Proceedings of Hypertext Standardization Workshop, NIST, Washington, January 1990

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A STANDARDIZATION ARCHITECTURE FOR HYPERTEXT AND HYPERMEDIA

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Medium: an intermediate agency, means, instrument or channel,
Hyper: over, above, beyond (Oxford English Dictionary)

ABSTRACT

The full potential of hypertext and hypermedia as media for the dissemination of knowledge, competing with and complementing books and journals, will not be realized unless the material disseminated is widely accessible. There is a need for a standardization architecture which supports accessibility while not stifling experiment and innovation. This paper is based on practical experience in designing, implementing and applying a range of hypermedia systems, and on the reports of others with related experience. It abstracts, discusses and illustrates the functionality required in hypermedia systems, relating them to design considerations, and proposes a basis for a standardization architecture.

INTRODUCTION

The value of a medium as a means of dissemination of knowledge is critically dependent on the accessibility of material in that medium. We have come to take for granted the ease of access to scientific and technical literature in printed books and journals. We have achieved a remarkably high degree of accessibility to textual material on electronic networks. Hypertext and hypermedia have the potential to increase the quality and utility of knowledge communication through both on-line and off-line electronic media. However, accessibility is a major problem that needs to be addressed if the full potential of the new medium is to be realized. Hypermedia dissemination of knowledge will be little more than a curiosity if material is accessible only to those with a particular hardware/software environment closely related to that of the originator.

Thus standardization issues are relevant to hypermedia at what may appear to be at an inappropriately early stage in its development. Any proposed standards must take into account the volatility not only of the technology but also of the underlying conceptual framework. What is needed are achievable principles of standardization that encourage innovation rather than stifle it, for example, in allowing a novel hyperbase to be issued in such a way that it demonstrates its full capabilities in the intended hypershell but also functions usefully in more conventional hypershells. There are significant examples of the achievement of such graceful degradation in existing media, such as the mono decoding of stereo phonograph records and the dual transmission of low-resolution (PICT) and high-resolution (Postscript) images in the same document. It is appropriate at this stage of development of hypermedia to establish a *standards architecture* that supports and encourages such stratified information encoding.

The accurate description of hypermedia system requirements capabilities to developers, customers and users is also important in supporting the advance of the technology. There is a need to establish a framework for the notions of hypertext and hypermedia systems that can encompass both the very narrow and very broad definitions of the term, and enable us to communicate with as much precision as is appropriate to the scope of a particular discussion. There is a need to establish a minimal standard vocabulary and corresponding conceptual framework on which to fall back if discussion becomes difficult due to differing terminological and conceptual usage.

Again it is a standards architecture which is appropriate rather than monolithic standards—we must leave ample scope for innovation in terminology and concepts but provide a well-defined set of standard terms and concepts that capture the significant primitives of hypermedia systems.

This paper provides an initial specification for such a standards architecture. It put forward as an attempt to raise and clarify critical issues rather than resolve them. The vocabulary used and suggested usually has obvious roots in existing media technologies, but is not intended to compete with any particular vocabularies gaining strength in the hypermedia literature. It is the underlying concepts which are important and for which it would be useful to achieve some degree of consensus on terms and definitions.

WHAT ARE HYPERTEXT AND HYPERMEDIA?

At the root of the terms, hypertext and hypermedia, is the notion of a medium that goes beyond existing, pre-1980s, standard media, that is of new and advanced forms of intermediate systems mediating between people and their experience of the world, including other people. Hypertext and hypermedia are often defined in terms of the technologies involved, such as computers and videodiscs, but these are local to our era and continually changing. Any definition must also take into account the intentions of the designers and users of such systems—to bring people into effective communication with sources of knowledge.

General Definition of Hypermedia

The following definition captures both the intentions and the technology: 'A hypermedia system is one that uses the most advanced technology practically available to facilitate those significant activities which result from increasing the effectiveness of interaction between people and materials relating to knowledge.' This is intended to be as timeless as possible; to subsume the wide variety of activities possible, such as problem-solving and creative thinking; and to leave open the question of what are materials relating to knowledge. At one time it would have been meaningful to regard a book as a highly innovative hypermedium system, and at later times radio and television could have been similarly regarded. In our era, computing systems, knowledge bases and videodiscs exemplify the 'advanced technology' which can facilitate the 'significant activities' of education, training, decision-making, problem-solving, and so on.

This definition still allows for various interpretations, and Figure 1 attempts to capture the key features of various concepts of hypermedia. Four major conceptual areas are involved: human society and culture, particularly its knowledge processes; instrumentation and control technology, particularly transducers that capture audio-visual events in the world; information technology, particularly databases and information retrieval; and media, ranging from basic drawing materials through to videodiscs. The *strict hypermedia* definition sees hypermedia as integrating some components of information technology and modern graphic and videodisc media. The growing *hypermedia* concept is more general, seeing them as using information technology to extend all past media. The *generalized hypermedia* definition sees them as *knowledge support systems* that integrate existing human knowledge transfer processes with information technology, instrumentation and control technology, and the full range of media. There is no conflict between these interpretations—they differ only in their strictness and are usually differentiated by context.

