



FizzX

Multiplayer Time Manipulation in Networked Games

Decoupled Time & Event Rewind

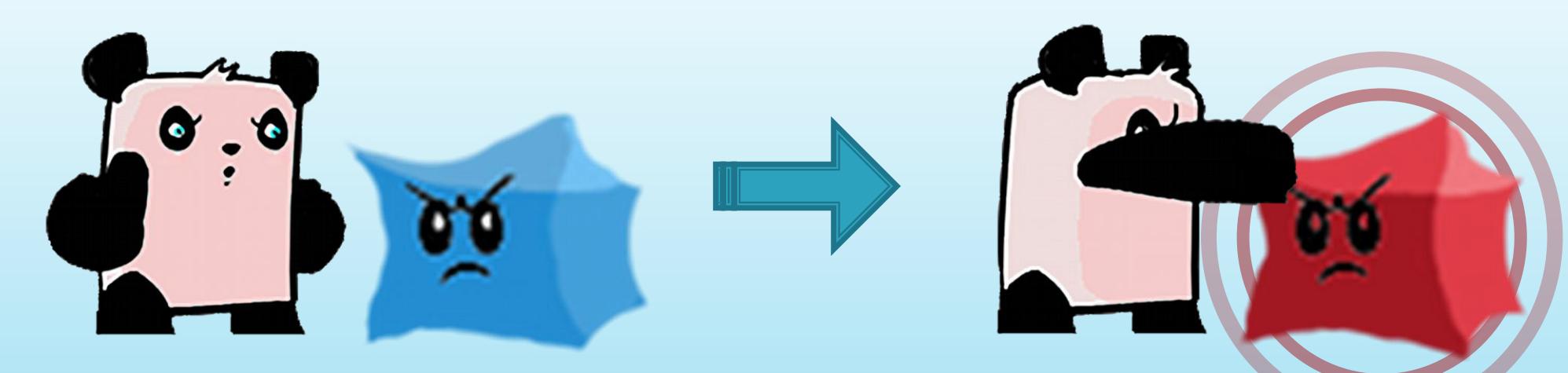
"Time" is made to be dual natured.

The illusion of time, seen as the flow of events in the game, is separate from the game system clock, which is the ever increasing game frame count.

