A Summary of the Presentations from The First Conference on Cyberspace

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1.0 Introduction

Take fourteen people of varying specialities and ask them to talk about aspects of a common interest. The result is the first conference on cyberspace.

Cyberspace does not exist yet in any palpable form. We have seen some glimmerings of what is possible by using equipment varying from a Commodore 64 to the VPL DataGlove. But this is just the tip of the iceberg. What is needed is some framework for future development in, and research on, cyberspace.

For this reason, the conference focused on directions and ideas, not implementations. The presenters and attendees covered a broad spectrum of disciplines comprising architecture, art, computer science, engineering, philosophy, political science, psychology, sociology and writing (authors). Also the academic, corporate, and industrial worlds were well represented.

Such a mix of disciplines led to a diversity of ideas. However, as the presentations and discussions progressed, some definite themes became clear. This paper attempts to integrate the ideas presented at the conference, gives a partial definition of cyberspace , and indicates directions for future research and discussion.

The paper starts with a general discussion of the nature of cyberspace. This background is used to discuss cyberspace from three different views: interface, information and communication. Next, some theoretical foundations of cyberspace are discussed. Then possible approaches to implementation including architectures and paradigms are outlined. Next the effect on humans individually and in general is covered. After that is a discussion of the issues raised and some areas of conflict. Then some possible areas of research are covered. And finaly a partial definition of cyberspace is given.

2.0 An Introduction to Cyberspace

The most common description of cyberspace comes from the four novels of William Gibson (Gibson 84, 86a, 86b, 88). These novels feature the Matrix, described in Neuromancer as "A consensual hallucination...A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data..." (Gibson84 P. 51). In his books, interaction with the Matrix is through a 'cyberdeck' that has direct connections to the brain. Gibsononian cyberspace is a space that gives form to computer data, and allows direct interaction with that data using all of the senses.

However Gibson's view of cyberspace, though a useful framework, is by no means a complete description. Nor is it the only word associated with information spaces. The term *virtual*

reality or *virtual worlds* tend to be used interchangeably with cyberspace. During the conference, a distinction was made between cyberspace and virtual reality. A *virtual reality* is a simulation of the real world designed to impart some life experience that can change attitudes and behaviours [Henderson]. It allows you to see what is in a different way [Novak]. *Cyberspace* is an information space providing access to information and allowing for links that can be used for retrieval and work with the data [Henderson]. It gives a different relationship with the data, allowing someone to see what is not [Novak]. There is also a sense of cyberspace as a medium of communication as well as an information medium [Briken, Lewis, Morningstar & Farmer, Stenger].

As an idea, cyberspace is not new. It can be seen as the latest clash of the world of technology with the worlds of ideas, belief and faith [Anderson]. Every new media, such as written language and television, has challenged and changed humanities view of itself and the world. Cyberspace will be no exception. Cyberspace is the next step in the desire to find a home for belief [Anderson]. It is also a step in the desire to stabilize and quantify the world, the quest for Eros [Heim]. That is, the search for a more intense reality [Heim]. Even virtual realities are not new. Theatre people have been building them for a long time [Wallser]. Cyberspace is not a new idea, but it is a new technology.

Elements of the technology already exist today in three areas, electronic forums, computer graphics movies and software technology. Electronic forums have three characteristics of cyberspace. They provide a public meeting place, they give a sense of personal identity and they are geographically independent [Anderson]. They are a space that is 'out there', where an individual exists as a collection of contributed information. Computer graphics movies are a precursor in two ways. First they provide a representation of the unreal. They also 'communicate on a wavelength of pulse, image, music, meaning, love; the language of cyberspace.' [Stenger]. Software technology is continually advancing in both the interface and in end user programming, two elements that will be an important part of cyberspace [Pruitt & Barrett].

3.0 Three Views of Cyberspace

The previous section tried to provide a feeling of what cyberspace is. It seems to involve aspects of information and communication along with a new type of interface. This section will bring out points that characterize cyberspace along the three dimensions.

3.1 Cyberspace as an Information Medium

Underlying most of the presentations was a medium composed of information. Whether that information was used directly, or provided a background, it is a major element of cyberspace. Tim McFadden pointed out this basis and characterized cyberspace as a set of connected information spaces that contain information in a transmittable form. The cyberspace would also contain agents that transform the data into a form that humans can directly experience [McFadden] allowing visualization, manipulation and navigation [Henderson].

