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The HyperVerse - Concepts for a Federated and Torrent Based "3D Web"

The 1st International Workshop on Massively Multiuser Virtual Environments

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Overview

1. Vision of the HyperVerse
2. Backbone Infrastructure
3. Data Distribution
    - Interest Management
    - Application of Torrent Principles
4. Consistency
5. Social-Based Aggregation
6. Conclusion and Future Work

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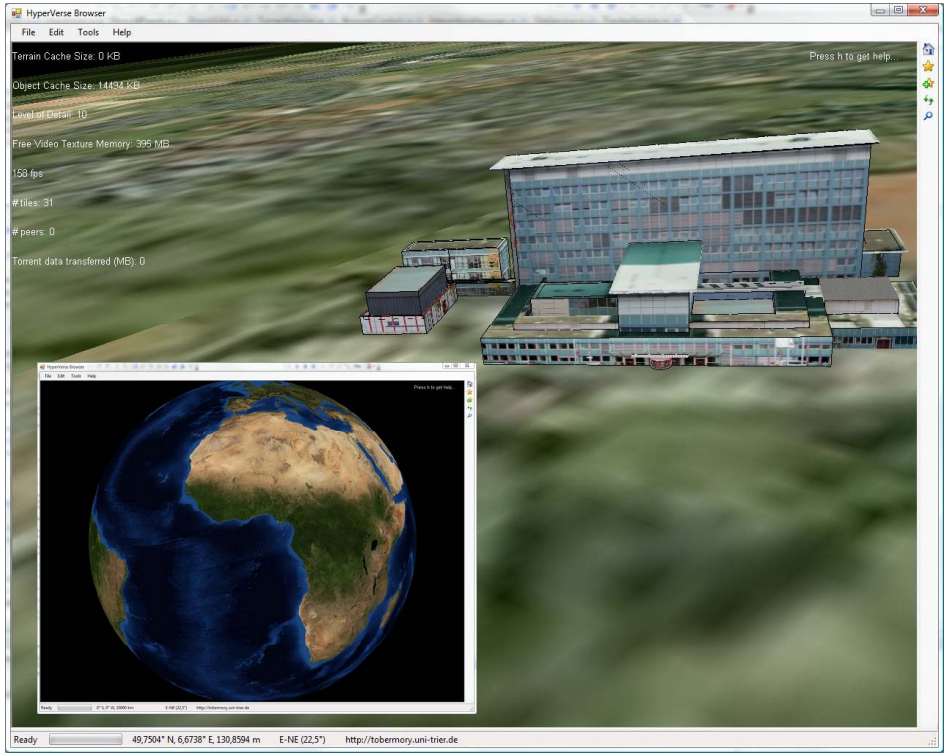
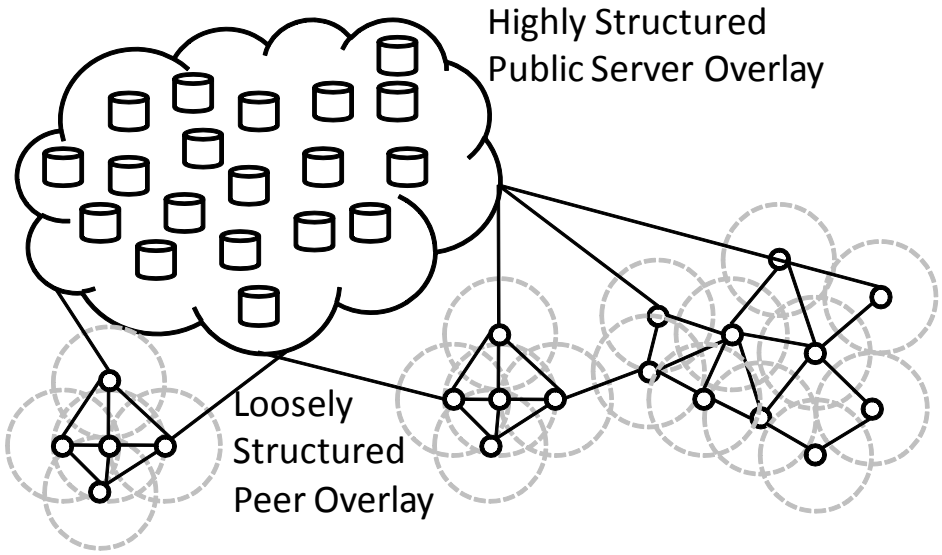
1 Vision of the HyperVerse

