SE3D Programme

Overview

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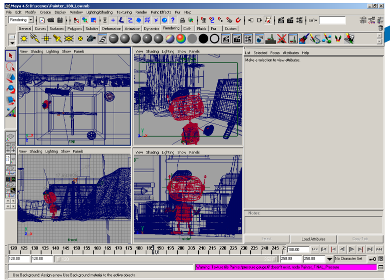
Localised for UK English

Research Technologies

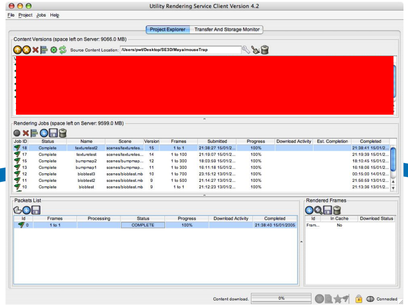
- Frame Factory: a fully-featured, streamlined remote CG rendering service designed to run on a utility infrastructure, consisting of client- and server-side applications, and supporting connection over the public Internet.
- Elephant Store: a novel compression mechanism based on finding the minimum difference between one version of a data-set and the next. Used to vastly accelerate the upload of source data to the rendering service, and to store many versions of the data efficiently in the storage cache.
- Utility Security & Trust Record: protects the utility services from unauthorised access, and the service users from connecting to an impostor service. Protects customers' data from one another, and supports audit to check that the utility's automatic behaviour is compliant with expected, secure standards.
- Sumatra: the resource allocation system. Supports market-based determination of how to allocate resources amongst customers (as well as other mechanisms), and performs the actual allocations securely.
- Mercado: the user interface to the market-based resource allocation system. Presents available auctions, allows bids to be placed and credits to be managed.
- Management by Business Objectives: a service-level agreement decision technology. Decides how to re-allocate resources to customers in the event of not being able to fulfil all resource reservations (e.g. due to failures), based on criteria such as minimising penalties.
- SmartFrog: used to capture the configuration of the entire software stack as a set of templates; these drive the automatic installation, start-up and operation of thousands of software components on hundreds of machines. Also allows the software to be stopped and removed automatically.
- Anubis: A reliability protocol used to detect failures (software, hardware, network) and recover from them in a manner that is guaranteed to be timely and consistent across the complete system. Also used as a core component of Sumatra to perform resource discovery and allocation.

Utility Rendering Service: Workflow

1. Create input data in Alias Maya



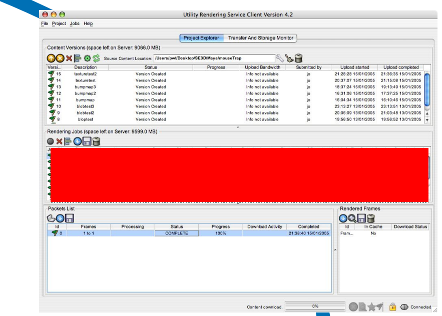
2. Upload versions of input data to the URS



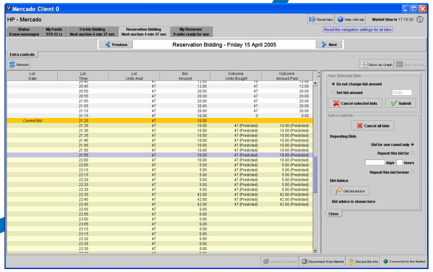
Utility Rendering Service Client Version 4.2

