content is structured in such a manner that it can be scaled without decryption.

Content Adaptation

Textual Content

The system reduces textual content by "pruning" bulleted lists. The highest level of a bulleted list is numbered level $m = 1$, hence all levels $m > b$ are completely discarded. This operation is performed by simply searching each slide for all the meta-data tags (`<a:pPr lvl="m"/>`) and removing the corresponding parent tag (`<a:p>`), content, and children. The textual content could be reduced in a more intelligent manner by using a semantic processor capable of summarizing the content. While this is beyond the scope of the developed tool, the proposed system easily supports this approach.

Visual Content

In the case of raster graphics, the slides are preprocessed (at the source, before adaptation) by converting all image files within PPTX container to the JPEG2000 format. This significantly simplifies the adaptation process since the JPEG2000 format supports resolution scaling via a simple truncation process. During the conversion operation, a series of values is generated, corresponding to the image file truncation points which achieve resolution scaling factors of 2^n, for $1 \leq n \leq 3$. These values are inserted into the PPTX file as meta-data, allowing the adaptation engine to scale the resolution of the images by simply truncating the files and without having to decrypt them.

For vector graphics imported as WMF or EMF files, or drawn as native PowerPoint or SmartArt objects, the embedded string that denotes the absolute size is parsed and the size and offset values are reduced by a factor of 2^n. This approach does not scale the individual features (e.g., line stroke width) of the vector graphics, effectively making them larger and more legible with respect to the display of the entire graphic. Since the slide size will also be scaled by a factor of 2^n at a later stage, the relative position and space occupied by the vector graphics remains unchanged.

Layout and Display Adaptation

Once content reduction has been performed, the meta-data describing the slide display and layout must be adjusted to maximize the utility of the smaller output display size. Firstly, the slides are reduced in size by a factor of 2^n. The slide sizes are marked by `<p:sldSz>` in the file presentation.xml.

Font sizes are described using the attribute `sz`, for each text tag `<a:rpr>`. The font size values, stored as hundreds-of-points, are scaled by dividing by n. This is less than the slide scaling factor 2^n and was empirically determined to be a reasonable value, increasing the font size relative to the slide size, making the text more visible, but not occupying an excessive amount of slide real estate.

Text box and picture box sizes are stored as the children of `<a:xfrm>` or `<p:xfrm>`. All sizes and offsets are reduced by a factor of 2^n.