Peer-to-Peer Gaming Research at DVS

TECHNISCHE UNIVERSITÄT DARMSTADT

DVS

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Research Challenges

- Analyze and develop decentralized network architectures that
  - can handle thousands of players
  - make use of excess peer resources and dedicated servers
- A realistic evaluation

Game parameters
- Maximum avatar speed
- AOI Size / vision range
- Update message frequency
- Map parameters

Bots vs. Mobility Model vs. Human Players
- Asses if simulated behavior is realistic
- What are the quality metrics for human players?

Object Management
- Degree of coupling to the spatial multicast?
- Determine a "good" object manager by
  - using network coordinates
  - in-game proximity
  - other methods

Simulation Scenario
- Player session duration distribution
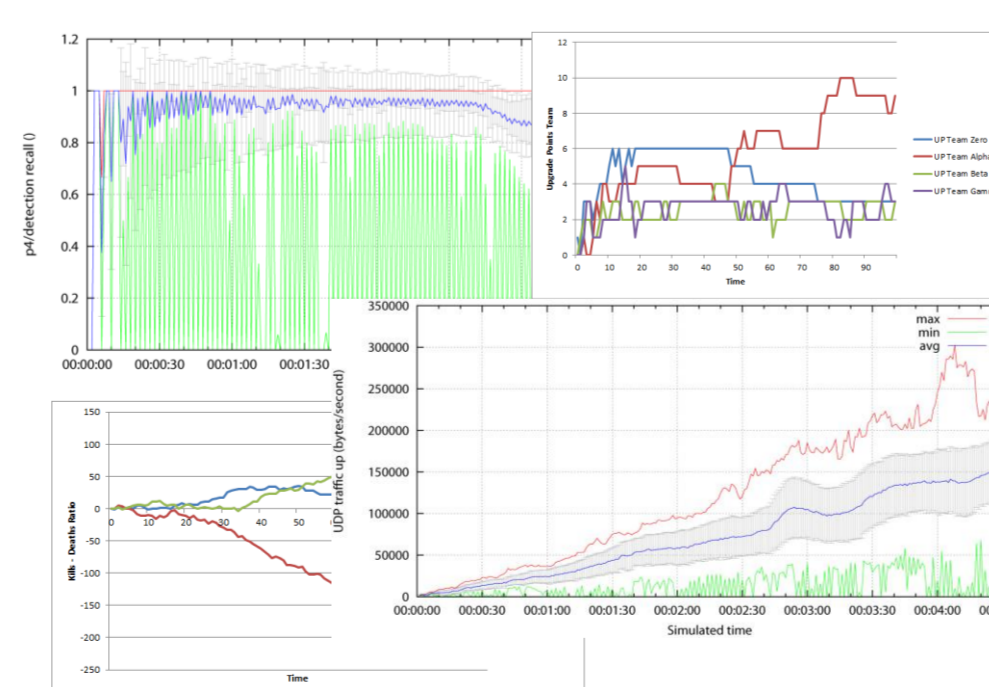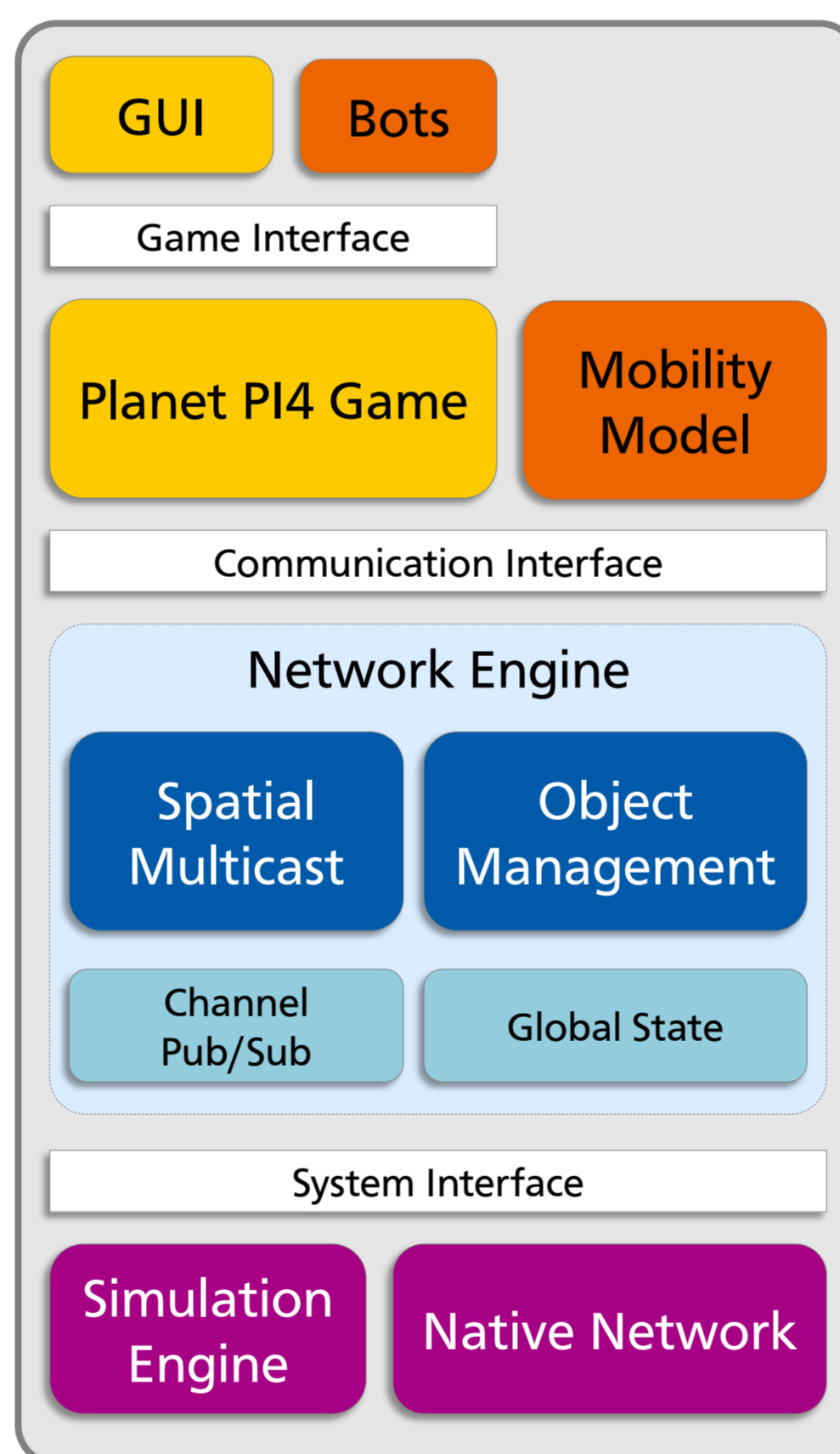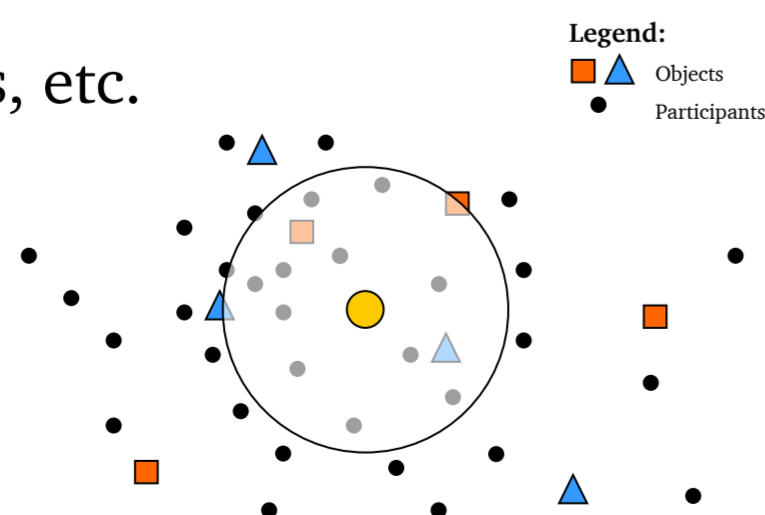- Churn Model
- Player density distribution

Network: Spatial Multicast

- Dissemination of events in a spatial context
- Implementations:
  - VON
  - pSense
  - pSense3D
  - BubbleStorm-based
  - client/server
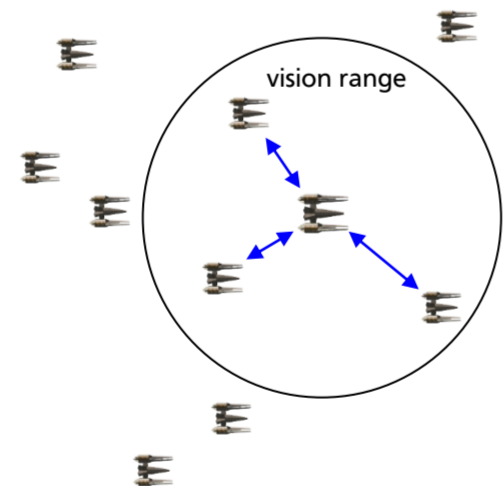
Network: Object Management

