

Web3D 2011 Tutorial: Building Networked Virtual Worlds

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Tutorial Outline Networked Virtual Environments Basics History State of the Art Research and Future Directions acm



Basic Ingredients Culture of Multi-User Context Content Technology of Multi-User Networks Messages Software



Networked Computer Culture

- Its Possible: 'Cyberspace'
- Its Cool:'Metaverse'
 - Facebook, Second Life, ...
- Its Here:
 - Virtual Worlds
 - Mobile devices & situated awareness



Virtual World Content **Decades of innovation** • Art, Engineering, Consumer The ISO standards • X3D H-Anim VRML





: the Scenegraph Standard

Scene graph for real-time interactive delivery of virtual environments over the web:

- Meshes, lights, materials, textures, shaders
- Integrated video, audio
- Animation
- Interaction
- Scripts & Behaviors



- Multiple encodings (ISO = XML, VRML-Classic, Binary)
- Multiple Application Programming Interfaces (ISO = ECMA, Java)
- X3D 3.3 includes examples for Volume rendering, CAD and Geospatial support!



Sharing Online

- A shared world requires
- scene updates are passed among participants via messages describing:
 - Entities
 - Events
- updates to be managed by regions and filtered by LOD or some other criteria
- considering update rate



Managing Large Worlds

- If the world is divided into quad regions, there are 4 areas to update
- If hexagonal, there are 3
- A fully p2p network of regions and messaging can be n² messages!
- A tree can be log n (base 2 for binary)





web|**3D**

History Technology Destinations Vehicles



Frontiers (circa 1998)

Vnet

DeepMatrix v1







Colonizing ColonyCity, Cybertown Canal++









Empire Building

Vivaty
 -> Microsoft



DarkStar (Sun)
 ->
 RedDwarf



MPEG-4 BIFS Binary Interchange Format for Scenes: A patented streaming protocol using compressed (binary) X3D content









Populating H-Anim 1.0 vs. segmented H-Anim 1.1 Bones and skin



 Avatar structure bound to VRML and X3D and its runtime APIs
 (EAI, SAI via EcmaScript and Java)



• Where did they go?

Lost civilizations







Wild Wild West (again) Nature abhors a vacuum... a new generation of colonizers Be There (RIP) Second Life Teleplace Vastpark **OLIVE** Avaya acm

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State of the Art **Participants & Communities** FCVW V-Gov Immersive Education Technology DeepMatrix BitManagement **OpenDIS**



FCVW V-Gov



- USDA hosting 4 different VW engines for US Federal Agencies (none are SL)
- Corresponding conference event @ National Defense University (4 years)
- Neither worlds nor avatars are portable





RayGun

RayGun[™] is a White Label Software Platform for Navigation, Social Networking and Friend Finding Running on PC's, In Car Systems, PND's and Cell Phones













RayGun on iPhone with THE DARK DESIGN Game

Kyoto, Japan



planet 9 studios

RayGun

London

San Francisco, with Clue



London



Planet 9 Studios – RayGun Overview

aem

Mobile Multi-user X3D on IPad (Raygun)



Distributed Interactive Simulation (DIS)

DIS is an IEEE standard (IEEE-1278.1) developed by the Simulation Interoperability Standards Group (SISO) and approved by IEEE. It is very widely used in real time, virtual world military simulations.



DIS DIS is a network protocol. It describes the exact layout of a few dozen Protocol Data Units (PDUs) that contain information about the position and orientation of entities in the world, and more

- ESPDU refers to Entity-State PDUs
 - Articulated Parameters provide space for other messages (eg OpenSim?)