3. Manage multiple versions of input data

4. Submit rendering jobs against any version of the input data



Utility Rendering Service Client Version 4.2

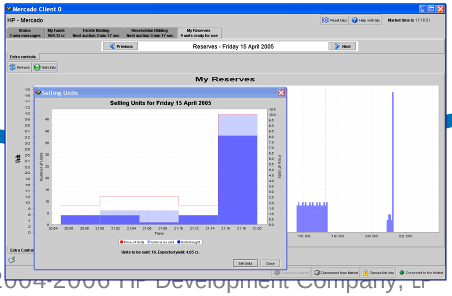


Mercado Client 0

HP - Mercado

Reservation Bidding - Friday 15 April 2005

5. Purchase rendering power using the resource markets



Mercado Client 0

HP - Mercado

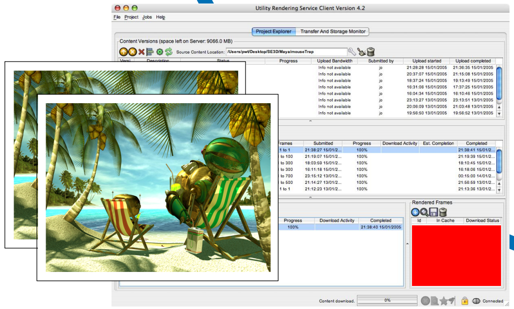
Reserves - Friday 15 April 2005

My Reserves

Selling Units

Selling Units for Friday 15 April 2005

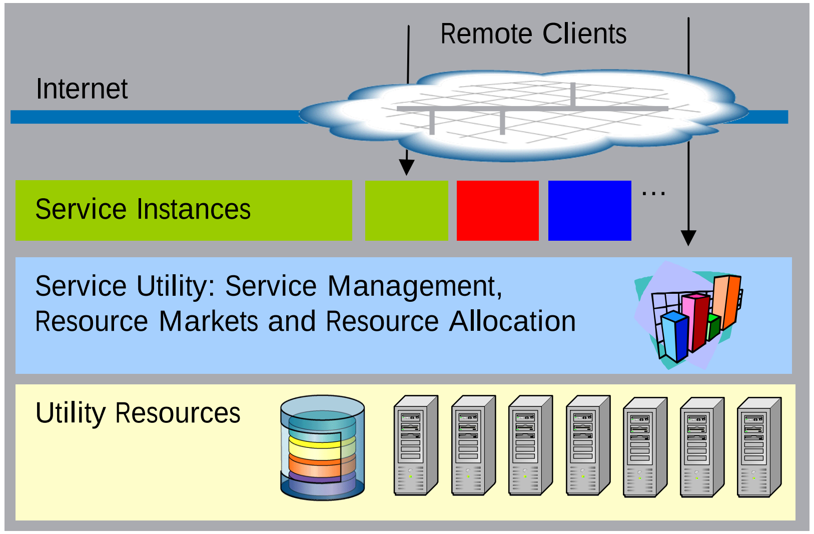
6. Manage your reserves of rendering power