With this duality in place, game events can be rewound

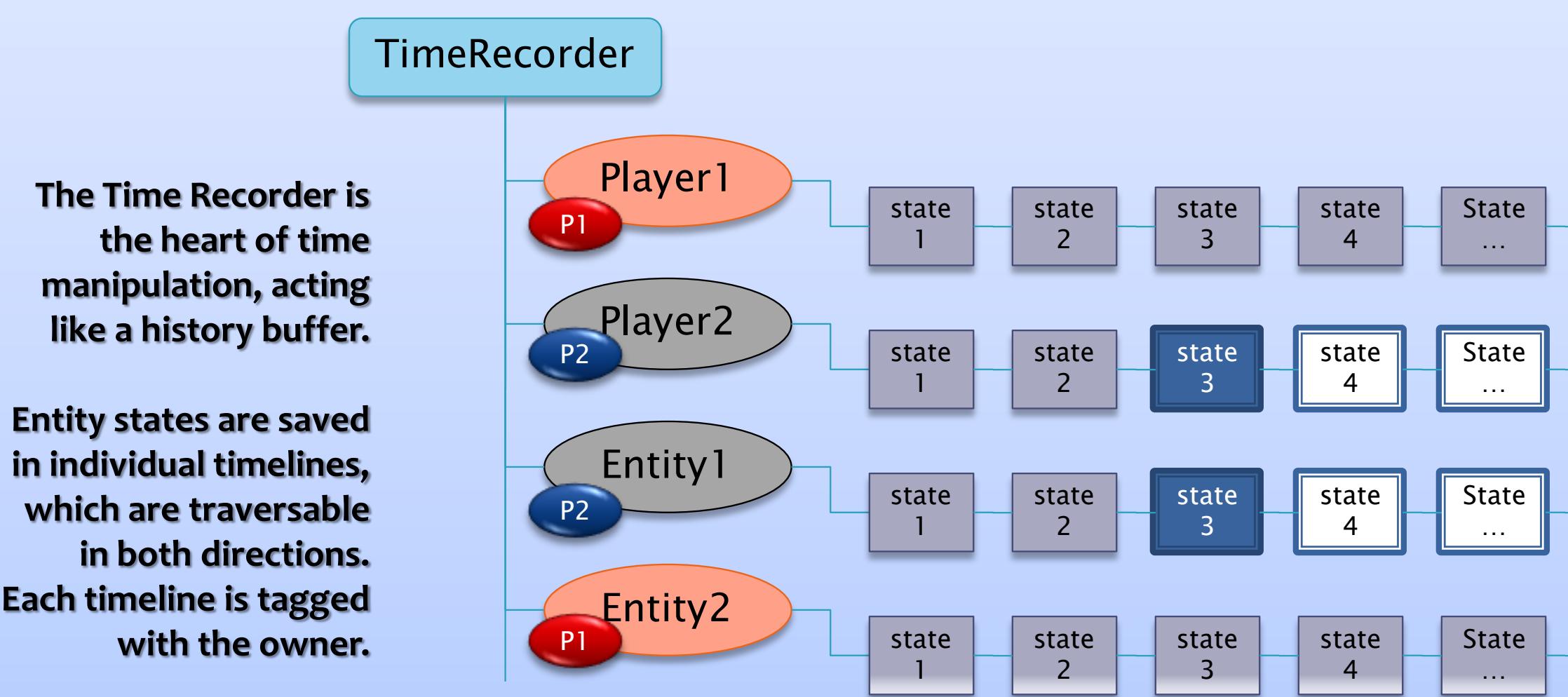


Effect Delineation: Entity Owners

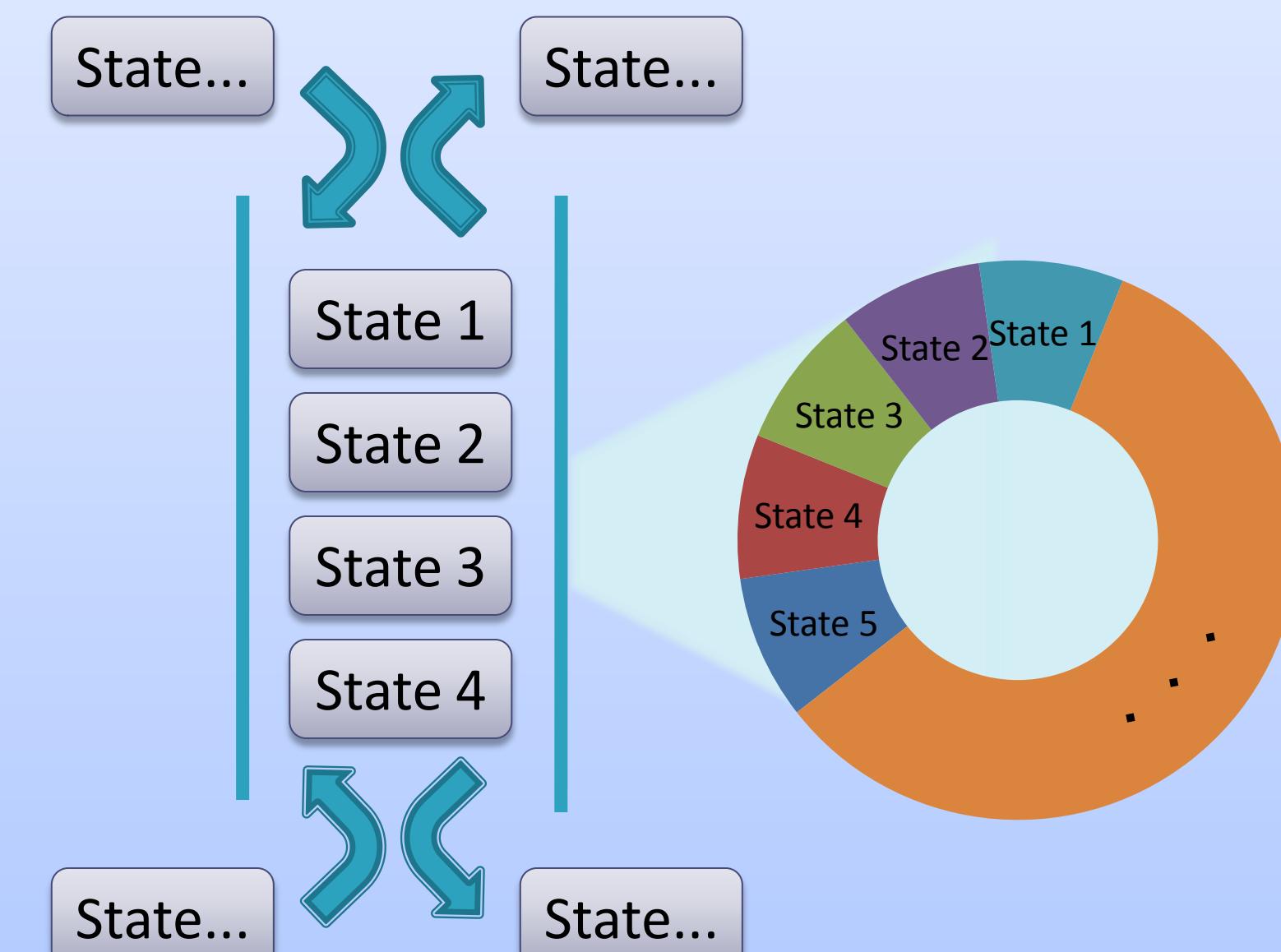


Entities are owned by the last player to touch them. When a player initiates time rewind, it affects only the entities owned by the player.

