Aspects of Networking in Multiplayer Computer Games

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History and Evolution

1980
- SIMNET

1990
- DIS
- HLA
- NPSNET, STOW

2000
- DVE
- CVE
- RB2
- DIVE, Spline, MASSIVE, Coven

Academic
- Amaze
- Air Warrior

Military
- MUD

Entertainment
- Doom
- Ultima Online
- Battle.net
Motivation

- entertainment industry
  - investing on MCGs (e.g., online gaming, mobile games)
  - game development is moving towards engineering (e.g., mods, 3D engines)

- academia
  - beginning to take interest in the problems of MCGs
  - much research has been already done in related fields

- still, collaboration has been scarce
Aspects

1. Networking Resources
2. Distribution Concepts
3. Scalability
4. Security and Cheating
1. Networking Resources

- Bandwidth
- Latency
- Computational Power
2. Distribution Concepts

- Communication architecture
- Data and control architecture
Communication Architecture

Degree of deployment

- Single node Peer-to-peer
- Client/server
- Server-network
Data and Control Architecture 1 (2)

**Relay Model**

- consistency
- responsiveness

```
\[
\text{local} \quad \text{control} \quad \text{data} \quad \text{network} \quad \text{global}
\]
```

```
\[
\begin{array}{c}
\text{relay} \\
\text{two-way} \\
\iff \\
\text{short-circuit}
\end{array}
\]
```
Data and Control Architecture 2 (2)

Centralized

Distributed

Replicated
Compensatory Techniques

- reduce communication by increasing computation
- techniques:
  - message compression and aggregation
  - interest management
  - dead reckoning
3. Scalability

- how to adapt to varying amount of players
- how to allocate the computation of the game world
Serializable Parts and Communication

- Serializable parts: agreement on the sequence of events ⇒ requires communication
- Communication capacity of the deployment limits the scalability
- Linear capacity requirement too large ⇒ sublinear communication
4. Security and Cheating

- **Packet and traffic tampering**
  - reflex augmentation
  - packet interception
  - packet replay

- **Information exposure**
  - compromised software

- **Design defects**
  - distribution
  - heterogenous networks
Aspects (revisited)

1. Networking Resources
   - bandwidth, latency, computational power

2. Distribution Concepts
   - communication, data and control architectures
   - compensatory techniques

3. Scalability
   - parallel and serial parts

4. Security and Cheating
   - tampering, information exposure, design defects