Utility Rendering Service Client Version 4.2

7. Download the rendered frames

8. Repeat until your film is perfect!



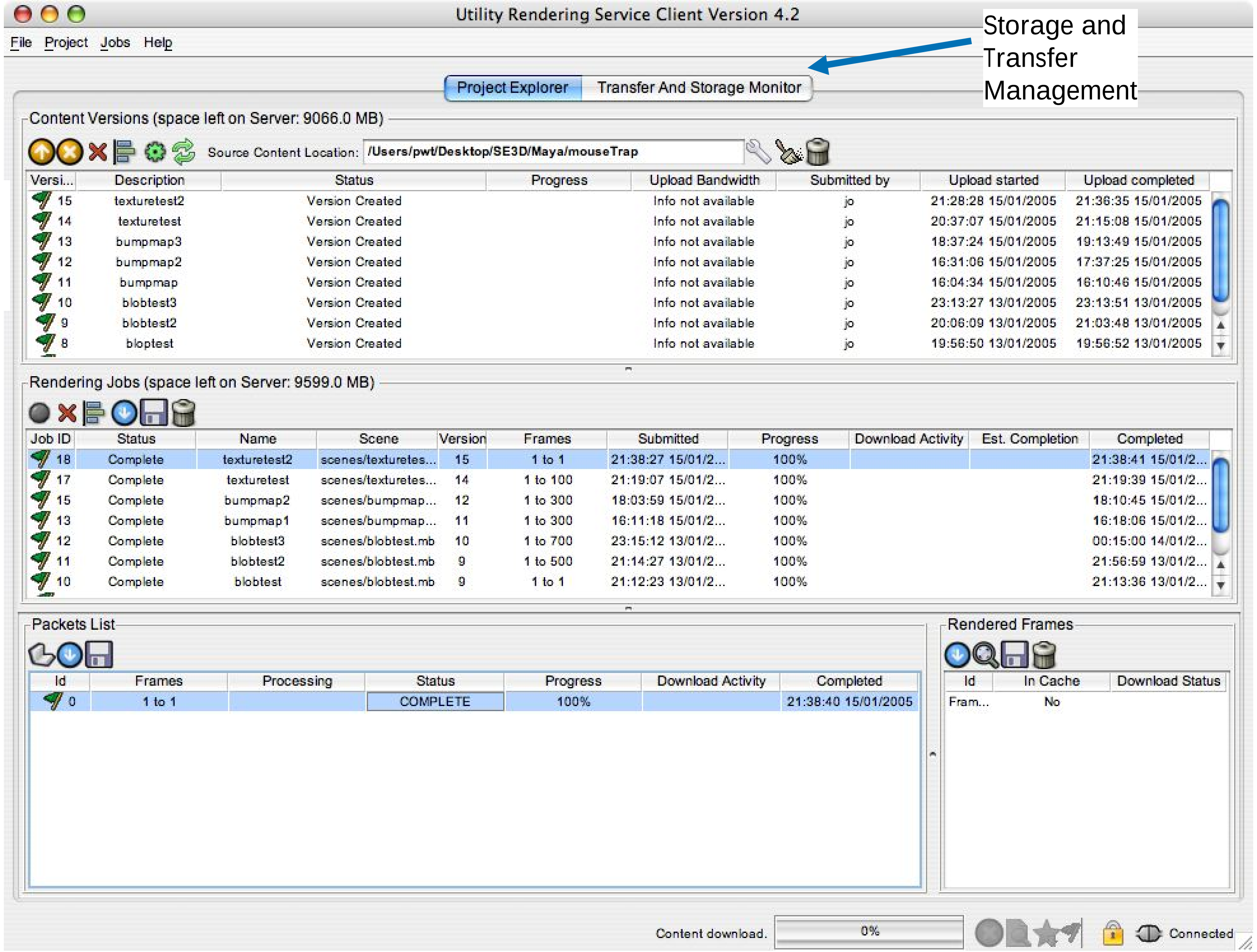
Remote Clients
Internet
Service Instances
...
Service Utility: Service Management, Resource Markets and Resource Allocation
Utility Resources

Utility Rendering Service Client

Uploaded Source Content Versions

Rendering Jobs

Progress of Rendering Jobs



Storage and Transfer Management

Information on Rendered Frames

Utility Rendering Service Client Version 4.2

Content Versions (space left on Server: 9066.0 MB)

Source Content Location: /Users/pwt/Desktop/SE3D/Maya/mouseTrap

Versi...	Description	Status	Progress	Upload Bandwidth	Submitted by	Upload started	Upload completed
15	texturetest2	Version Created		Info not available	jo	21:28:28 15/01/2005	21:36:35 15/01/2005
14	texturetest	Version Created		Info not available	jo	20:37:07 15/01/2005	21:15:08 15/01/2005
13	bumpmap3	Version Created		Info not available	jo	18:37:24 15/01/2005	19:13:49 15/01/2005
12	bumpmap2	Version Created		Info not available	jo	16:31:06 15/01/2005	17:37:25 15/01/2005
11	bumpmap	Version Created		Info not available	jo	16:04:34 15/01/2005	16:10:46 15/01/2005
10	blobtest3	Version Created		Info not available	jo	23:13:27 13/01/2005	23:13:51 13/01/2005
9	blobtest2	Version Created		Info not available	jo	20:06:09 13/01/2005	21:03:48 13/01/2005
8	bloptest	Version Created		Info not available	jo	19:56:50 13/01/2005	19:56:52 13/01/2005

Rendering Jobs (space left on Server: 9599.0 MB)

Job ID	Status	Name	Scene	Version	Frames	Submitted	Progress	Download Activity	Est. Completion	Completed
18	Complete	texturetest2	scenes/texturetes...	15	1 to 1	21:38:27 15/01/2...	100%			21:38:41 15/01/2...
17	Complete	texturetest	scenes/texturetes...	14	1 to 100	21:19:07 15/01/2...	100%			21:19:39 15/01/2...
15	Complete	bumpmap2	scenes/bumpmap...	12	1 to 300	18:03:59 15/01/2...	100%			18:10:45 15/01/2...
13	Complete	bumpmap1	scenes/bumpmap...	11	1 to 300	16:11:18 15/01/2...	100%			16:18:06 15/01/2...
12	Complete	blobtest3	scenes/blobtest.mb	10	1 to 700	23:15:12 13/01/2...	100%			00:15:00 14/01/2...
11	Complete	blobtest2	scenes/blobtest.mb	9	1 to 500	21:14:27 13/01/2...	100%			21:56:59 13/01/2...
10	Complete	blobtest	scenes/blobtest.mb	9	1 to 1	21:12:23 13/01/2...	100%			21:13:36 13/01/2...