The information can be divided into two types, data and formalisms. Data is a product of the Renaissance quest for empirical evidence. The formalisms come from Plato's Forms, attempts by humanity to formalize the world. Cyberspace will also link data to forms [Heim]. Cyberspace will represent both information and knowledge. This can also be seen in Wendy Kellogs information web. The information web contains the formalisms, and the objects attached to it are empirical data. A more concrete example comes from Pruitt & Barrett. There personal virtual workspace is a workers office (date) and knowledge stockpile.

One important point to note is that the information and knowledge will not be complete. Any information that comes in will be filtered [Anderson]. Thus some information will be lost.

But also something will be gained. Cyberspace will allow the non-visible to become visible. New correlations can be seen, those that come from affects of higher dimensions of data [Henderson]. And virtual aspects of objects will become visible [Kellog].

Cyberspace as an information medium is one that allows the representation, manipulation and navigation of data and knowledge both real and imagined.

3.2 Cyberspace as a Communication Medium

A hidden assumption above is the presence of people. Cyberspace is a multi-user medium [Morningstar & Farmer]. The information needs to be exchanged between people, communication needs to take place.

The communication can be at three levels, self to self, self to others and self to the Temple [Stenger]. The self to self communication can occur in two ways. It is possible to argue with a representation of the self, communicating concurrently. Or one could leave message for oneself, or view a statistical representation of what the self would be at a future date, communicating over time.

The communication of self with the Temple is the quest for ultimate understanding. The answers to the how and why of our existence. Nicole also refers to it as the self to Deity communication.

The widest scope exists for self to others communication. The others could be objects in cyberspace, or other humans. The objects can be self disclosing, able to converse on function related details [Kellog]. Cyberspace is an animistic space, the trees can talk [Novak].

Human to human communication can be greatly enhanced. Using the McFadden translation agents given above provides a new basis for the exchange of ideas. This assumes that some common intermediate representation exists, and that all ideas can be translated into that representation (See 7.0).

G. Micheal Lewis points out that communication of problems can also be enhanced. He showed that problems can be translated into many different representations, and the the representation had a large effect on the ease of solving the problem. Cyberspace could be used as a translation engine for problem presentation, able to show a problem to an individual in the form best suited to them. Again, this requires a common base representation (See 7.0)

So far, the communication has been of the normal information and knowledge discussed above. But there is also the non-visible that will be made visible. This consists of two parts, simulation and imagination. The simulation part is the discovery of new correlations in data. Some elements of this are already present in scientific visualization.

The imagination part makes cyberspace a 'major perceptual change' [Stenger]. It provides a connection between computer graphics and hallucination, dreams and mysticism [Stenger]. Cyberspace will allow us to see the imagination, a new tool for art [Stenger, Novak]. It allows the creation of objects that have no relation to anything else, a presentation instead of a representation [Novak].

As a communication medium, cyberspace allows a deeper understanding of the self, of others, and perhaps of Deity. It provides tool for communicating at higher level of sympathy and understanding [Stenger].

3.3 Cyberspace as a New Interface

In Gibson Cyberspace the interface is a direct connection to the brain. Although a nice idea, it is not likely to occur in the near future. The presentations covered many different ideas for interfaces.

A starting point is to view cyberspace as an extension to the desktop/direct manipulation metaphor. Cyberspace is the addition of a third dimension to the desktop, a virtual dimension [Kellog]. This requires the use of three dimensional pointing devices and perhaps includes three dimensional windows [Benedikt]. But the 3D desktop still lacks many elements of the Gibson cyberspace interface.

A better interface is described by Meredith Bricken and has four characteristics; inclusion, multimodal, intuitive, virtuality. Inclusion means that the user is inside the interface, passing through the screen barrier. A direct connection to the medium that allows total involvement [Anderson, Wallser]. Multimodal means that the interface can affect more than one sense. Currently interfaces can affect sight and sound, and touch is in the research stage. Taste and smell are as yet unaddressed. Cyberspace is intuitive in 2 ways. The interaction is at a functional level, where the form of the object suggests the function [Morningstar & Farmer]. And the representation is experiential instead of symbolic [Anderson, Bricken, Wallser]. Virtuality means that instead of using a metaphor, the real thing can be used. You can *be* in a bedroom [Bricken]. In addition, the medium is dynamic allowing for simulation and change [Anderson, Bricken, Kellog, Stenger]. In contrast, a museum is a dead and static medium.