The Time Recorder

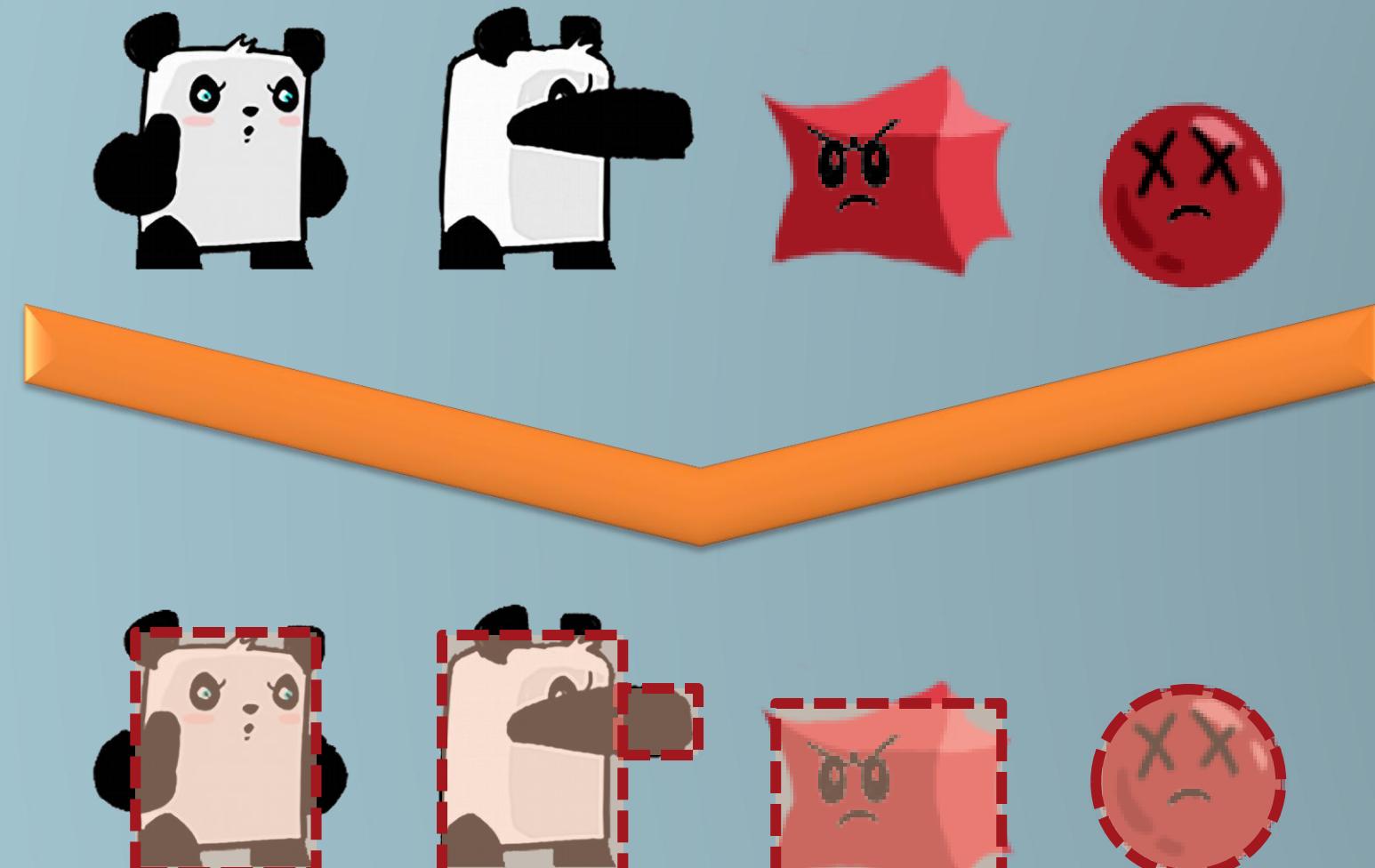


Timeline Storage Solution



This custom solution is not found in the XNA 2.0 framework. The deque's backend is a circular array, whose size is determined by the game rewind limit.

Stylized Visuals & Bounding Boxes



The use of stylized visuals limits the number bounding boxes required. This limited set in turn reduces the complexity of collision detection and handling.

