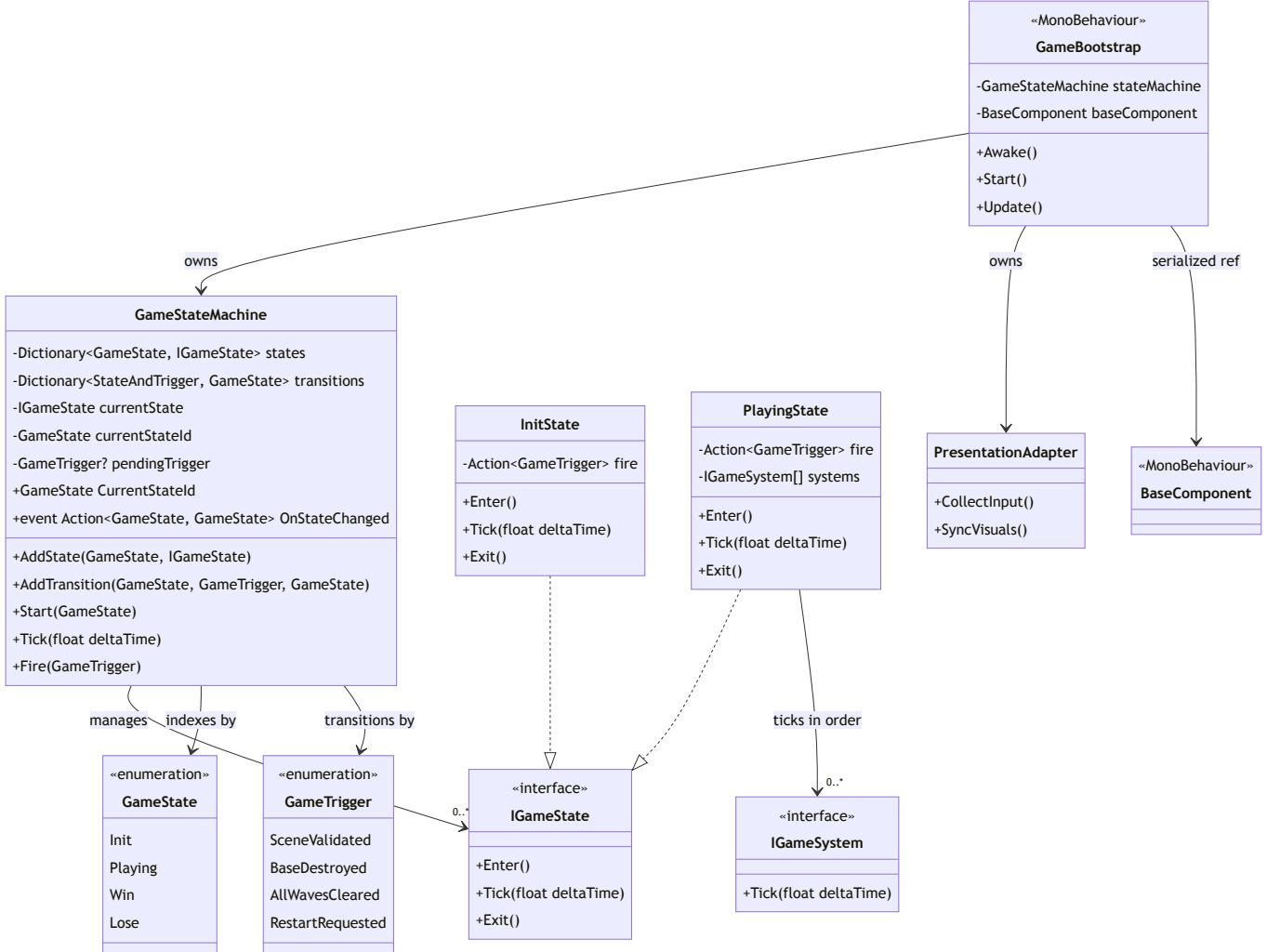


# Architecture Diagrams

Visual companion to TDD.md Section 2 (Detailed Design). Render with any Mermaid-capable viewer.