Cyberspace can be seen as an interface for simulation and discovery. The power of the interface derives from the participants ability to explore it and make their own cognitive maps of the worlds and the connections [Bricken]. But to do this requires defining what the user space is.

Meredith Bricken suggests three participant questions that need to be answered. *Where am I* determines what a participant sees, and therefore the overall actions that are possible. *What can I do* further constrains the possible actions and interactions of the participant in the key areas of movement, mapping, manipulation and navigation between worlds.

Who am I opens up new worlds of perception. There is no reason to limit the perspective to either the first or third person. Nor is there any reason to link control to the perspective. Thus it is possible for the participant to view and control their representation in cyberspace from another perspective. Even the level of participation can vary from an observer of the action to a full participant [Morningstar & Farmer]. In addition when participating, the acuity of the environment can be tuned down to enhance concentration [Pruitt & Barrett].

As an interface, cyberspace provides a complete environment. It is no longer a user, but a participant, who is fully immersed in the virtual world. By putting on some clothing, and one day plugging in a jack, the participant will take on some perspective in a different world, where objects are used with manipulative organs, instead of keyboard and mice. To paraphrase Wendy Kellog, currently it is a 2D desktop/direct manipulation metaphor, then a 3D desktop with a virtual dimension and then the real world in virtual space.

4.0 Theoretical Foundations of Cyberspace

Three of the presentations gave some theoretical basis for cyberspace, those of M. Heim, G. M. Lewis and Tim McFadden. The presentation given by M. Heim is covered in section 5.

Tim McFadden touched on three main areas of theory for cyberspace. Firstly since cyberspace is an information medium, it will be governed by information theory. This will place limits on the implementation of cyberspace and on how communication can occur. It also provides a theoretical basis for the investigation of Joel Anderson's point about the loss of information stored in cyberspace.

The next point is that cyberspace has no equilibrium. In the real world, all the forces are in equilibrium due to physical laws. Thus the world is boring, we know that the book will stay on the table, and not fly up, or turn into a tomato. Cyberspace has no such governing laws. This suggest that some should be put in place. It also means that laws of large numbers do not apply, meaning that statistics can not be used to measure quantities in cyberspace.

The final contribution is a potential language of description for cyberspace. Tim McFadden used an extension of the Actors model of Agha[1]. Actors provides an encapsulated object oriented model of distributed processing. The extension, called the Ballistic Actors model, is required due to the nature of cyberspace. Since the underlying implementation is on a computer, and since it is a space, some coordinate system is required. To travel through the space requires moving from one coordinate to the next, but the coordinates are not continuous. Thus a jump is required to move form one discrete coordinate to another, hence the ballistic extension to shoot actors between coordinates.

A language of description is important since it allows communication of ideas in a field. Currently, there is a lot of leaway in the meaning of terms such as cyberspace, participant and other terms.

The presentation by Lewis deals with cognition of problems. According to the ecological theory of psychology, the constraints that allow solution of a problem are inherent in the representation of the problem. For any given individual there is a representation that is better suited to their cognitive style. As the match becomes closer, more information is conveyed, and the constraints become more obvious. The problem becomes easier to solve. This has three implications. First, cyberspace is a representational medium, thus the facilities are there for a participant to draw up their own representation of problems, making them easier to solve. Also, given a common base representation for problems, cyberspace can be used as a translation medium to enhance the communication of problems. Finally, there is not limit on the amount of information that can be conveyed by any given representation or re-representation in cyberspace.

5.0 Implementation

This section brings together the practical suggestions from the presentations and discussions. It provides an outline of some of the things necessary to build a cyberspace. As with most general purpose programs, there is more than one way to build and present cyberspace. The four subsections discuss different parts of an implementation. Aspects is a partial set of the elements that will be present in an implementation. Objects gives more insight into what the non-human inhabitants of cyberspace are. Architectures describe frameworks to place the implementation aspects into. And metaphors gives ways to present the architecture.

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[1]For a full reference, refer to Tim McFadden's paper.

5.1 Aspects of the Implementation

One aspect of implementation gained almost universal acknowledgement. An *object oriented representation* is essential to cyberspace. The objects correspond to the participants conceptual model of the world, they are the people, places and artifacts of the world [Morningstar & Farmer]. They are the concepts of cyberspace [Pruitt & Barrett].

