WebCGM - The Choice for Technical Illustrations

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ABSTRACT: In 1989 the ATA (Air Transport Association) adopted CGM (Computer Graphics Metafile) as the format for the interchange of 2-dimensional vector based technical illustrations in maintenance documentation. Both The Boeing Company and United Airlines, along with much of the rest of the industry, use CGM internally to transfer 2-dimensional vector data between diverse systems.

The decision to use CGM, both at the industry level and by individual companies, was made after a review of available open and proprietary formats. Requirements for creation, interchange, delivery, and use were considered. In addition, ATA requirements for intelligent graphics and the expansion of CGM to support application structuring played a major role in that decision.

Over the last few years with the explosion of the World Wide Web, delivery of technical documentation is migrating in that direction. Two emerging W3C (World Wide Web Consortium) vector graphic specifications have appeared to address requirements for scalable vector graphics on the Web. WebCGM was developed by the CGM Open Consortium and W3C graphics expertise as an application profile to the CGM standard based on the ATA graphics interchange profile (GREXCHANGE). SVG (Scalable Vector Graphics) format was developed by a W3C working group and designed specifically for the Web environment.

This paper will review the requirements of the ATA (and companies like The Boeing Company and United Airlines) for graphics in technical documentation. The graphics formats available on the Web will be reviewed and compared against those requirements. In particular WebCGM and SVG will be examined in detail for delivery of technical illustrations in the Web environment. Based on this analysis, the authors will demonstrate why CGM and WebCGM will be the choice of the industry for interchange of 2-dimensional vector illustrations.

Requirements — An Historical Perspective

Prior to the availability of software to aid in the creation of illustrations, nearly all technical illustrations were delivered on paper. Illustrations were often created by manual-drafting or on pasted-up boards that could be reproduced for delivery in a paper manual or on microfilm. The introduction of computer aided drafting and illustrating systems made the generation and management of technical illustrations much easier. This advancement also introduced the problem of digital interchange. Drafting and illustrating systems typically stored the digital illustrations in an internal proprietary format. When a requirement arose to transfer an illustration between systems there was no good solution, and often redrawing was the only solution. In other cases specialized filters were developed to handle specific interchange situations. The introduction of CGM as an international standard in 1987 facilitated the interchange of 2-dimensional graphics between these

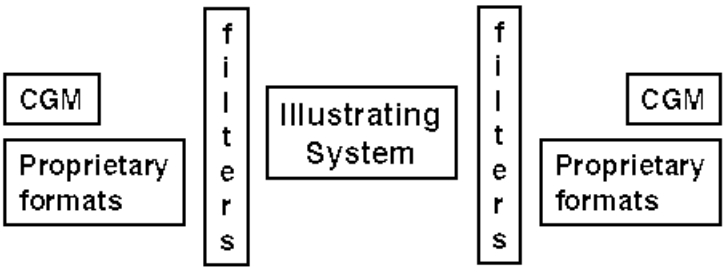
applications.

2D Vector Interchange

The primary requirement for transferring graphical data between different applications is to reuse the art in other illustrations or edit it for use in another area. While raster formats are available to support the transfer process, they do not satisfy the requirement for editing and reuse like vector formats do. The ATA and companies within the industry found they had similar requirements to support digital interchange.

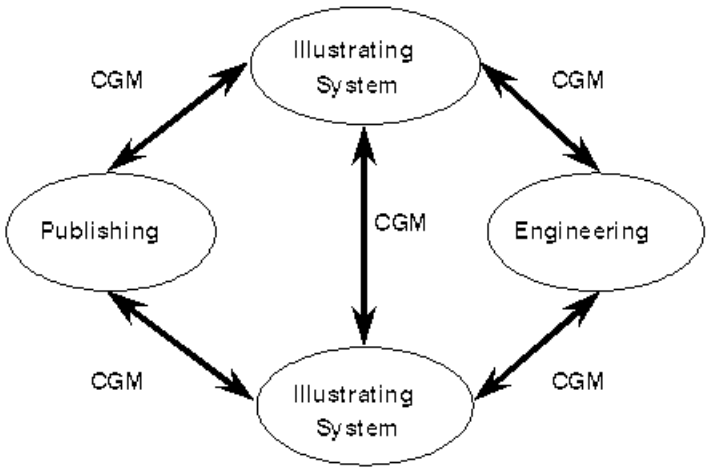
Internal Interchange

Companies within the industry like Boeing and United Airlines create a significant number of technical illustrations to support maintenance documentation. Prior to a common interchange format for 2D vector graphical data, many interfaces needed to be maintained



As the simplified figure above shows, a single illustrating system may have to maintain multiple filters to translate various formats on import and export. The proprietary formats external to the illustrating system may interface with other illustrating systems, CAD systems, or desktop publishing systems. When the illustrating system is modified, several filter applications need to be updated to support the various formats required externally. If an external application is modified or added, the filter must be modified or developed.