Hypertext is the restriction of hypermedia to those materials normally presented in printed material, that is text and graphics.

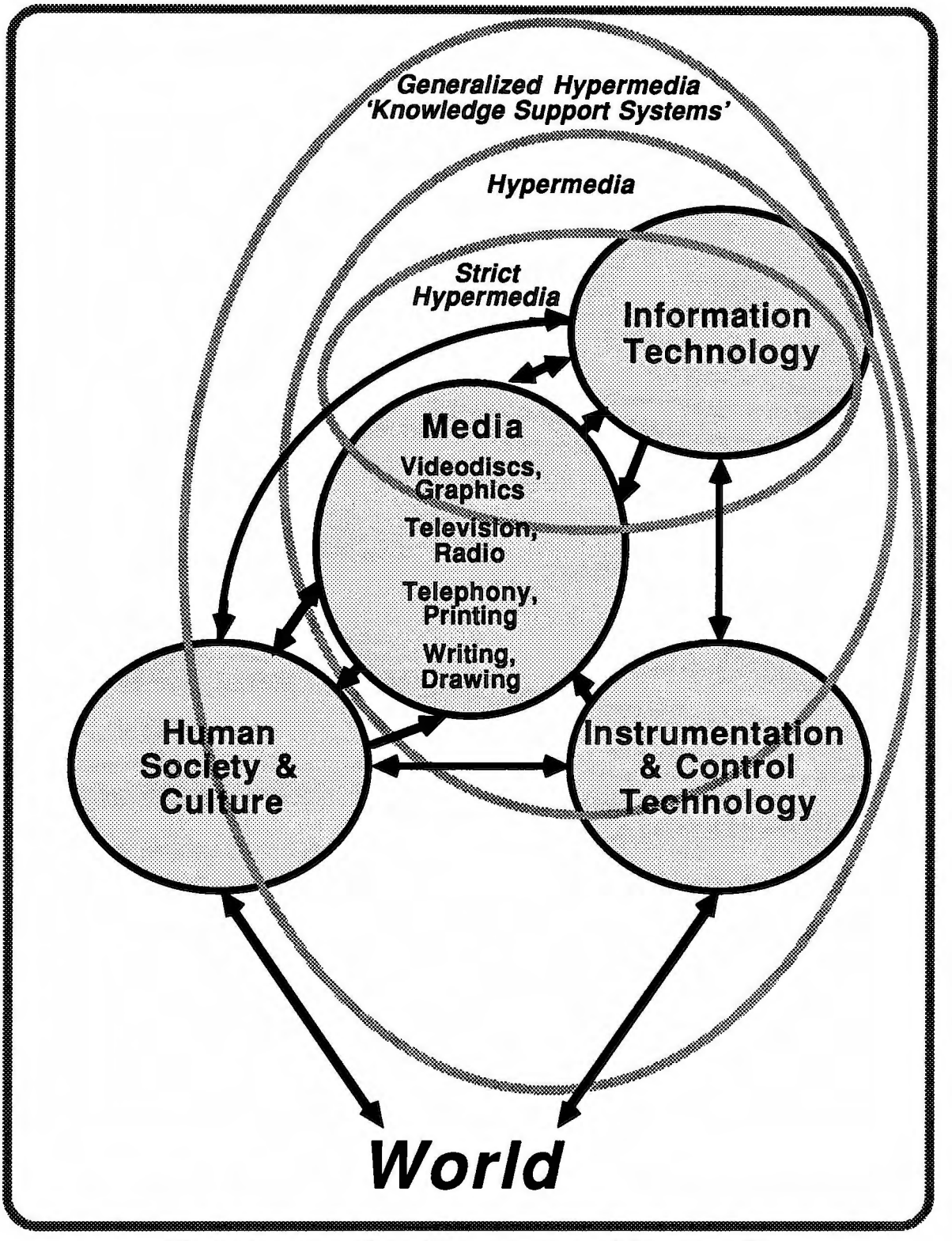

Fig.1 Features of various concepts of hypermedia

Technologies Within Hypertext and Hypermedia Systems

Generalized hypermedia systems can include conventional media as components and can also include non-mediated human activity and non-human activity. There are situations in interacting with a hypermedium system where it may be appropriate for the system to suggest to the user that he undertake activities quite apart from the system, possibly reporting back on the completion or consequences of the activity, for example, in sports coaching. There are also situations where it may be appropriate for the system itself to interact directly with the world rather than the user, for example, in process control.

