

virtual reality transfer protocol (vrtp) Design Rationale

WET ICE 97 Workshop on Distributed System
Aspects of Sharing a Virtual Reality

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http://www.stl.nps.navy.mil/~brutzman/vrtp/vrtp_wetice97.ps .ppt

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Synopsis and goal outcomes

- **Internet connectivity is the core issue in large-scale virtual environments (LSVEs)**
- **Technical rationale for designing a virtual reality transfer protocol (vrtp)**
- **Bricks, bouquets, collaboration welcome**

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Briefing topics

- **Virtual reality modeling language (VRML)**
- **Background: 4 key network components**
- **Multicast and exploiting reality**
- **Spectrum of client-server ... peer-peer**
- **vrtp defined**
- **open issues**

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virtual reality modeling language

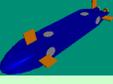
- **3D scene specification for the Web**
- **VRML 2.0 specification is done** ✓
- **behaviors: Java, JavaScript, more**
- **VRML is active and open**
 - ⇒ **Consortium** <http://www.vrml.org/>
 - ⇒ **Repository** <http://www.sdsc.edu/vrml>

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Background: NPS research

- **Many years of work implementing large-scale virtual environments**
- **NPSNET virtual battlefield**
- **Virtual world for NPS Phoenix autonomous underwater robot** 
- **Our definition of large-scale = all Internet machines, all Web content**
- **Bottleneck is network, not graphics**

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information flow in distributed virtual reality: four key network components

- **light-weight entity interactions**
 - e.g. Distributed Interactive Simulation (DIS) protocol
- **network pointers**
 - e.g. Uniform Resource Locator (URL)
- **heavy-weight objects**
 - e.g. http client/server request
- **real-time streams**
 - e.g. MBone audio/video

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large-scale virtual environments

- LSVEs are now possible
- interactive 3D graphics using VRML
- fully internetworked
- extendible in every direction
- scales with the World Wide Web
 - that means as easy as building a home page
- details details:
 - <http://www.stl.nps.navy.mil/~brutzman/vrml/breakthroughs.html>

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multicast networking crucial

- many-many communications, Class D addresses, unreliable UDP packets
- filter packets at network interface card
- Global Mbone “works,” also built in IPv6
- partition network traffic (Macedonia)
 - spatial, temporal, functional, your choice
- exploiting reality to better use network
- experimentation & testing are essential

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use client/server or peer-peer?

- troublesome cul de sac: many conversations always seem to end up here
 
- must we choose only one?
- client/server: browsers, http, object request
- peer-peer: DIS PDU, other Mbone streams
- realization: networking is not bipolar, rather a spectrum of functionality. Use all of it well.

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why not use the full spectrum?

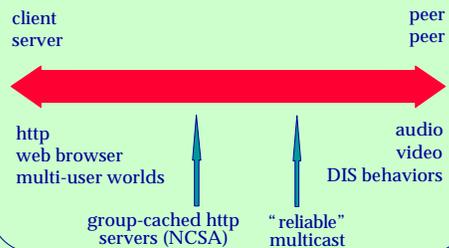


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examples in midspectrum



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what does desktop look like?

- **client**
 - looking at someone else’s world
- **server**
 - showing others your world
- **peer**
 - scalable behavior interactions
- “**everything just works**”
 - nobody knows what is happening on the Internet

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what else is on desktop?

- **client**
 - looking at someone else's world
- **server**
 - showing others your world
- **peer**
 - scalable behavior interactions
- **“everything just works” means network monitor capabilities needed**
 - figuring out what the heck is going on out there

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vrtip defined

- **client**
 - looking at someone else's world
- **server**
 - showing others your world
- **peer**
 - scalable behavior interactions
- **network monitoring**
 - client/server/peer, enable “everything just works”

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so where does vrtip live?

HTML

http

VRML 2.0

vrtip

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http/vrtip: similar development plan

- **http**
 - combined ftp, gopher, telnet etc.
 - optimized for serving hypermedia documents
 - optimized for single machines
- **vrtip**
 - combine client, server, peer-peer, monitoring
 - optimize for desktop
 - optimize across Internet

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vrtip IS NOT...