Packets List

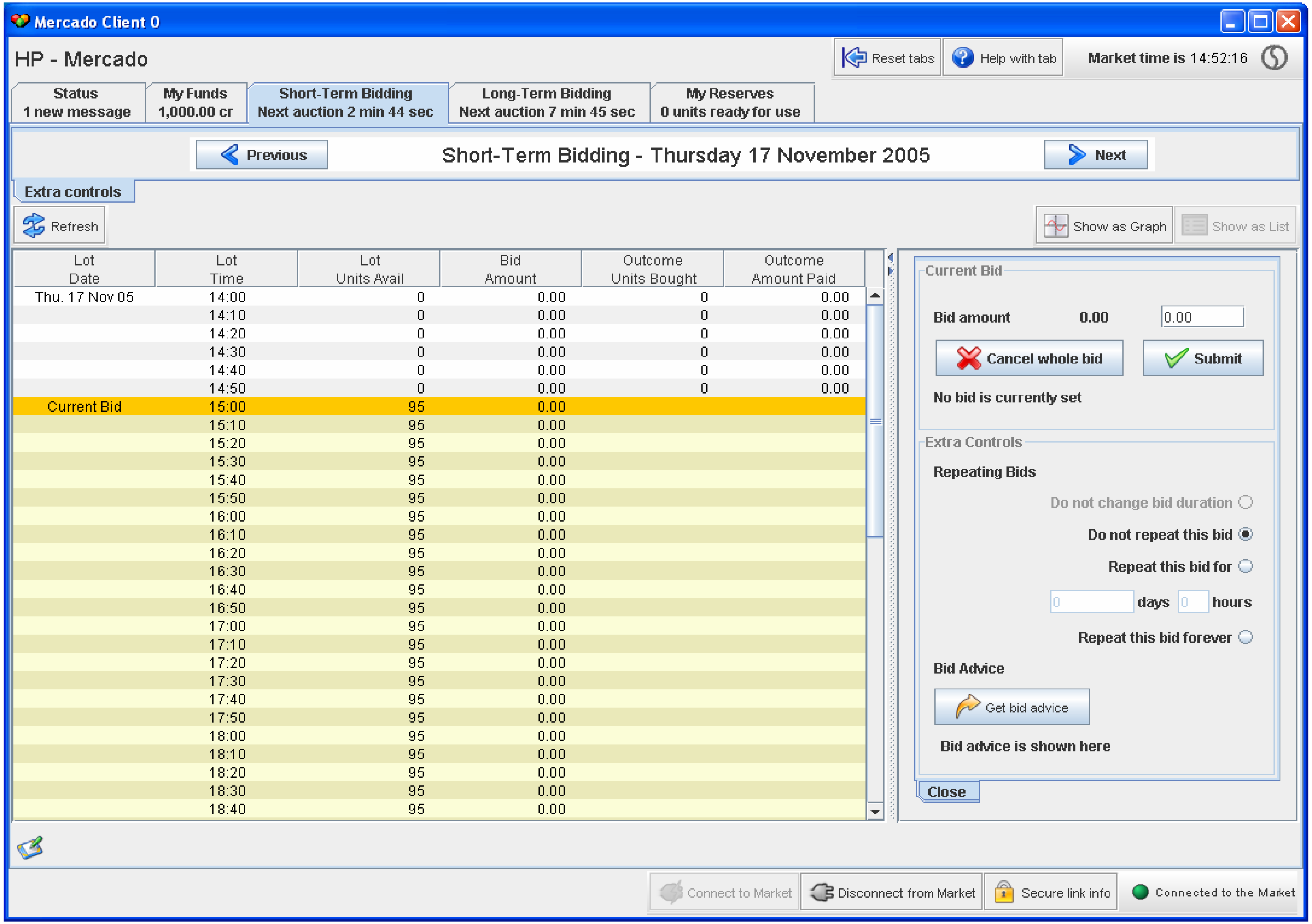
Id	Frames	Processing	Status	Progress	Download Activity	Completed
0	1 to 1		COMPLETE	100%		21:38:40 15/01/2005