There is a spectrum of components from those remote from the human-interactive and computer-comprehended central aspects of hypermedia to the diversity of peripheral ways of transmitting knowledge which may have to be included in a hypermedia system to achieve its overall functionality:

non-human activity, e.g. process control, robotics, computer communication;
human activity not monitored by the computer, e.g. reading, walking
computer-monitored human activity, e.g. typing, gesture, speech
computer-controlled activity, e.g. videodisc display
computer-communicated activity, e.g. pre-stored speech, graphic and text display
computer-generated activity, e.g. computed speech, graphic and text display

Distinctions may also be made about computer-generated activity in terms of the sophistication of the underlying algorithms, for example, that it is formula-based or knowledge-based.

Terminology for Hypertext and Hypermedia Systems

Within hypermedia technology, some important distinctions are worth making: between the hypermedium as a general carrier of information; a form of system using that hypermedium; a particular instance of such a system; and the the material that particular system carries. Possible terms are: hypermedium shell, or *hypershell*, for a general system capable of carrying material in a particular hypermedium; hypermedium system, or *hypersystem*, for a particular instance of such a system loaded with material; and hypermedium base, or *hyperbase*, for the totality of material carried by a particular system. These neologisms are necessary to describe precisely the structure and contents of hypermedia systems, and are coined on a model of *expert system shell*, *data base*, *knowledge base*, and so on, so as to link with past referents.

Two other important concepts in hypermedia are the linkage structure embedded in the material and the paths through the material generated by a user following parts of the linkage structure. Possible terms are: *gateway* for a link within material to other material, and *perspective* for the viewpoint into the material that is built up through access to it. These have obvious spatial analogs and correspond to important features of hypermedia, that linkages are embedded in the material and that users build up new viewpoints to the material through their modes of access to it.

HYPERTEXT AND HYPERMEDIA FUNCTIONALITY

As a technology hypermedia are defined by their *functionality*, the technical capabilities that they offer. It is useful to distinguish those aspects of functionality that are: *essential* in that systems without them would not be regarded as hypermedia; *expected* in that systems without them would be regarded as limited examples of hypermedia; and *desirable* in that systems with them would be regarded as particularly good examples of hypermedia. Figure 2 summarizes the definitions relating to hypermedia and the key features of their functionality discussed below.

Hypermedia

Use advanced technology to facilitate interaction between people and knowledge-related materials

Terminology

Hypershell: system to carry material in a hypermedium
Hyperbase: collection of material in a hypermedium
Hypersystem: hypershell loaded with a hyperbase
Gateway: link between materials in a hyperbase
Perspective: structure built to access a hyperbase

Essential Functionality

Integration: provide for materials to carry gateways linking materials
Freedom: allow users to browse through non-predetermined paths
Flexibility: provide multiple perspectives on same material
Usability: provide natural user interfaces

Expected Functionality

Diversity: integrate a range of media and representations
Extensibility: allow users to add new data and new perspectives
Sociality: allow multiple users to access, update and communicate
Spatiality: provide extensive spatial metaphors

Desirable Functionality

Programmability: provide for the incorporation of other programs
Orientability: show users their paths through the hyperbase
Guidability: indicate suitable paths through the hyperbase
Recreatability: allow users to recreate past perspectives
Attributability: allow users to check sources of material
Communicability: aid users to check their understanding of material

Fig.2 Definitions of hypermedia and features of their functionality

Essential Functionality

The essential features of hypermedia come from the intention of bringing people into effective communication with sources of knowledge through as direct as possible access to the hyperbase.

Integration: An essential feature of a hypermedium is that the medium itself carries gateways linking materials in the medium. Standard media require external indexes or directories to carry such linkage information. In books, footnotes, sidenotes, literature citations and explicit references may be used to approximate such gateways.

Freedom: An essential feature of a hypermedium is the freedom to browse through the material along paths which are not predetermined, or determined by the system in response to user answers to its questions. A hypermedium is as *mode-free* as possible within a particular context and across contexts. Note that this freedom may sometimes conflict with usability, but this should be overcome through guidance not restriction.

Flexibility: An essential feature of a hypermedium is its flexibility in giving multiple perspectives upon the same data and in allowing perspectives to be established which were not built in to the original hyperbase. New perspectives will often be generated as the side-effect of action such as search activity. There is an analogy to the way in which a traveller may come upon a significant but unexpected viewpoint by virtue of his attempt to get from one place to another rather than by specifically intending to find, or mentally create, that viewpoint as might a skilled artist.

Usability: An essential feature of a hypermedium is that the functionality provided is made as usable as possible. The functionality/usability distinction is a critical one in the human factors of computing. Ease of access to media has always been important and the incorporation of information technology should simplify access, not make it more complex.