Morningstar and Farmer give three types of objects, scenic, structural, and functional. The scenic objects provide a backdrop, structural objects contain other objects or provide support, and functional objects do something. There are also three characteristics of objects. Their representation is based on behavioural characteristics instead of polygonal representation [Morningstar & Farmer]. Objects can evolve, they are alive [Bricken]. And objects are themselves a cyberspace [Tollander].

This points out another aspect, cyberspace is *naturally recursive.* This is true in two ways. First the onion skin property allows a cyberspace inside a cyberspace, either as a strict containment relation (personal virtual workspaces contained by the corporate virtual world), or as a full recursive relation (an object is itself a cyberspace). The other way is the Indra's net property [McFadden]. This simply states that any given cyberspace can have a full or partial representation of any or all other cyberspaces.

The fact that there are multiple interconnected cyberspaces means that it is a *distributed system.* The component cyberspaces can be of different types, such as private, corporate and public spaces. The distributed system will also be heterogeneous.

To facilitate exchange between these systems *communication standards* are essential. This involves both the form and the level of the data communicated. Morningstar and Farmer suggest that the level should be behavioural and definitional. The behavioural part is used when participants interact with objects. It defines what functions an object performs and how it performs them. The definitional part is used to introduce new objects into the environment. The standards must include standard representations for objects and problems as well as protocols for exchanging and translating these representations. As someone mentioned during the discussions, the participant exists in a bubble in cyberspace, the protocols govern what can be communicated between cyberspace and the participant.

Since the emphasis is on communication of information, some solution to the *bandwidth problem* is needed. The most common solution is to vary the resolution of what is communicated. Instead of an all or nothing representation, partial representations can be rendered [Benedikt]. In addition, objects in the background can be less detailed than those in the foreground [Tollander]. Morningstar and Farmer argue that there is absolute solution to this problem. As the amount of information that can be transmitted increases, so does the power of the CPU, and thus the amount of information needed. They recommend transmitting only what is different, and using the local cyberspace engine to manifest the differences in the local environment.

Communication is important since the system will be in a constant state of flux. It will be an *evolving system.* At the simplest level, cyberspaces are defined by the interactions of people within it [Morningstar & Farmer]. The information content evolves as people change what is in cyberspace. Objects themselves are not closed systems since their boundaries can change as they are manipulated [Novak]. Meredith Bricken talks about different types of cyberspaces, active, passive, reactive and emergent. The objects can have their own life.

Carl Tollander gives the most complete view of an evolving cyberspace. His proposed implementation is based on natural selection controlled by the frequency of selection of objects. Objects that participants select often tend to propagate, objects that are not selected tend to fade away. Since cyberspace is also a personal space, the mutability of the object can be controlled, thus changing how easily the object decomposes. This uses the idea of a *selective system* to control the evolution. All actions of participants are a selection, including not selecting something.

All of the above aspects are combined into an infrastructure for cyberspace. It is important that the infrastructure be general enough to accommodate changes in representation and paradigms [Pruitt & Barrett, Wallser]. Morningstar & Farmer also believe that the implementation platform is relatively unimportant. Their system used a Commodore 64 as a front end to the virtual world. Given the correct infrastructure and representation, a tree can be rendered as a simple text phrase 'there is a tree here', or a complex real time ray traced image complete with wind effects.

5.2 Objects in Cyberspace

The objects in cyberspace have many different levels of complexity. They can vary from a simple cell, to a common object (such as a book, or chair), to complex objects (cars, buildings, forests), to another agent or individual. As mentioned above, everything in the space is an object. And since the space is recursive, the attributes and values of an object will themselves be objects [Tollander].

This points to objects as the underlying representation for cyberspace, merging object oriented programming with frame based systems. Objects will also be concepts, providing the base for Michael Heim's Platonic forms, or G. Michael Lewis' common problem representation. Instead of a separate symbolic language used to interact with or program in cyberspace, the objects will match the symbols [Pruitt & Barrett]. Having said that, the objects may not actually have any real world existence [Benedikt]. As mentioned above, objects may be presentational as well as representational [Novak].

