Online video games
- Game market size $78.6 billion, 2.5 billion players
- Scalability and cheating are important issues

Game prototype
- Difficult to find an open-source P2P game
- Game prototype: players move on a map
- Network communication synchronous
- Players exchange move command
- Cheating player knows all positions

Scalability vs cheat-resistance
- Client-server: Cheat resistance
- Peer-to-peer: Scalability

Our goal

Scalability and cheat-resistance
- Scalability: Peer-to-peer architecture
- Cheat-resistance:
  - Trusted Execution Environment (TEE)
  - Encrypted communications

Implementation
- TEE: Intel SGX (80% gaming PCs have Intel CPU)
- 3500 lines of code
- Small well-defined interface: 4 calls

Performance results
- Two SGX-capable 6 cores machines, 1Gbps LAN

1ms network delay
10ms network delay

TEE-based Scalable and Cheat Resistant Online Video Game Architecture
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Trusted Execution Environment:
- Special execution mode
- Protects code and data from strong attacker who controls both software and hardware
- Specific interface to access TEE

1.6% performance overhead