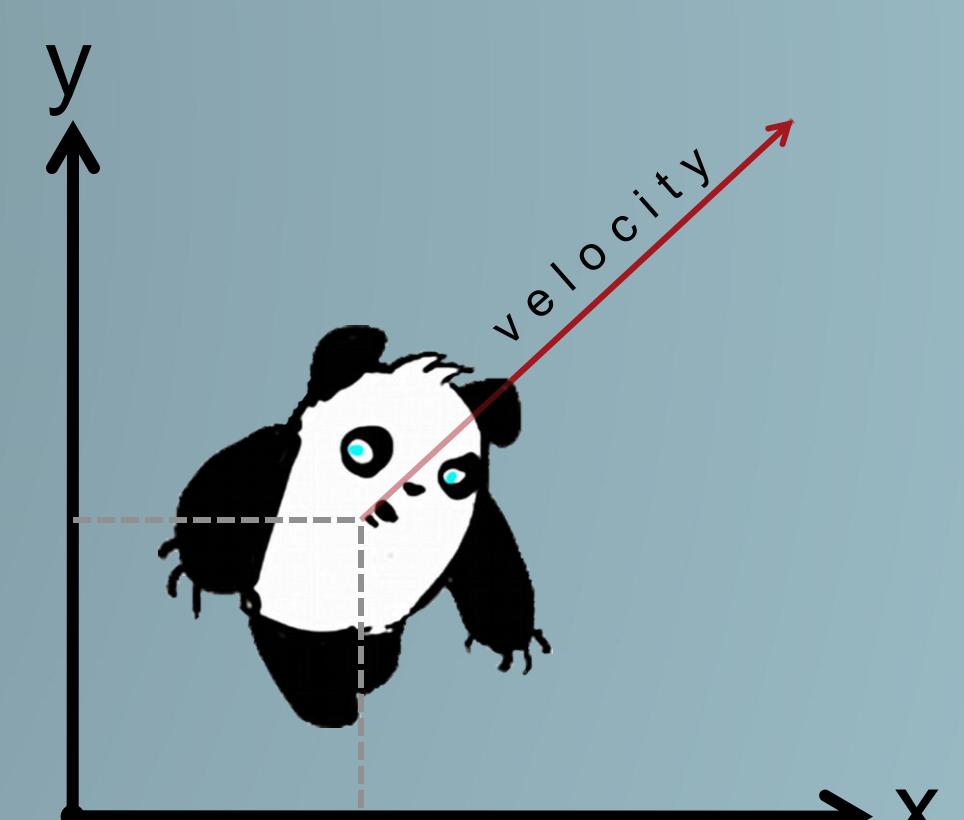


Quantized Physics

To facilitate collision detection, game physics are advanced in small discreet steps and entities have terminal velocities.