DIS

- Velocity field allows for dead-reckoning
- DIS is supported in X3D Edit, Xj3D
- X3D-Edit has DIS recording and playback
- Demonstrated w/ DarkStar / Red Dwarf and Multi-cast



X3D specification: DIS support

DIS component includes following X3D nodes:

 EspduTransform, ReceiverPdu, SignalPdu, TransmitterPdu, DISEntityManager, DISEntityTypeMapping

DIS PDU message types

- Collision, Detonate, Entity State, Fire, Receiver, Signal and Transmitter
- Numerous other DIS PDUs defined by DIS protocol, but corresponding X3D mappings are not defined.

Open-DIS

- DIS examples in X3D examples archive
- BSD license
- Java, C++, C#,
 Objective C

Mail :: Inbox (3993) X Distributed Interactive Simulation X +								
Open-DIS	DIS	Documentat	tion Down	loads	Collabor	ation	Users	
Exam	oles	Community	Developers	Prop	aganda	MOVE	S	

Distributed Interactive Simulation

 DIS Plain and Simple: an Introduction to DIS

- SISO DIS Protocol Support Group
- <u>SISO DIS Protocol Development</u> Group (Members Only)
- Group (Members Only
 Wikipedia DIS Page
- <u>Wikipedia DIS Page</u>
 <u>Virtual Combat by David Neyland</u>



http://open-dis.sourceforge.net/Open-DIS.html

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DIS is a network protocol. It describes the exact layout of a few dozen Protocol Data Units (PDUs) that contain information about the position and orientation of entities in Open-DIS on Mac

Objective C version of Open-DIS able to run on iPhone, iPad

Screen snapshot shows PDU tracks superimposed on Google Maps using iPhone Simulator





Red Dwarf server ports

- Enterprise–scale multi-user game server
- Originally developed by Sun (Dark Star), now on SourceForge
- Protocol-agnostic (map-able)
- Integrates messages across several ports
- Demonstrated with DIS & X3D (NPS)

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For More See References at end • DIS slides in Advanced X3D at: www.x3dgraphics.com



Virginia Tech



- Collaboration Services for HPC users
- A common infrastructure
- Testing DeepMatrix and Bitmanagement's Collaborate

DeepMatrix.org Thanks Gerhard Reitmayr, Geometrek • GPL in 2003 Uses Java EAI Newly updated

Current distro works with Instant Reality









11.1

Bitmanagement Add to file: BSCollaborate { connection NetConnection { address "metagrid1.edu" port 14140 protocol 3 • } + Scripts for authentication, avatar management, chat

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acm)





Goals

- + Ease of Publication
 - + Ease of Client install
 - + Ease of content distribution
- + Ease of avatar & gesture creation

Challenges

- Licensing
- "Put that there"







- Other notable efforts RE Avatars :
 - VastPark OpenAvatar SDK

- Protocol-agnostic nodes
- Web3D Consortium Strategies

Embrace Protocols

- Distributed Interactive Simulation
- SWAMP
- Bubblecloud
- OpenSim
- Red Dwarf can bridge several protocols and ports
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Improve X3D's use of HTTP 9.3.2 X3DUrlObject X3DUrlObject { MFString [in,out] url [] [URI] SFBool [in,out] load TRUE SFTime [in,out] refresh -1 web|3D acm

Privacy & Security

- A major concern in virtual worlds
- Authenticating participants and their roles
- Wither the logs and transcripts?
- Position X3D Binary as data-centric security layer with authentication and encryption



Opportunities

- Participant = Consumer + Producer
- Babelization has reached the point of pain for many VW customers
 - Engage other efforts:
 - VastPark's OpenAvatar SDK
 - OpenSim















X3D Scene Authoring Hints

•https://savage.nps.edu/X3D-Edit





References 4

- David L. Neyland, *Virtual Combat: A Guide To Distributed Interactive Simulation*, Stackpole Books, 1997.
- Sandeep Singhal and Michael Zyda, Networked virtual environments: design and implementation, ACM Press/Addison-Wesley, 1999. Online course available.





 Anthony Steed and Manuel Fradinho Oliveira, <u>Building Networked Games and Virtual</u> <u>Environments</u>, Morgan Kaufman, 2009.



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