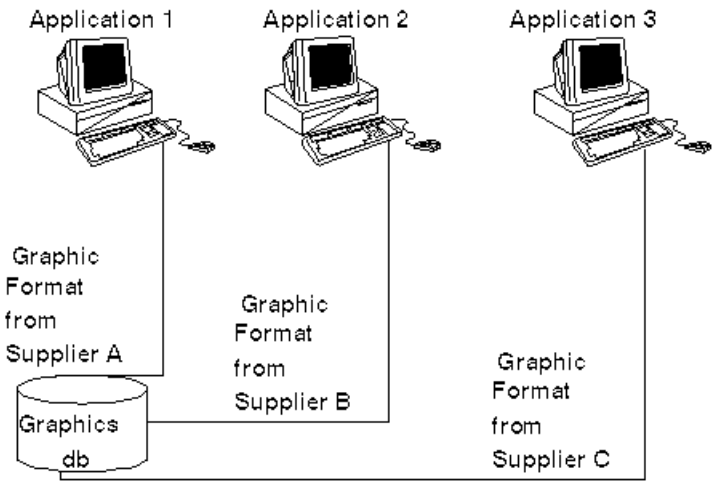
Once CGM gained acceptance, the requirement to maintain multiple filters for proprietary formats was eliminated.



All interfaces beyond the illustrating system are controlled by CGM interchange. A single interpreter and a single generator filter is maintained, resulting in a more robust architecture. Changes to the illustrating system result in less development effort to support interchange.

External Interchange

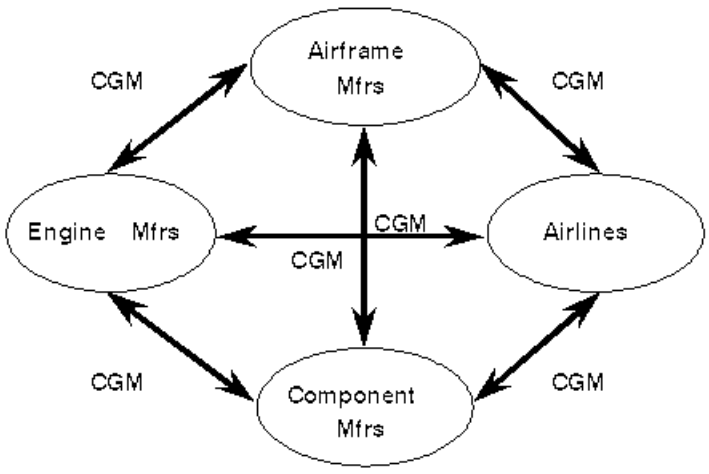
As the concept of digital delivery technical documentation began to emerge, a similar problem existed in the industry. Customers would have to maintain several different systems to handle digital data from different suppliers.



The ATA Graphics Working Group was formed in 1989 to address this issue for technical illustrations. The following is a list of the requirements developed for the solution.

- It must support the interchange of 2D vector line art
- It must have a robust set of graphical primitives and attributes
- Preferably, it is standards based
- It must be testable
- It must be editable to enable reuse
- It must be well supported in multiple applications.
- It must be widely adopted by other industries

CGM met all these requirements as was adopted as the graphical interchange standard for technical documentation. As a result, the need for multiple systems at the airlines was eliminated.

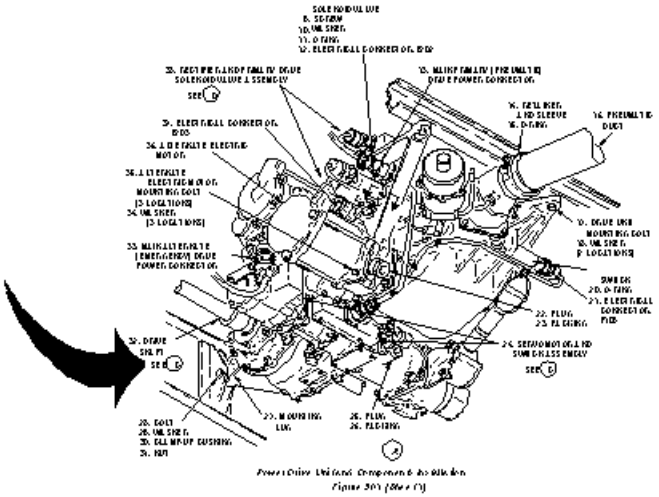


The ATA interchange profile for CGM has been very successful in providing the industry with a common method of delivering and interchanging technical illustrations. Several other industry groups have adopted this profile, and it was used as the baseline in the development of the WebCGM profile.