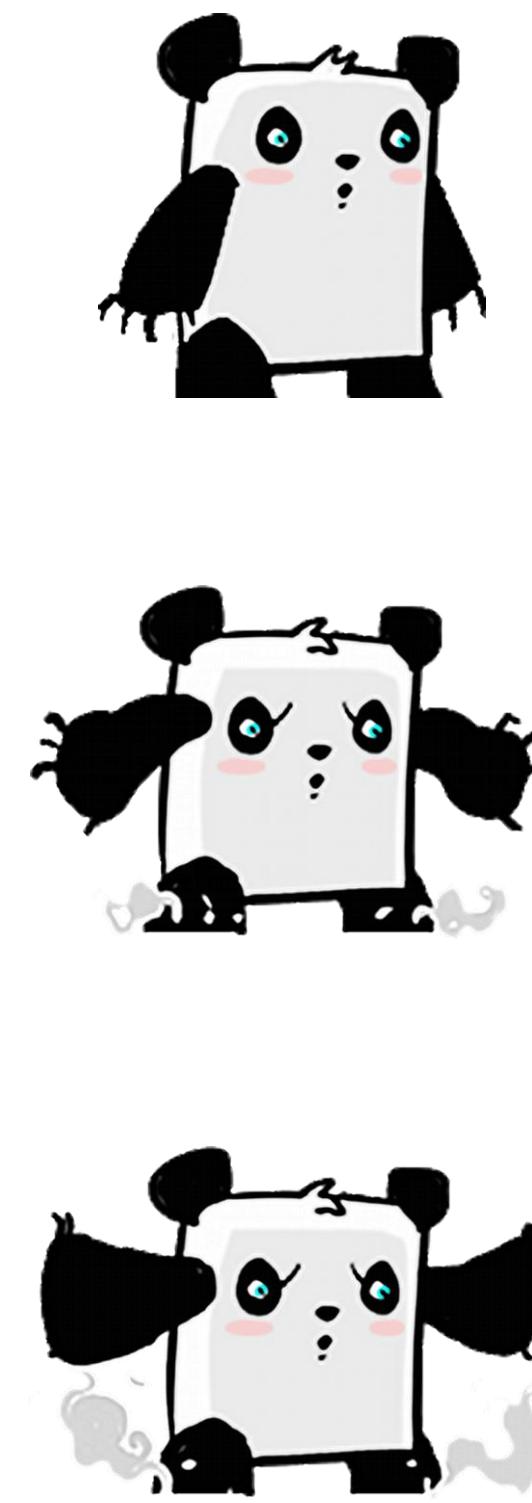
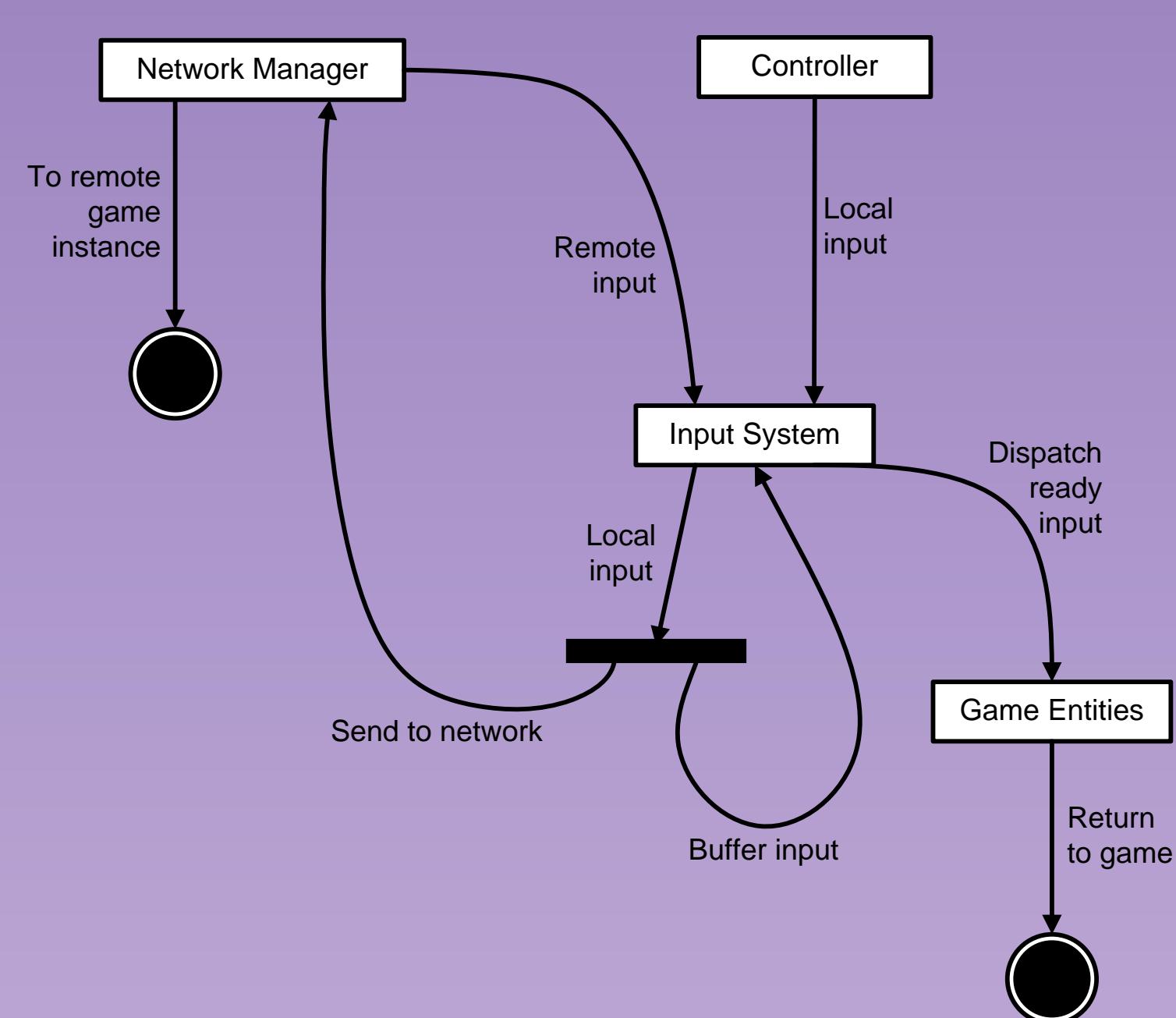


At each time step, entity states are processed, and corrected if they are illegal. This can occur due to time rewinds.