- Combination of VE and WWW
- Avatar-based interaction
- Coexistence of arbitrary worlds
- “Freedom of Travel”
- Dynamic worlds
- Single instance of each world
- High demands on responsiveness



2 Backbone Infrastructure

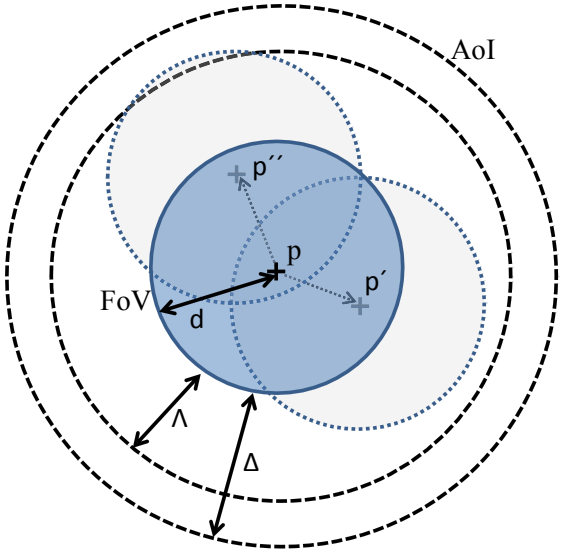
- Global scale number of users
- Two-tier P2P infrastructure
  - Structured public server overlay
    - Rather stable nodes
    - Provides world data
  - Unstructured client overlay
    - Dynamic nodes
    - Data distribution
- Balancing load between all nodes
- Keeping maintenance "costs" low
- Providing high degree of interactivity and scalability



3 Data Distribution

3.1 Interest management

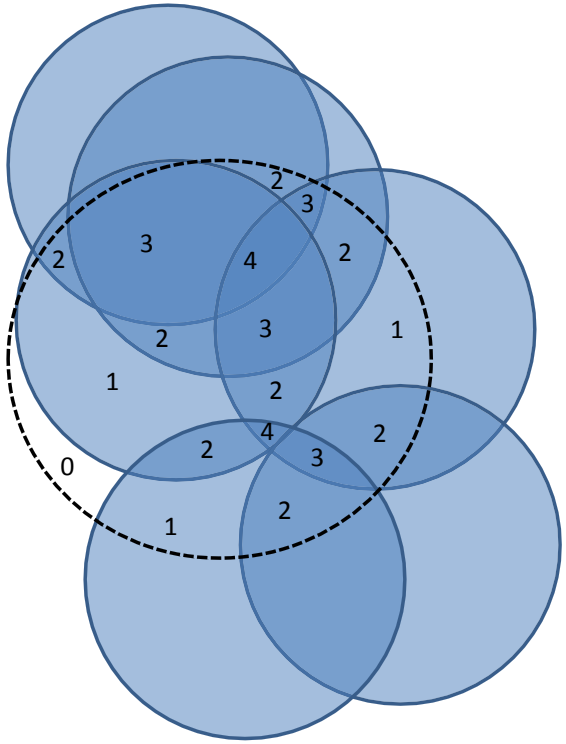
- Interest Spheres
  - FoV - Sphere with radius d around p
  - AoI - Sphere with radius $d + \Delta$ around p
  - Φ - Sphere with radius $d + \Lambda$ ($\Lambda < \Delta$) around p
- Φ is used to mitigate the retrieval latency
- Whenever FoV leaves Φ a new AoI will be set
- Λ and Δ set up a tradeoff between:
  - Retrieval frequency
  - Amount of persistent data