- possible using just http
- yet another transport protocol
- a competitor to existing protocols
- a step in an untested direction
- about adding complexity
- hard for users to understand

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vrtip IS...

- a framework for combining essential best-of-breed protocols
- a combination of existing software
- a way to give user scenes easy access to a full spectrum of network capabilities
- URL extensions: client/server/multicast
- easy to use
- all about simplification & streamlining

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maybe... a Cyberspace Backbone

- controlled experimental environment in order to enable vrtp optimization
- CBone (in homage to MBone)
predecessors: DSI, I-WAY, OpenVE Net
- Virtual network for distributed VR apps with open real-world research testing
- Guaranteed bandwidth, latency, QoS
- later - not needed for most vrtp work

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goals review: vrtp and CBone

- vrtp
 - enable large-scale virtual environments using VRML graphics, client/server/peer/monitor networking
- CBone
 - uses Internet Protocol (IP), merely a dedicated experimental network for globally optimizing vrtp
- professional opinion:
 - vrtp is an essential basis for scaling up all media within large-scale virtual environments (LSVEs)

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vrtp client components

- web browser
 - Netscape *Navigator*, Microsoft *Internet Explorer*
- browser API hooks
- plug-ins
- mime types for application handoffs
- Java virtual machine

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vrtp server components

- http:
 - build on proven public domain server
 - ~~CERN~~ ~~NCSA~~ Apache
 - cgi-bin/perl scripting <http://www.apache.org>
- maybe
 - object servers
 - installable object broker support
 - world databases

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vrtp peer components

- multicast/unicast UDP/TCP sockets
- RTPv2, RTSP, RSVP, path to IPv6, others
- MBone tools (audio/video/wb/sdr/others)
- DIS & DIS-based dial-a-behavior protocol
- compatibility with experimental “reliable multicast” protocols, once clear winner
- network time protocol (NTP) clock synchronization: everyone has right time

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vrtp monitoring components

- diagnosis of local and remote networks
- automatic statistic collection
- source code profiled for self-optimization
- reports problems of global significance
- agent-based approaches are feasible
- queriable: SNMP, *mtrace*/*mrinfo*, others
- vrtp able to automatically upgrade itself

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Other resources

- **Our SIGGRAPH, SIGCOMM tutorials on internetworked 3D graphics**
- **IETF Large-Scale Multicast Applications (LSMA) WG**
- **DIS-Java-VRML WG**
<http://www.stl.nps.navy.mil/dis-java-vrml>
- **VRML 98 Symposium**
 - Monterey California, February 16-20 1998

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Related work: Open Community

- **Proposed vrml standard for user avatars**
 - <http://www.merl.com/opencom/>
- **An information infrastructure**
 - for online commerce, composable interactions across VRML worlds, and (eventually) cyberspace
 - based on MERL's SPLINE work
- **Not possible without underlying vrtp**
 - providing necessary low-level network functionality of ubiquitous client, server, peer-peer & monitoring

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Big-picture: next-generation Web

- **Client, server, peer-peer on all desktops**
- **vrtp: seamless network environment**

leads to

- **all machines just part of one computer**
- **network is the shared backplane**
- **Web is the shared global database**

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What we've heard at this workshop

- **Many variations on similar themes**
- **Reasonable consensus about what functional success looks like for LSVEs**
 - consistency/persistence/interest management/etc.
- **Interesting small-scale implementations**
- **Little consensus on network architecture structure, but (unexpected) consensus on network architecture components**

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What we haven't heard so far

- **Wide-area network support is needed**
 - “network issues” on our “broader problems” list
 - only mentions: http, NTP
- **Experience above low 100s of entities**
- **HLA/RTI as a credible alternative**
- **Synergy with WG efforts in IETF, IPv6, IRTF Reliable Multicast, others**
- **Hard numbers based on experiments**

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What I hope happens

- **We continue building large systems**
- **They interoperate & compose, on the fly**
- **Mere mortals build networked content**
- **vrtp provides Internet-wide connectivity needed by our various approaches**

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