Rendered Frames

Id	In Cache	Download Status
Fram...	No	

Content download. 0%

Mercado Market User Interface Example



Mercado Client 0

HP - Mercado

Market time is 14:52:16

Status	My Funds	Short-Term Bidding	Long-Term Bidding	My Reserves
1 new message	1,000.00 cr	Next auction 2 min 44 sec	Next auction 7 min 45 sec	0 units ready for use

Short-Term Bidding - Thursday 17 November 2005

Lot Date	Lot Time	Lot Units Avail	Bid Amount	Outcome Units Bought	Outcome Amount Paid
Thu. 17 Nov 05	14:00	0	0.00	0	0.00
	14:10	0	0.00	0	0.00
	14:20	0	0.00	0	0.00
	14:30	0	0.00	0	0.00
	14:40	0	0.00	0	0.00
	14:50	0	0.00	0	0.00
Current Bid	15:00	95	0.00		
	15:10	95	0.00		
	15:20	95	0.00		
	15:30	95	0.00		
	15:40	95	0.00		
	15:50	95	0.00		
	16:00	95	0.00		
	16:10	95	0.00		
	16:20	95	0.00		
	16:30	95	0.00		
	16:40	95	0.00		
	16:50	95	0.00		
	17:00	95	0.00		
	17:10	95	0.00		
	17:20	95	0.00		
	17:30	95	0.00		
	17:40	95	0.00		
	17:50	95	0.00		
	18:00	95	0.00		
	18:10	95	0.00		
	18:20	95	0.00		
	18:30	95	0.00		
	18:40	95	0.00		