Expected Functionality

The expected features of hypermedia are logical extensions of the intentions, and experience, of bringing people into effective communication with sources of knowledge.

Diversity: An expected feature of a hypermedium is its integration of diverse audio and visual media. Hypertext and hypergraphic systems without audio or videodisc capabilities can be examples of hypermedia, but many of the important design problems do not manifest until a diversity of media are considered.

Extensibility: An expected feature of a hypermedium is its extensibility in allowing new material and new perspectives to be added to the hyperbase. Some components of current hypermedia systems, such as videodiscs, are not extensible at this stage of the technology. This is a significant limitation to their role in hypermedia and to the utility of particular hypermedium systems. A major design objective for a hypermedium system is to overcome this limitation, in the short term by providing remedial extensibility through the storage media of the computer, and in the long term by developing extensibility in components such as videodiscs.

Sociality: An expected feature of a hypermedium is its sociality in allowing multiple users to access and update a hyperbase. Nelson, in particular, has emphasized the communicative, social role of hypermedia (Nelson 1980). The designers have noted that, "One of the biggest limitations of NoteCards is the lack of support for collaborative work" (Halasz, Moran & Trigg 1987), and suggested extensions remedying this (Trigg, Suchman & Halasz 1986).

Spatiality: Existing hypermedia may be seen as making strong use of a spatial metaphor. Information is laid out in space and linkages are seen as paths accessed through gateways. This is so natural that it may not be seen as a metaphor, that is, knowledge in general has no intrinsic spatial representation, but we are so used to its presentation in books and through diagrams that we are conditioned to think of much knowledge in spatial terms. Other metaphors are possible and commonly used in our language: such as time and force (Lakoff and Johnson 1980), but the spatial metaphor plays a central role in existing hypermedia.

Desirable Functionality

The desirable features of hypermedia stem from the opportunities offered by hypermedia to subsume, and give effective end-user access to, many information technologies.

Programmability: A hypermedium shell provides an extraordinarily powerful end-user interface to a computing system, providing for intelligent help and presentation facilities to any depth required. To make use of this potential the shell must provide programming hooks into other programmed systems for dataprocessing, simulation, databases, and so on. A major limitation of simple hypergraphic systems is that they are not programmable in this way. NoteCards provides programming capabilities but only within the Lisp environment.

Orientability: One of the defects of current hypergraphic systems is that it is easy for the user to become disorientated, losing track of where he is in the hyperbase, along what path he has arrived there, and what further territory is open to exploration (Conklin 1986). It is desirable that some form of overview facilities be provided to map the hyperbase and show the user's path through it.

Guidability: It has already been noted that the requirement for *freedom* may conflict with that for *usability*. A mode-free system that makes every possible choice available to a user may be difficult to use because it places an excessive decision-making burden on the user. The hypersystem should make provision for a range of different forms of guidance which do not restrict choice but indicate the basis of choice, the most likely choices, and the reasons for these.

Recreatability: To optimize their perspectives users may take advantage of the freedom to browse through the system looking for relevant data. However, it is possible that they will regard the finishing perspective as less desirable than some earlier one, and it is important that they can checkpoint a perspective at any time and recreate it easily.

Attributability: A hyperbase contains a diversity of information of various origins, dates, and reliability. It is desirable that a user be able to check the attribution of material. Technically, this can be just another gateway, but it requires proper management of accessions to the hyperbase.

Communicability: It is never clear to either user or system wether material presented to a user has been understood. At times this can be very important, and it is desirable that explicit gateways are established to material which checks the understanding of other material.

STANDARDIZATION ARCHITECTURE

The previous sections have established a conceptual framework for hypermedia functionality and suggested terminology for a number of key concepts that relate to major design issues. A standardization architecture needs to provide a conceptual framework for the implementation of systems having this functionality, with implementation recommendations that maximize the accessibility of hyperbases.

The main considerations in a standardization architecture are:

Accessibility: Maximize the accessibility of material distributed in the medium. This is analogous to the open-system concept of *portability*, but goes beyond it in considering not only access on different hardware and software platforms, but also accessibility through the creation of different instances. For example architectures in which the distributed hyperbase is in an intermediate form that can be translated into several different platform-dependent versions with equivalent functionality.

Degradability: The standardization architecture should make provision for increased accessibility through graceful degradation of functionality on some platforms. The design of material with layered functionality such that a minimal kernel is available on a wide range of platforms requires corresponding layered standards for platform capabilities.

Conformity: The standardization architecture should conform to existing practice wherever possible, and, in particular attempt to subsume widely available current systems.