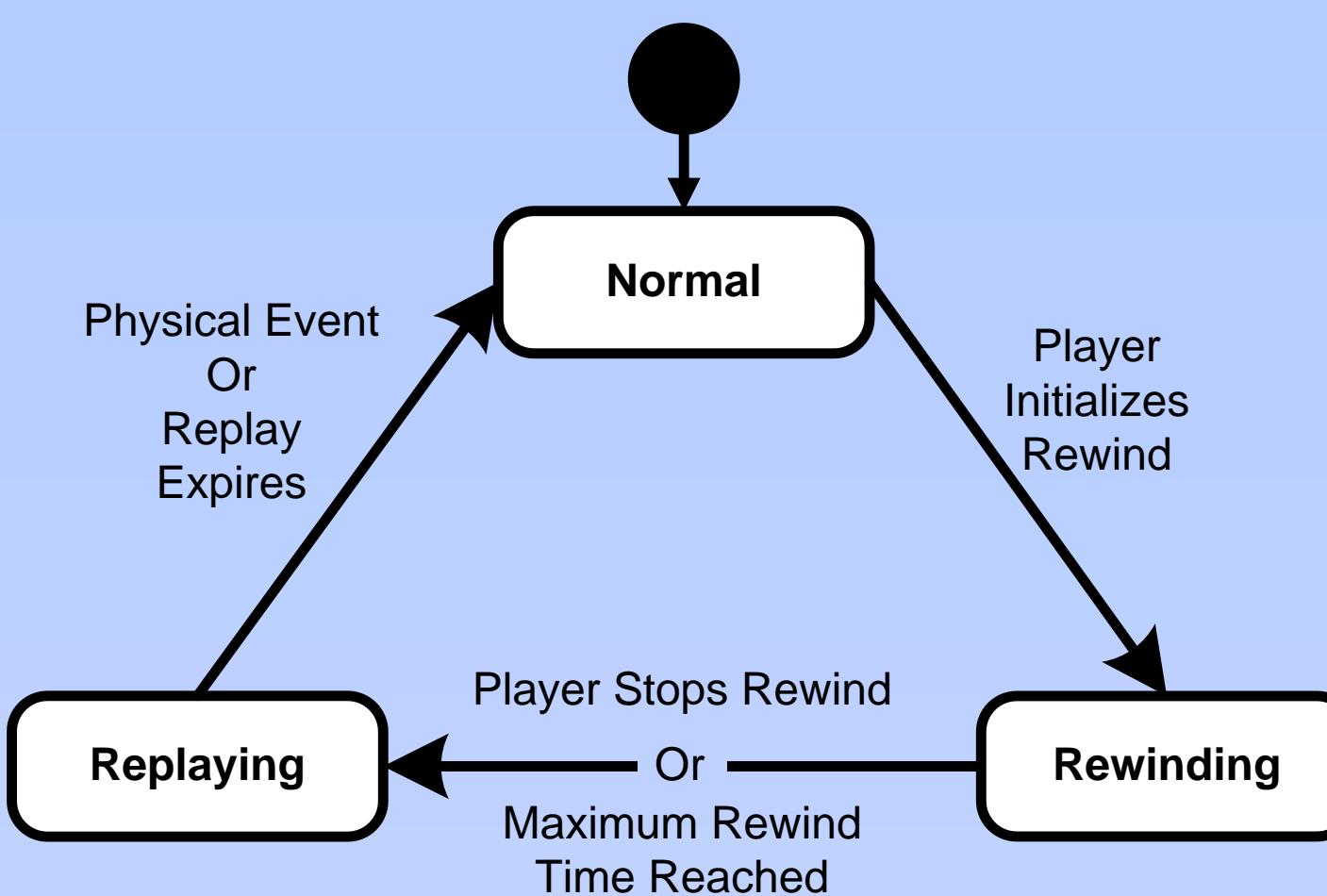


Accommodating Network Latency

Network latency is accommodated by using local player input delay. When a game instance receives player input, it is buffered locally for a short time; at the same time it is sent to the remote peer over the network with a deadline time. The remote instance receives the input and stores it. Both instances apply the input to their simulations at the deadline. This makes the external forces on both simulations identical.