Two important object types are agents and cyberspace decks. Agents are the participants in cyberspace. They can be either human or machine based. The machine based agents are extensions of individual power and responsibility [Kellog, Pruitt & Barrett]. They can perform many different functions, from finding and filtering information, to performing tasks related to their functions. For a good example of the latter, see the Jack's Kitchen example in the paper by Kellog et al.

The instrument of participant control is the cyberspace deck. Carl Tollander views it as a container of consoles, where a console is a set of cyberspaces. The consoles are used to set the mutability controls on the objects within them. The deck is the area of cyberspace that an individual participant controls.

Randy Wallser gives seven elements of a cyberspace deck. A cyberspace engine provides the simulation capabilities. It presents the rendered space to the participant. The control space is a physical volume of space used for tracking the movement of a participant. Sensors in this space take input from the participant. They can be as simple as a keyboard and joystick, or as complex as 6D sensor, or even a jack into the brain. Effectors translate actions in cyberspace to effects in the real world. Props are physical analogs for virtual objects, such as chairs or bikes. A network interface provides communication between participants. And an enclosure provides the physical limits of the virtual environment.

The advantage of this metaphor is that many individuals in western society are already familiar with it. It provides a good basis for cyberspace, and a good argument to the corporations whose money will be needed to fund cyberspace. As long as a general infrastructure is provided, cyberspace can change later. However, as one person put it during the discussion 'Frankly, I'm appauled.'

The metaphor organizes cyberspace from one point of view. Though there are boxes for academia, governments and the public, these boxes are not well specified. The relations were also based on the corporate view. The metaphor would be good for those currently in corporate America, but does not provide much for the rest of us.

Randy Wallser's view is more general. It is based on *cyberspace as theatre*. Under this metaphor, participants would enter into a cyberspace playhouse (enclosure of 5.2), be given a part of the stage (control space of 5.2), and the role of a character in the cyberspace. The metaphor provides a good organizing principle that we are used to since people play roles in everyday life. A cyberspace theatre would extend that to new roles used for interacting with others in cyberspace. As mentioned above, virtual reality construction has been the business of theatre for a long time.

The other advantage lies in economic cost. Cyberspace technology is currently expensive and bulky. It is unlikely to reduce in cost or size in the near future. To start a cyberspace industry requires large scale access to cyberspace that can be done at a reasonable cost. The cyberspace playhouse would provide such access.

Some more specific elements of metaphors were also given. Michael Benedikt presented several methods of navigation. Some were based on cylinders as an organizing shape. The advantage of cylinders is that they have two solid dimensions and one infinite one. Thus navigation consists of moving through the cylinder, with the information present on the sides. He also suggested a submarine metaphor, where the view is from the front of a vehicle that can be manoeuvred in three dimensions. The method that looked closest to Gibson's Matrix used cubic information space. Here, information was represented on three inside surfaces of a cube and was chosen using a three dimensional pointer. Cyberspace consisted of a toroid of these information cubes. Navigation is done by flying over the surface of the toroid until the required cube is found. Speed of flight depends on height above the surface of the toroid, the higher up the faster the speed. The images of high flight were close to descriptions of the Matrix in Gibson's books.

6.0 Effects of Cyberspace

This section is divided into two areas. Effects of cyberspace on the world, and effects on the individual. The following section also contains some effects. The world effects are based on the Pruitt and Barrett view of cyberspace. There are three main ones, the survival and expansion of corporate America, the more efficient use of resources, and the ability to work at home.

The use of the corporate virtual workplace metaphor will allow corporate America to continue. It would allow corporations to remain viable in the emerging hyper-competative marketplace. It may also give rise to a global virtual corporate economy. Corporations may exist only in cyberspace. Other market niches will be opened up, and there is a potential contribution to the feeling of a global village since the corporation that you work for will no longer have head offices in New York, the base will be out there in cyberspace.

The combination of CVWs and PVWs will allow the efficient utilization of people resources. This is good since people are still the most expensive part of any system. Project teams can be organized and changed very quickly. People can be given easy access to the information and

5.3 Architectures for Cyberspace

There are two main architectures suggested for cyberspace. One is the world model [Morningstar & Farmer, Tollander], the other is based on the monadology of Leibnitz [Heim]. The architecture has a front end and a back end. The back end consists of the cyberspace world. It maintains the consistency of the world and coordinates the changes made by front ends. The front end is the individual participant machine that contains the local user space, the cyberdeck. It is responsible for updates, display, object invocation and communication with the world. The back end does not have to exist on a single machine, it can be distributed. The important point is the separation of the back end from the front end.