Cross-standardization: The standardization architecture should conform to existing standards wherever possible. Hypermedia are extensions to existing media and the standards should be, as far as possible, supersets of existing standards. This is obvious at the level of ISO/ASCII character codes, but runs into problems with standards that are not yet widely adopted like SGML for structured texts and the plethora of graphic image and picture standards.

Enhancibility: The standardization architecture should take into account developing practice and standards and make provision for future enhancement. The explosive growth of information technology continues to accelerate and the next few years will see widespread adoption of new technologies such as object-oriented programming languages and knowledge bases that are themselves subject to new standards related to those for hypermedia.

Functionality: The standardization architecture should support the essential, expected and desirable functionality already defined for hypermedia. The criteria for graceful degradation, in particular, should at a functional rather than a technical level.

Specificity: The standardization architecture should focus on the specific features of hypermedia which differentiate it from other information technologies. What will be suggested is that the essence of hypermedia, namely the linkage structures and gateways, should be separated from the content. In this way the problems of accessibility, portability, translation and graceful degradation can be compartmentalized in relation to components of content and semantics of links and gateways, and can treated independently.

Figure 3 should the layers of a standardization architecture taking these considerations into account.

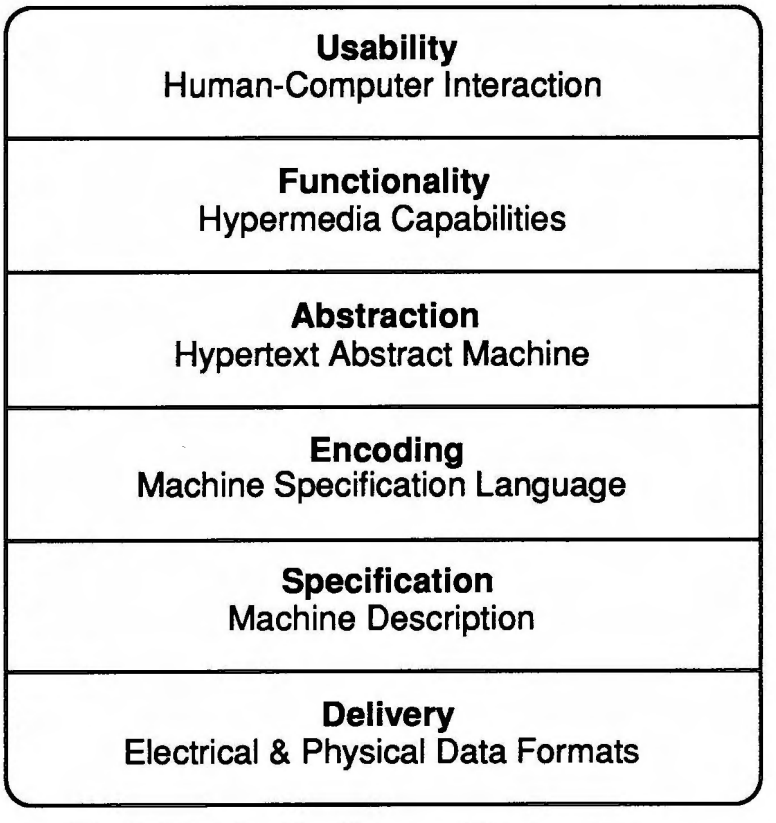

Fig.3 Standardization architecture layers

Usability Layer: The detailed human-computer interaction shell is irrelevant to the essence of hypermedia standardization, despite its critical role in the effective delivery of material. There are many possible ways of presenting material and displaying and activating links, and what the

standard specified should be the minimum functionality to do so. In terms of conformity and cross-standardization three major interaction shells are emerging, X-Windows, IBM's Presentation Manager, and Apple's Macintosh user interface. It is technically straightforward to write interfaces in macros that expand to any of these, and commercial tools are available to support this.

Functionality Layer: The functionality to support has been discussed in detail. The standards architecture should specify this as essential, expected and desirable, and ask that the functionality of any hypermedium shell be classified in terms of the forms of functionality. Degradation when material designed for one shell is run on another should be similarly classified.

Abstraction Layer: The abstraction layer should specify a minimal set of high-level primitives appropriate to the technical specification of hypermedia. HAM, Campbell and Goodman's (1987) Hypertext Abstract Machine is a good starting point. Its primitives of graphs, contexts, nodes, links and attributes can be simplified without loss of generality or expressive power by noting that a graph is a top-level context, that contexts need not form a pseudo-hierarchy and that links can be treated as node attributes. What needs to be added to HAM is the lower-level abstraction of gateways as methods attached to the node-link terminations which can be activated to determine within the node the nature of an incoming or outgoing link attachment.

Encoding Layer: At the encoding layer a separation should be made between the encoding of the node contents and that of the hypermedia structures. Node content standardization should be through cross-reference to other standards with an available minimal standard for each type of content. For example text should always be available in raw ISO/ASCII form. Typographic and layout information should be separated, not embedded to simplify degraded access.