Current Bid

Bid amount 0.00 0.00

No bid is currently set

Extra Controls

Repeating Bids

Do not change bid duration ○

Do not repeat this bid ●

Repeat this bid for ○

0 days 0 hours

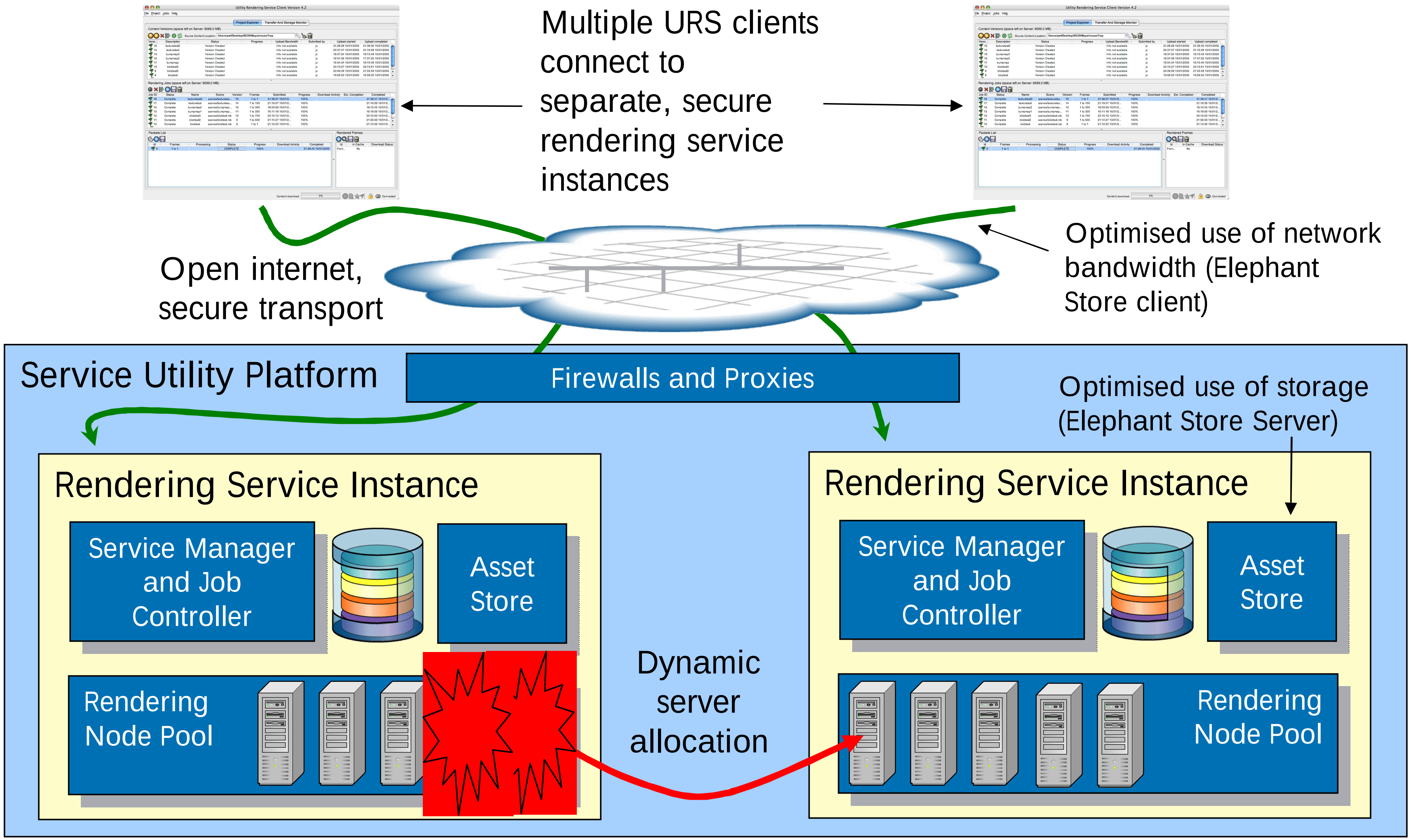
Repeat this bid forever ○

Bid Advice

Bid advice is shown here

Connected to the Market

Rendering Service Architecture



Multiple URS clients connect to separate, secure rendering service instances

Open internet, secure transport

Optimised use of network bandwidth (Elephant Store client)

Service Utility Platform

Firewalls and Proxies

Optimised use of storage (Elephant Store Server)