The Monadology of Von Leibnitz provides a structure for cyberspace. 'It gives a conceptual description of beings capable of supporting a universal computer matrix.' [Heim]. Each node in the matrix is a Monad. A monad is a single solitary entity. Its actions are dictated by its own appetites, it has an independent will-power, it achieves its goals according to internal dictates, and it has its own representation. In computer terms, it is a self enclosed inhabitant of cyberspace (computer or human) that pursues activities based on its own world view and using its own software.

Each monad also has an interface that allows it to see a mental life procession of internal representations and simulations. It can sense things directly through this interface. In other words, it has data sensing, storage and manipulation capabilities.

In addition, each monad has a full or partial representation of the entire universe of monads. Each representation is different and depends upon the monads internal mental landscape. In cyberspace, each inhabitant has a representation of the other inhabitants, and this will differ according to the viewpoint of the individual.

The only weak point in the architecture is the requirement for a central infinite monad. This is the node that coordinates all others, and has knowledge of the global state. This deficiency could be fixed by the application of Tollander's natural selection principles.

5.4 Metaphors for Cyberspace

The use of paradigms and metaphors in cyberspace may be a moot point. The general view is why use a paradigm when you can use the real world. However, as pointed out in discussion, some element of familiarity is needed, otherwise you will always be mounting the learning curve to use the space. Thus the metaphor for cyberspace is the *real world.* Of these, there were two major suggestions.

Pruitt and Barrett presented the *corporate based* metaphor. The framework is a corporate virtual workspace (CVW) that takes the place of the corporate office building. It provides the resources, meeting places and office spaces for employees. The individual in the corporation has a personal virtual workspace (PVW) that is hooked into doors in a virtual hallway. The PVW is located at the home of the employee, and is meant as a replacement for the traditional cubical or office. It is an Island of Automation. The PVW can be easily moved both inside and between CVWs. Thus projects can be quickly put together and solved, then personnel can be re-assigned.

experts they need. This would also have an effect on the academic world since more specialized people would be required.

Individuals would work at home. This will reduce the need for mass urban centres and the transportation load. The result is an overall reduction in air pollutants and change the nature of population concentrations. Currently, western culture cities tend to provide a support network for the corporate structure. This is no longer necessary when the people that are being supported can remain at home.

Comments made in other sections apply here. It is not clear that the corporate structure is a good one for cyberspace. Nor would a drastic emigration from cities be all good. The current suburban trend in major cities is good for those who can live in surburbia, but does not help those that are stuck in the city. In some ways, it is bad for those that are left, since crime rates tend to increase. It is also not clear how those who become unemployed from the emigration will find other employment. Talk of retraining only works if there is something to be retrained for.

The retraining is only one possible effect on the individual. Those who work in cyberspace will need lifelong learning. Expertise will be a commodity in cyberspace. People will have more freedom to move between jobs, but will require the edge to get the jobs. Thus there is a gain of freedom at the expense of self reliance [Pruitt & Barrett].

So far the assumption has been that cyberspace will not be opposed. However, experience shows that new ways of doing old things are opposed. People feel threatened and intimidated by the new way [Bricken, Henderson].

On the positive side, cyberspace will allow an amplification of personal power [Anderson, Kellog]. People can accomplish more things by delegating work to agents and objects in cyberspace. Tasks such as information collection, correlation, and filtering are good examples. As well as the ability to reduce menial tasks present in Jack's Kitchen [Kellog].

On a different level, cyberspace may effect how people sense time. There has always been an element of time distortion in our society. In medieval times, plans had to be made based on what might occur, and orders issued that may not reach their destination for months. In todays world, newspapers report events that have already occured, and are possibly quite different by the time they are read. It is possible to read an article in the newspaper, that some electronic mail has already obsoleted. However, Nicole Stenger points out that cyberspace will make it worse by merging three types of time. Currently there is vector time, the serial progression from event to event. Cyclic time, where trends tend to repeat themselves (the cycle of economic recessions is a good example). And microtime, the crowd of moments that film media can give us. All three of these will merge together in cyberspace.