The essential components of a hypertext link are shown in Figure 4. An abstract type hierarchy is also shown to give the semantics in object-oriented terms. Gateways are seen as attributes as of nodes and an outgoing link as an attribute of the source gateway with its value being the destination gateway. Less abstractly, the gateways are methods attached to node objects with external effect (since they operate on the undefined content of the node), and links are relations between gateways.

An important feature of this specification is that it allows a formal and practical specification of degradation in terms of equivalence classes. Gateways may be equivalenced to nodes may be dropped for systems that do not support methods other than retrieval and display. Link labels may be dropped for systems that do not support structured links. There is a very clear separation between the hypermedium infrastructure and the node contents. The remaining HAM primitives can be built out of this node/gateway/link abstraction.

Specification Layer: The specification layer is that at which author operates and the only standards appropriates are guidelines that aid graceful degradation. For example, that node content should be chunked at a reasonably low level to minimize degradation in systems that support only node links and not gateway methods.

Delivery Layer: The delivery layer encompasses the ISO OSI specification from the presentation layer down. That is it is concerned with text, image and sound encoding, through validated delivery down to electrical representation and physical media. There is a tendency to think of the OSI specification narrowly as applying to networks but, in practice, it is also a proper conceptual model for media such as video-discs, CD-ROM and even books. It is important that hypermedia standards adopt a strong conceptual model at this level that is adequate to encompass the wide variety of potential delivery media.