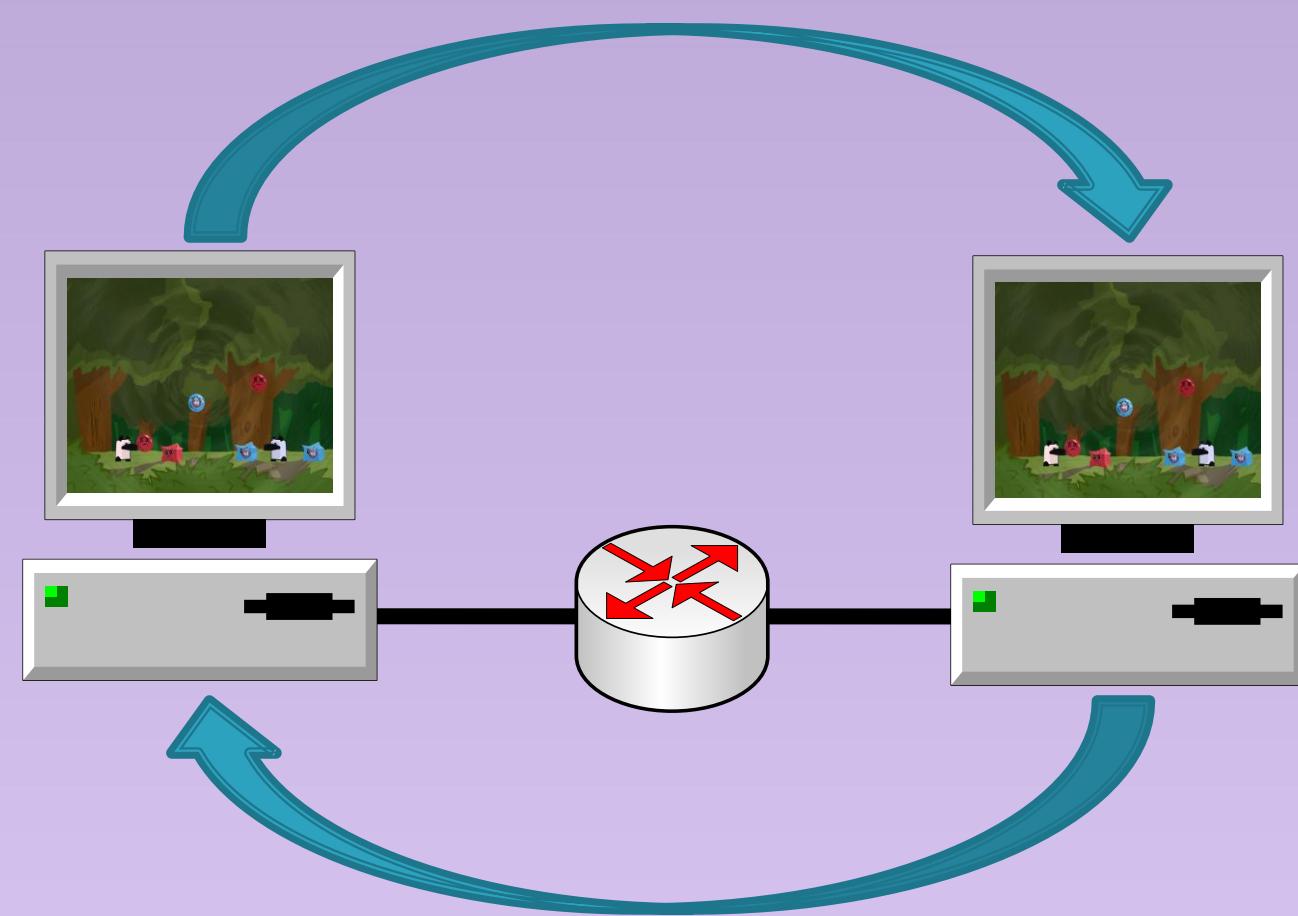


Entity Time Mode Evolution



Inter-Peer Synchronization

Synchronization is achieved by a peer pausing its simulation, allowing the other to catch up. This responsibility is switched between the peers.



Time Mode Collision Matrix

	Normal	Rewinding	Replaying
Normal	X		X
Rewinding			
Replaying	X		X

Once all entities' time mode as established for a given time increment, the collision matrix is used to determine how collisions are detected between different time modes.