7.0 Issues of Cyberspace

This section has two parts. The first covers problems and questions raised by cyberspace, both an a practical and philosophical level. The second part points out conflicts that occur. These are conflicts that effect the very nature of cyberspace and will need resolution either before cyberspace is implemented, or shortly after implementation.

7.1 Questions Raised

The first three questions pertain to individuals in cyberspace. What is self, what is death, and what do others look like. Since a participant in cyberspace will be represented by another entity or agent, what are the bounds of the self [Bricken, Stenger]. This question is further complicated by

the possibility that the cyberspace agent can continue to exist even when the participant is not connected [Stenger]. The virtual extensions to the self proposed by Anderson and Kellog, call into question the notion that self ends with the physical body and the individuals mind. An extension to this problem is self image. A very interesting question was raised during discussion, what do mirrors look like in cyberspace and what will they show.

What is self thus involves the answer to both a technical and a philosophical question. The technical one is representational and, to some extent, can be determined on an individual basis. The image of oneself in cyberspace can be customized by the individual. The philosophical question is one that is best left for future research.

A further extension to the self question is what is death. If the agents of a participant can exist when the participant is not in the space, can the person really die [Stenger]. Gibson poses just such a question with his character Dixie Flatline [Gibson 84]. Flatline is a ROM construct, though from Flatline's point of view, he is very much alive. However, his life only exists in cyberspace, and can be turned on and off.

The question of self image is related to the question of how other look. This is especially important since it will effect how communication takes place [Bricken]. Since most interaction is based on social forms, the representation of others can give rise to new social and cultural forms [Bricken].

On a more practical level, it was mentioned above that cyberspace has no physics. This can be a major problem. In the real world well known axioms govern how humans react and relate to it. The behaviour of objects is predictable, allowing us to ignore most of the world and concentrate on the currently interesting bits [Benedikt, McFadden]. Cyberspace will also require such axioms in order to allow humans to interact with it. At a simple level, humans require visual cues such as floors and walls, otherwise they tend to get sick [Bricken]. But there is also a need for a physics of cyberspace, a set of axioms that will govern the behaviour of objects in expected ways [Benedikt]. In addition to physics constraints, spatial constraints can be violated. It is possible for a door to always lead to a new place, thus creating a crowd of spaces in addition to a crowd of moments [Novak].

7.2 Conflicts

There are three major conflicting ideas that occured during the conference; control of cyberspace, anarchy versus consensus and the communication of concepts.

The control of cyberspace conflict has two aspects. First is the issue of centralized versus distributed control. Under the Pruitt and Barrett view or the Heim architecture, some form of central control and coordination is essential. Corporate America is built on the idea of central coordination, as are most governing bodies. The monadology of Leibnitz requires the central infinite monad to exist. Yet Morningstar and Farmer claim that central planning is impossible. This is due to the nature of cyberspace as a medium for people, and the chaotic element that introduces to the space. This idea of no central control is the main reason behind an evolutionary based cyberspace. In the evolutionary scheme, the controls are implicitly present.

The other aspect of the control conflict assumes that some degree of central control is possible. It asks the question who has control of cyberspace, and more importantly, who is left out [Bricken, Pruitt & Barrett Discussion]. There was a definite conflict of corporate world versus academic world at the conference. The corporations wanted control of cyberspace as a strategic technology to make them more competitive [Pruitt & Barrett]. Others wanted a cyberspace that had free access for individuals to do as they wished.

The anarchy versus consensus conflict centres on how others are viewed. The anarchists want full control of how they see cyberspace. Thus if one participant wishes to see a meeting as occuring on a beach, and another participant sees the same meeting taking place in an office, that is up to the individual. Cyberspace has the potential to support both views. One difficulty with this is that communication is based on social situation. As was pointed out in discussion, there is a basic unity of time, place and action that has never been broken by the theatre or other communication based arts. The reason is that human communication is based on this unity. To break it would break down the basis of communication. In defence of the anarchist view, it is possible for new social phenomena to arise [Bricken] that could accommodate the beach and office paradox.

The conflicting view sees cyberspace as a consensual reality. An object exists and has a particular form because that is what the consensus of participants believes. This is consistent with the view of cyberspace as an evolutionary system.