3.2 Application of Torrent Principles

- Public server (PS) overlay
  - Servers as initial seed
  - Acts as a distributed torrent tracker
  - Propagation of peers' AoIs information

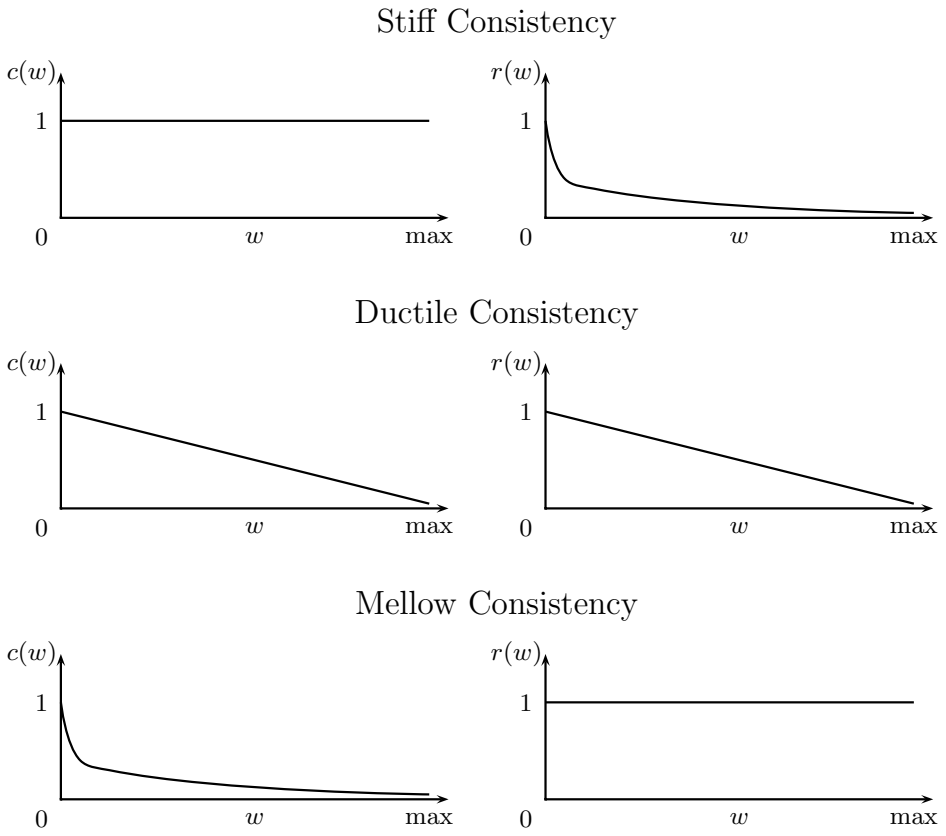
- Information retrieval in a new AoI
  - No further communication required
  - Local identification of relevant peers
  - Torrent-like data transfer
  - "Uncovered" data is retrieved from PS overlay



4 Elastic Consistency

- Discrete consistency levels:
  - Stiff Consistency
  - Ductile Consistency
  - Mellow Consistency
- App. scenario ⇒ consistency level
- Applied to *World Partitions*
- *Weight:* $w : \mathbb{R} \times \mathbb{N} \rightarrow \mathbb{R}$
- Continuous consistency function:

$$c : CL \times \mathbb{R} \rightarrow [0, 1]$$



Partition Weight Impacts on Consistency and Responsiveness

5 Social-Based Aggregation

- Fan-in problem
- Affects scalability and interactivity
- Based on the social characteristic
- Hiding of irrelevant information

6 Conclusion and Future Work

- HyperVerse
  - Global-scale virtual environment
  - Two-tier P2P infrastructure
  - Torrent-based data distribution
  - Elastic Consistency
  - Social-Based Aggregation
- Future Work
  - Application of P-Grid as public sever overlay infrastructure
  - Development of parameterized Elastic Consistency algorithms
  - Performance evaluation and comparison with other DVEs