Rendering Service Instance

Service Manager and Job Controller

Asset Store

Rendering Node Pool

Dynamic server allocation

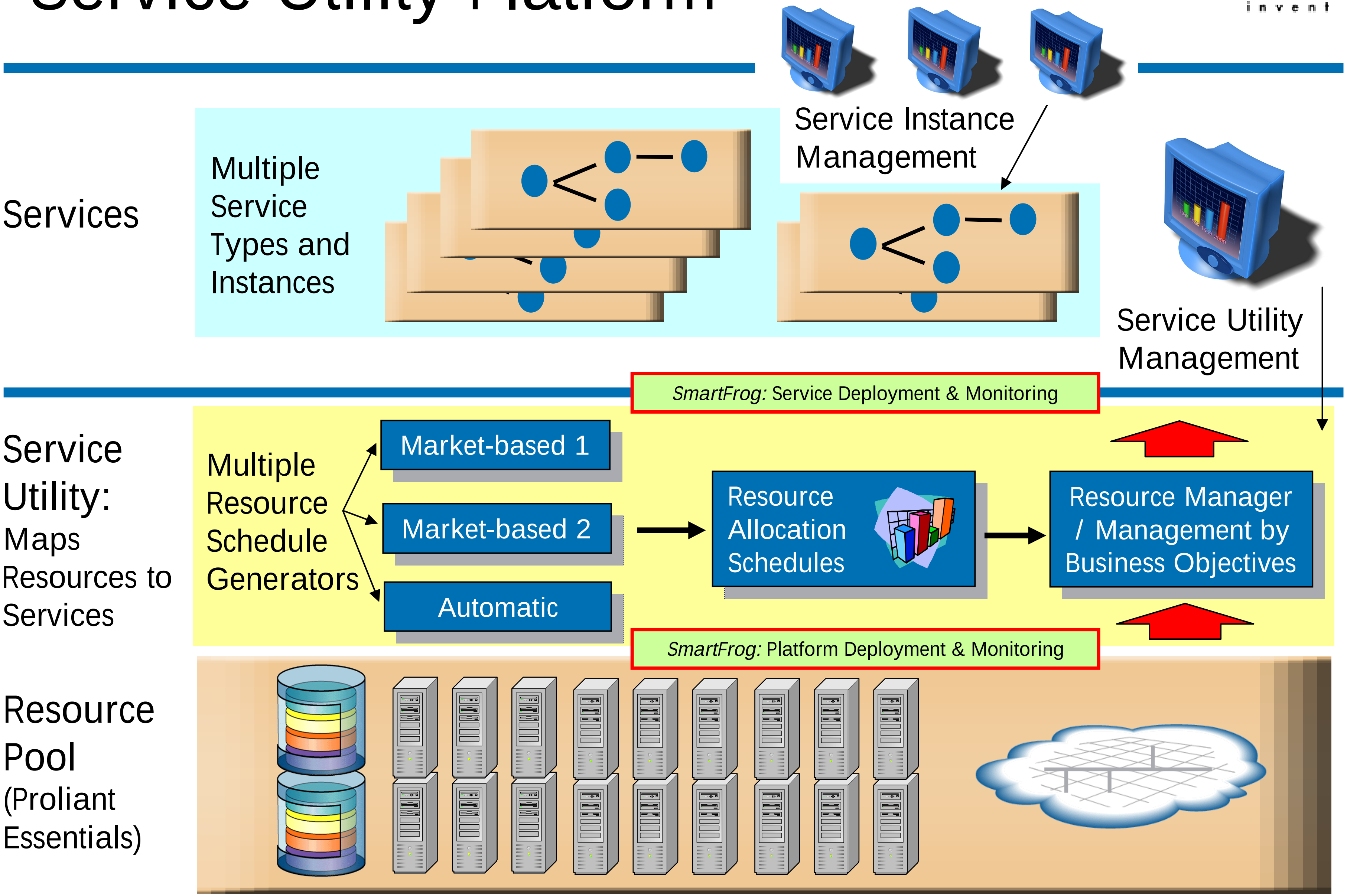
Rendering Service Instance

Service Manager and Job Controller

Asset Store

Rendering Node Pool

Service Utility Platform



Services

Multiple Service Types and Instances

Service Instance Management

Service Utility Management

SmartFrog: Service Deployment & Monitoring

Service Utility: Maps Resources to Services

Multiple Resource Schedule Generators

Market-based 1

Market-based 2

Automatic

Resource Allocation Schedules

Resource Manager / Management by Business Objectives

SmartFrog: Platform Deployment & Monitoring

Resource Pool (Proliant Essentials)