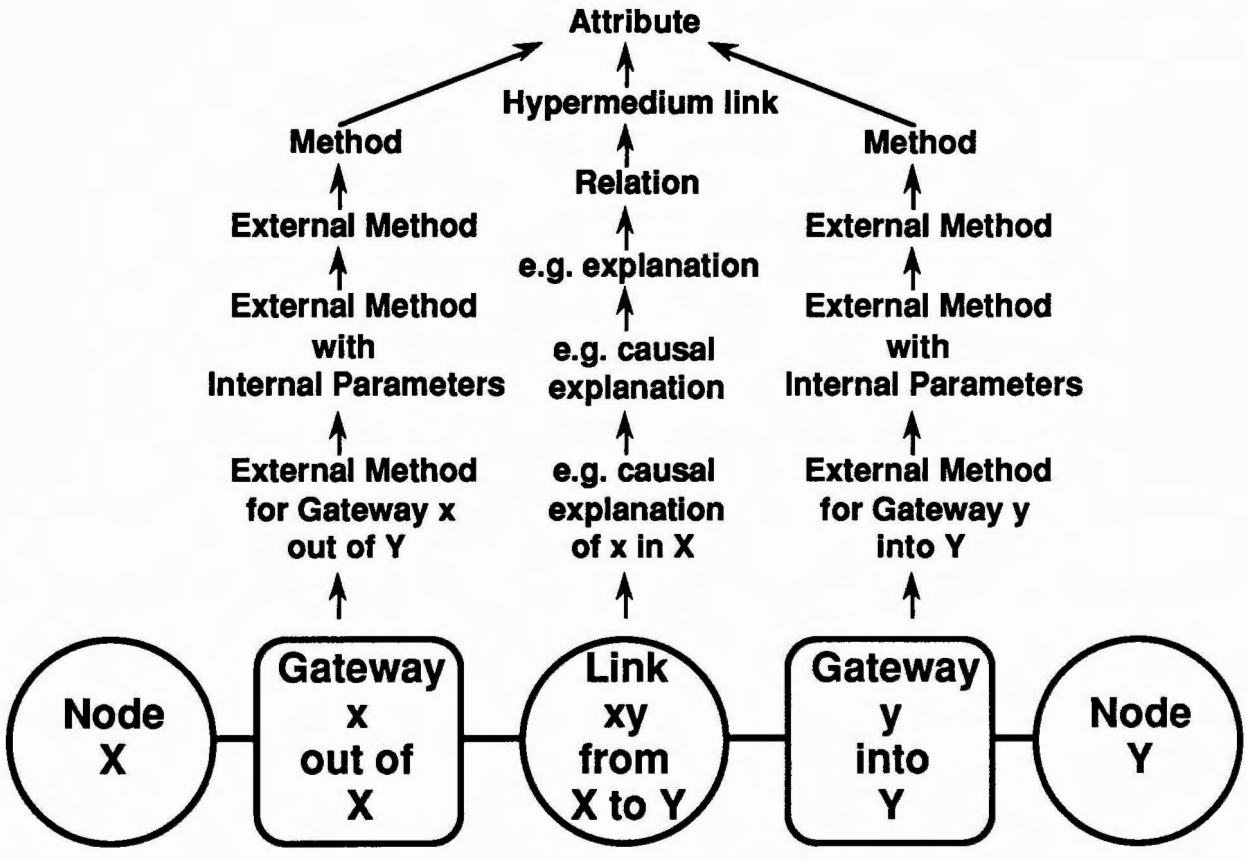

Fig.4 Semantics of a hypertext link

CONCLUSIONS

Hypermedia may be seen as a very significant stage in the evolution of media in general, and in that of information technology as a medium for human knowledge in particular. The new possibilities for interactive communication with passive and active stores of knowledge provided by new generation computing systems create opportunities for further enhancement of human intelligent activity through new media. The hypermedia concept provides a basis for the integration of the very wide variety of resources offered by information technology within a coherent but non-restrictive framework. Data-processing, simulation, information retrieval, text processing, presentation graphics, databases, knowledge bases, expert systems, knowledge acquisition, and so on, may all be regarded in a significant sense as particular aspects of hypermedia systems.

Standards for hypermedia need to take into account the diversity of content and delivery systems of hypermedia and focus on a standards architecture that cross-references existing and developing standards in the content areas, and specifies the linkage structures peculiar to hypermedia in a well-defined and generally applicable form.

The over-arching goal for hypermedia standards must be the accessibility of material in the media, and full account must be taken of increasing accessibility through graceful degradation of functionality. It is important that standards conform as far as possible to existing practice and support experiment and innovation.

The terminology used in this paper has no particular significance and is subject to consensual processes in developing actual standards specifications. However, the issues and conceptual frameworks outlined are critical to the development, delivery and application of hypermedia and should form a minimal check list of topics to be covered in considering standards.

ACKNOWLEDGEMENTS

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REFERENCES

Campbell, B. & Goodman, J.M. (1987). **Proceedings of Hypertext'87**. Chapel Hill: University of North Carolina. pp.21-32 (November).

Conklin, J. (1986). A survey of hypertext. MCC Technical Report STP-356-86. Austin:Microelectronics & Computer Technology Corporation (October).

Halasz, F.G., Moran, T.P. & Trigg, R.H. (1987). Notecards in a nutshell. Carroll, J.M. & Tanner, P.P. (Eds), **Proceedings CHI+GI 1987**. New York: ACM. pp.45-52 (April).

Lakoff, G. & Johnson, M. (1980). **Metaphors We Live By**. Chicago: University of Chicago Press.

Lambert, S. & Sallis, J. (Eds) (1987). **CD-I and Interactive Videodisc Technology**. Indianapolis, Indiana: Howard Sams.

Nelson, T. (1980). Interactive systems and the design of virtuality. **Creative Computing, 6**(11), 56-62 (November).

Trigg, R., Suchman, L. & Halasz, F. (1986). Supporting collaboration in NoteCards. **Proceedings of Conference on Computer Supported Cooperative Work**. Austin, Texas: MCC (December).

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

National Computer Systems Laboratory

December 22, 1989

Dr. Brian R. Gaines
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Dear Dr. Gaines:

Thank you for your contribution to the Hypertext Standardization Workshop to be held January 16-18, 1990 at the National Institute of Standards and Technology. We have received a number of high quality papers and feel honored to host this workshop.

The program committee divided the appropriate submitted papers into two categories: those selected for workshop discussion and those selected for discussion and accepted for inclusion in the workshop proceedings. Papers selected for workshop discussion will be numbered, included in a document register, and made available as a complete package to all workshop participants. Papers accepted for the workshop proceedings will be featured on the first day of the workshop and will be included along with discussion group conclusions in a proceedings to be published by NIST soon after workshop completion.

Your contribution, "A standardization architecture for hypertext and hypermedia", was selected for workshop discussion. Although it contains a number of good ideas, it was not considered sufficiently well-developed to include in the published proceedings. We expect that you will be able to use your paper to influence others in one of the discussion groups and thereby have your most important points reflected in the workshop proceedings as part of a discussion group report. If you wish to refine your contribution before the workshop, please have camera ready copy in our hands by January 5, as we will send the package for photocopy early the following Monday. We will try to have these packages available on Monday, January 15, before the workshop begins, so that you can pick up a copy when you register at the hotel or stop by the Green Auditorium at NIST.

We expect that the authors of papers selected for the workshop proceedings will make an approximate 20 minute presentation to all workshop attendees on Tuesday, the first day, and will be active discussion group participants the following day. Authors of papers selected for workshop discussion will be given an opportunity to express their ideas during the Wednesday discussion group sessions. Thursday morning is intended for the discussion groups to report back to plenary session, with an opportunity for cross-group discussion of the issues.

Enclosed with this letter is a document register containing a list of all the submitted papers selected for workshop discussion. On behalf of the planning committee, I thank you for your interest in this workshop and look forward to meeting you in January.