- Persistent storage
- Concurrent modification / synchronization
- Object lookup
- Enables bases, NPCs, etc.
- Instances:
  - Colyseus
 - client/server
  - VSM

A testbed for P2P gaming mechanisms

- Gameplay representing a real game
- Attractive game to real players, which provide the reference behavior
- Simple enough for focusing on the important aspects
- Resource-efficient for a good simulation scalability
  - Well-defined and flexible interfaces to facilitate the replacement of network components
  - Can run in a real network as well as in a deterministic emulated network environment

Gameplay

- Planet PI4 is a prototype of a 3D real-time massively multiplayer online game
- Competing teams
- Asteroid field sets the effective game world: parameterizable, random-generated
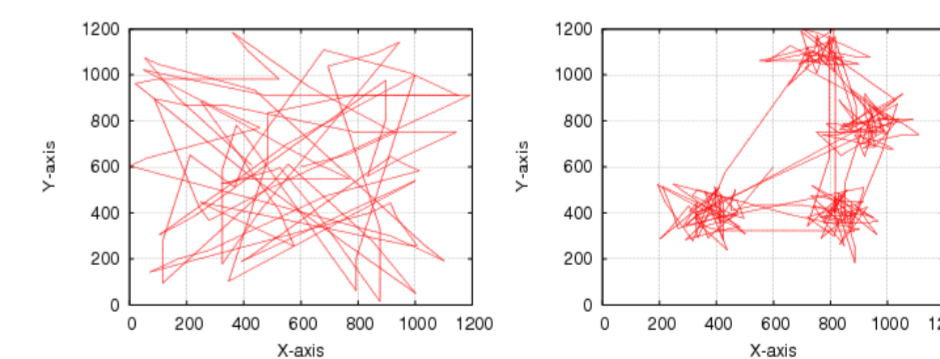- Points of interest: bases, upgrade points

Bots

- Reproducible game workload generation
- Simulate human user behavior
- Implementations using finite state machines (FSM) or behavior trees (BT)
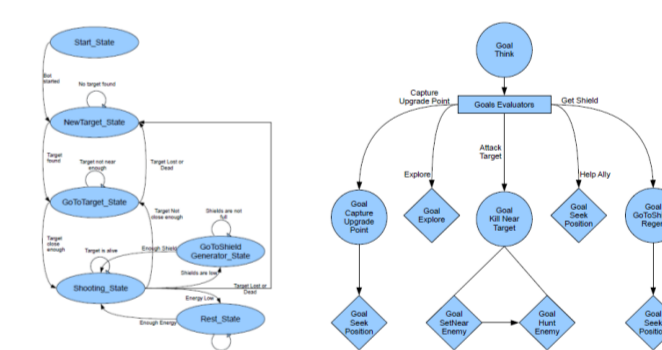
Mobility Model

- Not simulating whole gameplay
  → higher scale, faster simulation
- random waypoint model, special movement patterns, traces (other games)

Simulation Engine

- Discrete-event simulation
- Packet level network interface (UDP)
- Custom overlay simulator
- Statistics interface, live plotting from SQLite database using gnuplot

Further reading:
1. M. Lehn, C. Leng, R. Rehner, and A. Buchmann, "An Online Gaming Testbed for Peer-to-Peer Architectures," in *SIGCOMM 2011*, 2011.
2. C. Leng, M. Lehn, R. Rehner, and A. Buchmann, "Designing a Testbed for Large-scale Distributed Systems," in *SIGCOMM 2011*, 2011.
3. C. Groß, M. Lehn, C. M. A. Buchmann, and R. Steinmetz, "Towards a Comparative Performance Evaluation of Overlays for Networked Virtual Environments," in *IEEE P2P 2011*, 2011, pp. 34-43.
4. A. Schmieg, M. Stieler, S. Jeckel, P. Kabus, B. Kemme, and A. P. Buchmann, "pSense – Maintaining a Dynamic Localized Peer-to-Peer Structure for Position Based Multicast in Games," in *IEEE P2P 2008*, 2008, pp. 247–256.

QuaP2P

topology of technology