The final conflict states that communication of concepts is not possible. The basic problem is that no two people have the same concept space [Novak]. The associated meaning given to a token by an individual is likely to differ in some small degree, and possibly be completely different, to the meaning associated by another individual. Since a participants view of cyberspace is based on their own conceptual view of space, it is not possible for someone else to understand their space in their way. Thus I can not understand your space [Novak]. It is possible to become bilingual so that I can understand you concepts in my way [Novak]. The hidden assumption is that there is no common format for concepts. If G. Michael Lewis is correct, this is not the case. Then your concepts could be translated through the common representation to my concepts. The communication of concepts again begs the solution of new social forms [Bricken]. However, the true solution lies in finding out if some common representation of concepts can be found.

8.0 Research Areas

The research for cyberspace can be divided into four main areas; object oriented concerns, human information theory, network concerns and cyberspace physics.

Since the basis of cyberspace is objects, a number of issues need to be addressed. First is the theoretical issues of object oriented representation. There are some computational complexity concerns when using the inheritance heirarchies and lattices implied by the object oriented programming paradigm. These usually occur when representation is of a real world problem, especially a classification problem.

In addition there is a representational issue. Since objects represent all elements of cyberspace, some representation needs to be found for knowledge and concepts. There is currently research into knowledge representation, and some of it is object based. What is needed is a classification of what is to be represented in cyberspace so that issues of how to represent it can be addressed. The simple answer of 'everything needs to be represented' is not sufficient to direct research.

Another question is the possibility of a base representation for concepts and problems. The answer to this question determines the usefulness of cyberspace as a problem translation engine. One direction for this research is the comparison of Platonic forms and situational semantics.

The limits of humans in information theory needs investigation. This has to do with preserving information in cyberspace. Information theory gives us the Nyquist limit for sampling. What needs to be known is how much information is present in human events. This will allow a determination of how much information a human needs to understand an event, and thus how much information is needed to represent that event in cyberspace. This is not the same as viewing a human as an

information processor, it is trying to find out how to represent occurances as objects, and how to make sure that enough the information is retained.

Since cyberspace is a distributed system, it will require an underlying network. This gives rise to three areas of research. The first is what type of network topology to use. The answer may be as simple as 'whatever arises when the elements are put together', but the question should be addressed. A more important question is the bandwidth problem presented earlier. Research into how to overcome the problem is essential to a high information transfer medium like cyberspace. Some alternatives have been suggested, but others should be investigated. Also the common representation issue needs to be addressed. The OSI ISO model only addresses the communication problem, not the representation problem. Standards will be critical as networks merge to become a larger cyberspace. The likelihood of merging networks will also bring the possibility of heterogeneous systems. This is true both in terms of machine architecture and representation. Thus research into heterogeneous integration is also needed.

The last main area of research is the physics of cyberspace. This includes axioms that govern behaviour and interaction in the space. The work will need a firm grounding in the limitations of humans from physical, mental, social and emotional viewpoints. In some ways, this problem will never be fully researched. A good place to start is the insight gained by the astronaut program. These are the only humans who have existed outside of normal experience, in a space with no floors or ceilings.

9.0 A Consensual View of Cyberspace

Over the course of the paper some clear parts of cyberspace have emerged. First it is primarily a medium of communication between participants. This communication may be of information and concepts, or art and imagination. The medium is accessed through an interface that allows the participant to cross the screen barrier and become a part of the environment. To experience the environment through many senses, and to interact naturally with the elements of the environment.

The basis of cyberspace is objects. Everything in cyberspace is an object, thus cyberspace is fully recursive. It is also distributed, since any individual can have a private cyberspace that is both connected to, and has a view of, any or all other cyberspaces.

It is a place where individuals can encounter the real, the imaginary, and greater questions such as self and death. It is a place where the storehouse of human knowledge can grow and be more accessible to more people.

In short, it is a home for knowledge and belief, for imagination and Eros.

10.0 Acknowledgement

My main acknowledgement must go to the people who participated at the first conference on cyberspace. Many ideas came from the presenters, but other ideas came from the discussions of those presentations. If you were a participant, you will likely find your ideas present in this paper. Unfortunately, I can not acknowledge them directly since it is hard to associate names with many of the discussion ideas. The references section should really contain the names of every person present at the workshop

A further thank you must go to Geoff Bowie for his timely delivery of the conference video, and to my supervisor Dr. Brian Gaines for applying both the finances for the conference itself, the tapes of the conference, and the ruthless filter for the prose. And lastly to my wife for putting up with the late nights to get this paper done.

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