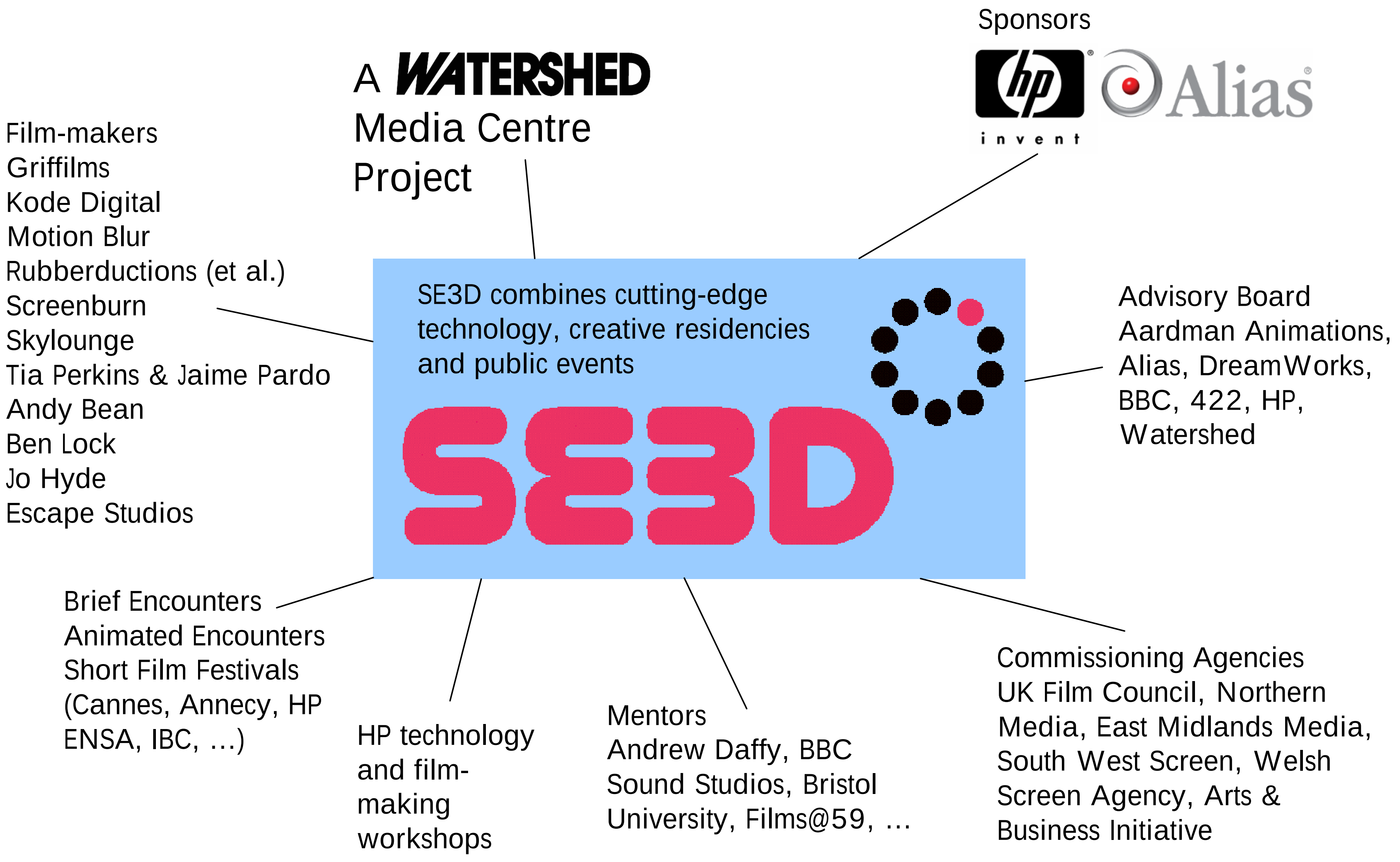
Research Results

- The Utility Rendering Service met the requirements of the SE3D film-makers
  - Worked well even over consumer-class broadband and the public Internet
  - No need to worry about configuring and maintaining the rendering servers
  - Could be a commercial service today
- Market mechanisms for acquiring computing power were easy to use
- Automation technologies performed very reliably and were key to operating the service efficiently
  - Little operator intervention required
  - Automatic resource allocation
  - Automatic failure detection and recovery
- Security measures defended against all attacks
- Some user interface changes to the URS client were recommended, e.g.
  - The ability to prioritise rendering jobs
  - A more transparent mapping between local and remote data
- For the rendering application, there is a need for a true reservation market including tentative reservations
- The market mechanisms did not experience enough contention to be tested as well as we'd hoped

Facts and Figures

- Service ran in Palo Alto, California
  - ~120 servers, 4TB Storage
- Service ran for 10 months with >99% reliability
- Peak of 15 simultaneous rendering services
- 9 films complete, 2 pending
- 500 bids placed in the resource markets, covering 5,500 hours of auctions
- 500,000 hours of CPU time ‘sold’
- 500,000 frames of animation rendered
- 1780 source data uploads
- ~30:1 compression performance on uploads
- ~ 25:1 compression performance on version storage
- More than 1,000,000 rejected connection attempts
- More than 15,000 worm attacks rejected

External Organisation



A WATERSHED Media Centre Project

Sponsors

Film-makers
Griffilms
Kode Digital
Motion Blur
Rubberductions (et al.)
Screenburn
Skylounge
Tia Perkins & Jaime Pardo
Andy Bean
Ben Lock
Jo Hyde
Escape Studios

SE3D combines cutting-edge technology, creative residencies and public events

Advisory Board
Aardman Animations, Alias, DreamWorks, BBC, 422, HP, Watershed

Brief Encounters
Animated Encounters
Short Film Festivals (Cannes, Annecy, HP ENSA, IBC, …)

HP technology and film-making workshops

Mentors
Andrew Daffy, BBC Sound Studios, Bristol University, Films@59, …

Commissioning Agencies
UK Film Council, Northern Media, East Midlands Media, South West Screen, Welsh Screen Agency, Arts & Business Initiative

invent