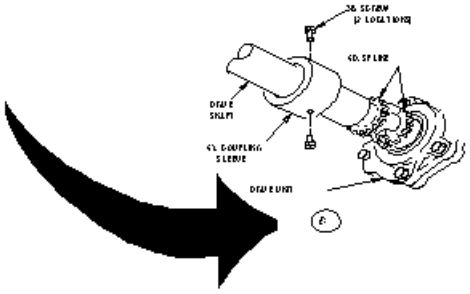
Intelligent Graphics

In the early 1990's, the ATA Graphics Working Group began working on requirements for intelligent graphics. In typical hypertext systems, displaying a graphic represented the end of navigation. To continue navigating, the user had to follow a link back to the text data from the graphic. The requirement define by the industry involved breaking down an illustration into a set of graphical objects. Each object could be assigned attributes to support various functionalities. The ATA developed 4 required funcationalities: navigation, data extraction, query, and analysis.

An example of navigation might include traversing a link from a complex view of an object to a detail view of a particular part.



The result of the navigation would result in the detail view of the part.



To satisfy these requirements a structured graphical format was needed that allowed for the identification of grahical objects with attributes. Since CGM was already a structured format and well-known within the industry, the ATA worked with the standards bodies to extend the standard to allow application structuring. In 1995 an amendment to the standard

was published with support for profile-defined application structuring and assignment of attributes to those structures. A natural extension to the ATA graphics interchange profile was the development of an intelligent graphics profile.

Web Delivery of Vector Graphics

In 1996 the W3C published a set of requirements for vector graphics in the web environment entitled "W3C Scalable Graphics Requirements" (http://www.w3.org/Graphics/ScalableReq). As a result of this document two efforts were launched to satisfy these requirements.

WebCGM

In 1995 CGM was officially listed by the W3C as a registered mime type for the web. In 1997 the W3C published a document entitled "Use of CGM as a Scalable Graphics Format" (http://www.w3.org/TR/NOTE-cgm). In 1998 a group of CGM technology vendors, standards participants, and users formed a consortium centered on this technology called CGM Open. With the help of W3C graphics experts the WebCGM Profile was developed (http://www.w3.org/Graphics/WebCGM). The WebCGM Profile was based on the successful ATA graphics interchange profile with extensions to support intelligent graphics using generic application structures and attributes. WebCGM was published as a W3C Recommendation in 1999. Vendors involved in CGM Open demonstrated interoperability of WebCGM in 1999 using technical documentation examples. WebCGM satisfies a significant portion of the W3C Scalable Graphics Requirements and certainly satisfies the requirements for technical illustrations.

SVG

In 1999 the W3C formed a working group to develop a graphics specification to satisfy the requirements of scalable vector graphics. This group is made up of graphics experts from several large companies dealing with graphics in the web environment. That work has resulted in a W3C Candidate Recommendation entitled Scalable Vector Graphics. SVG is a graphics specification developed from scratch and designed for creative graphics and design. It is encoded in XML (eXtensible Markup Language) and, as such, is fully stylable. It was also design to support integrated, dynamic, and animated web pages. Proprietary extensions are allowed using different namespaces.

A Quick Comparison

WebCGM is a profile based on a stable international standard. Interchange fidelity with CGM has been demonstrated over years of use. Interoperability of WebCGM has been demonstrated. The binary encoding of WebCGM provides a compact file for delivery on the web. Presentation aspects of CGM is self-contained. WebCGM prohibits private extensions.

SVG is a newly developed graphics language. Initial products have been released supporting the specification. Even in compressed form, the size of SVG files exceed those of binary encoded CGM files. Presentation can be carried as external style sheet specifications. Proprietary extensions are allowed.

Both formats support the functional requirements of the ATA industry delivery requirements.

Conclusion

The interchange of technical illustrations within a company like Boeing and United Airlines and between companies as a delivery mechanism has requirements unrelated to the simple delivery of a graphic from one place to another. Repurposing or editing is a large part of the activity that takes place after the interchange process. With web delivery becoming an important requirement for technical documentation, a format needs to be chosen that supports both the deployment of graphics on and web and the manipulation requirement driven by reuse. At this time, it appears WebCGM satisfies both needs.

Biographies

Dave Cruikshank is a Technical Fellow with The Boeing Company in the area of graphics and digital data interchange. He is also the Chief Technical Officer of the CGM Open consortium. He has several years of experience with SGML and CGM interchange. He is the co-chair of the ATA Graphics Working Group and has led projects within Boeing to convert maintenance information to SGML compliant with the ATA interchange DTD's. He is the technical architect of the ATA intelligent graphics model.

Andre DeWild is a supervisor in Wiring Diagram and System Schematic Production at United Airlines. He is the chairman of the ATA Graphics Working Group and has been instrumental in the definition of requirements for graphical interchange and intelligent graphics applications within the air transport industry. He has several years of experience with graphics interchange and use within the industry.