Sincerely,

Len Gallagher

Leonard Gallagher
Hypertext Standardization Workshop

NIST Hypertext Workshop Document Register

HT-1 Aigner and Dittrich. SmallTextHQT: The Development of a Hypertext System in Smalltalk for the Creation of Online User Documentation (Extended Abstract)

HT-2 Brown, P.J. Standards for Hypertext Source Files: the Experience of UNIX Guide

HT-3 Cole and Brown. Standards: What Can Hypertext Learn from Paper Documents? (with two supporting documents)

HT-4 Crane, Gregory. Standards for a Hypermedia Database: Diachronic vs. Synchronic Concerns

HT-5 Fox, Edward A. Why and How We Should Have Hypertext/Hypermedia Standards: ACM's Need and the CODER/LEND Approach

HT-6 Furuta and Stotts. The Trellis Hypertext Reference Model

HT-7 Gaines, Brian R. A Standardization Architecture for Hypertext and Hypermedia

HT-8 Goldfarb and Talbot. X3V1.8M SMDL: Part Two (Duplication of standard, see Newcomb)

HT-9 Halasz and Schwartz. The Dexter Hypertext Reference Model

HT-10 Handt-Kornzeki, Gomez, Patterson. Standardization of Hypermedia: What's the Point?

HT-11 Hanfling, Seymour. Standards for a Dynamic Concept - Is the Time Right?

HT-12 James, Mitchell E. Short letter with a few opinions

HT-13 Lange, Danny B. A Formal Model of Hypertext

HT-14 Limongiello, Soresi, Spinelli, Vannini (Bull, Italy). From Text to Hypertext through Metatext (Abstract only)

HT-15 Marshall, Catherine C. A Multi-Tiered Approach to Hypertext Integration: Negotiating Standards for a Heterogeneous Application Environment

HT-16 Miglin (ANSWER, Va.). Application of an Authoring Evaluation Framework to the Consideration of Industry Standards for Hypertext Software Shells (Abstract only)

HT-17 Newcomb, S.R. A Layered Model for Links in Hypermedia

HT-18 Nicholas and Rosenberg. Interchange Standards for Hypertext

HT-19 Oren, Tim. Toward Open Hypertext: Requirements for Distributed Hypermedia Standards

HT-20 Parunak, H. Van Dyke. Toward a Reference Model for Hypermedia

HT-21 Pugh, Kenneth. A Proposed Standard for Hypertext Interchange

HT-22 Riley, Victor A. An Interchange Format for Hypertext Systems: the Intermedia Model

HT-23 Rubinsky, Yuri (SoftQuad). Hypertext Standards Must Build on What Exists (Abstract Only)

HT-24 Shipman III, Frank M. A Layered Approach for Hypertext Standardization

HT-25 Thompson, Craig W. Strawman Reference Model for Hypermedia Systems

HT-26 Urr, Clifford. Will the Real Hypertext Please Stand Up - The Problem and Risk of Applying Standards

HT-27 Wojick, David. Why We Need a Standard Language of Linking

Preliminary Agenda
Hypertext Standardization Workshop
January 16, 1990
1:30 pm to 5:30 pm

1:30 - 1:50 pm	*"A Standardization Architecture for Hypertext and Hypermedia"* by Brian Gaines, Knowledge Science Institute, University of Calgary, Calgary, Alberta, Canada T2N 1N4.
1:50 - 2:10 pm	*"The Dexter Hypertext Reference Model"* by Frank Halasz, Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, CA 94304.
2:10 - 2:30 pm	*"Standardization of Hypermedia: What's the Point?"* by Shoshana Hardt-Kornzeki, Bellcore, 445 South Street, Morristown, NJ 07960-1910.
2:30 - 2:50 pm	*"A Formal Model of Hypertext"* by Danny Lange, Bruel & Kjaer Industri A/S, DK - 2850 Naerum, Denmark.
2:50 - 3:10 pm	Break.
3:10 - 3:30 pm	*"A Multi-Tiered Approach to Hypertext Integration: Negotiating Standards for a Heterogeneous Application Environment"* by Catherine Marshall, Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, CA 94304.
3:30 - 3:50 pm	*"Toward Open Hypertext: Requirements for Distributed Hypermedia Standards"* by Tim Oren, Apple Computer, Inc., 204 Mariani Avenue, Cuppertino, CA 95014.
3:50 - 4:10 pm	*"An Interchange Format for Hypertext Systems: The Intermedia Model"* by Victor Riley, Institute for Research in Information and Scholarship, Box 1946, Brown University, Providence, Rhode Island, 02912.
4:10 - 4:20 pm	Define Working Groups.
4:20 - 5:30 pm	Working Group Sessions.
5:30 pm	Reception at the Gaithersburg Marriott Hotel, until 7:00 pm.