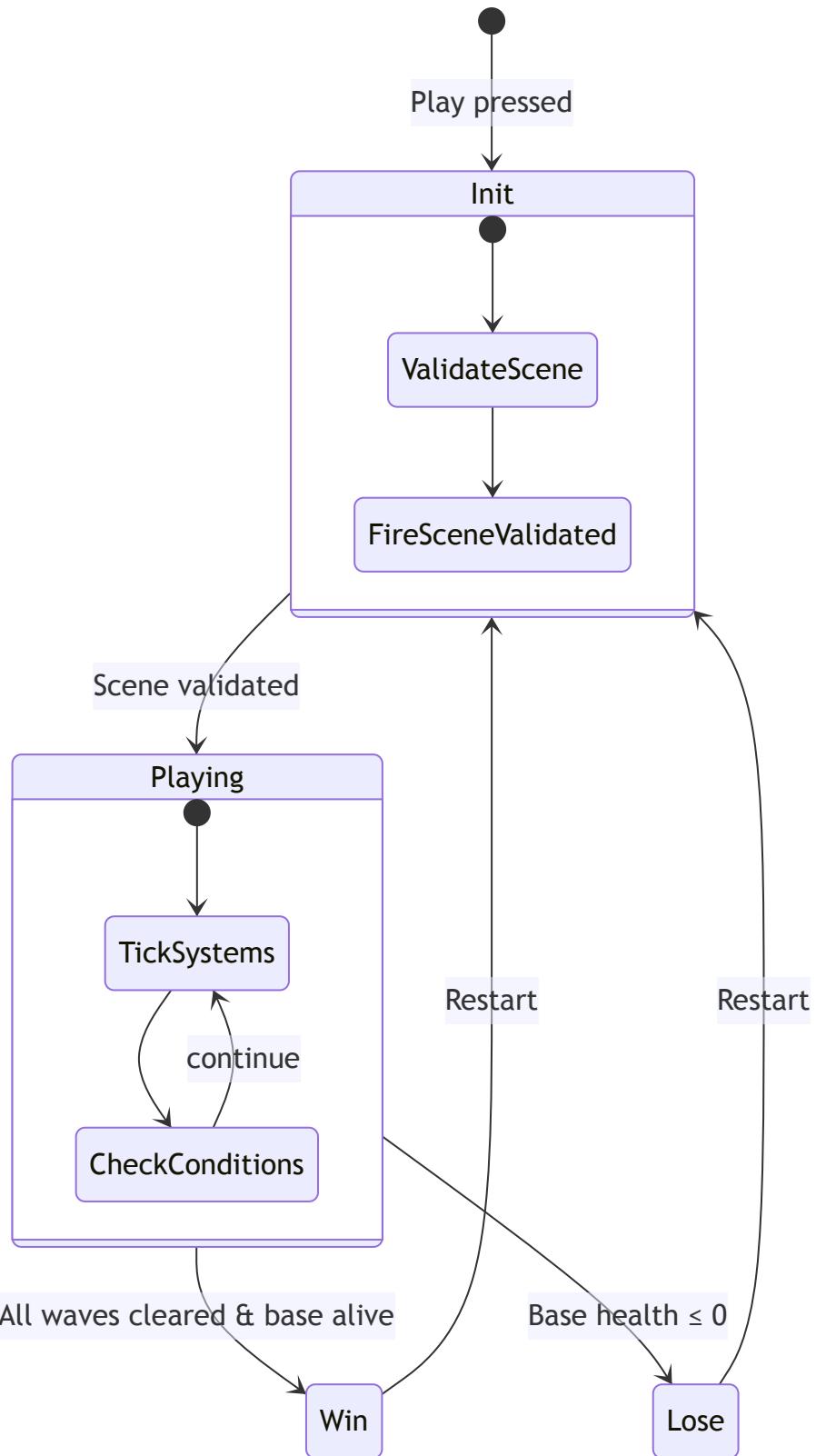
## Class Diagram — Story 1 Foundation



### Notes:

- GameBootstrap** is the only "god-level" MonoBehaviour. It is the composition root — creates the state machine, creates states, configures the transition table, and wires references.
- GameStateMachine** and all **IGameState** implementations are **plain C# classes**, not MonoBehaviours.
- BaseComponent** is a thin MonoBehaviour on the Base GameObject in the scene. It holds no logic — just identifies the object for system discovery.
- States receive an **Action<GameTrigger>** delegate at construction. They fire semantic triggers ( **SceneValidated**, **BaseDestroyed**, etc.) without knowing which state the trigger leads to. The transition table in **GameBootstrap** maps (state, trigger) → destination .
- IGameSystem** provides a uniform **Tick()** contract for gameplay systems. **PlayingState** receives an ordered array at construction and ticks them sequentially.
- PresentationAdapter** is a **plain C# class** owned by **GameBootstrap**. It is the only place that calls Unity input and rendering APIs. Systems never reference it directly — they read input structs it produces and write sim data it consumes. Stub in Story 1; gains responsibilities as systems are added.
- Win** and **Lose** states appear in the enum but are implemented in later stories.
- GameTrigger** values are added incrementally as stories introduce new transitions.

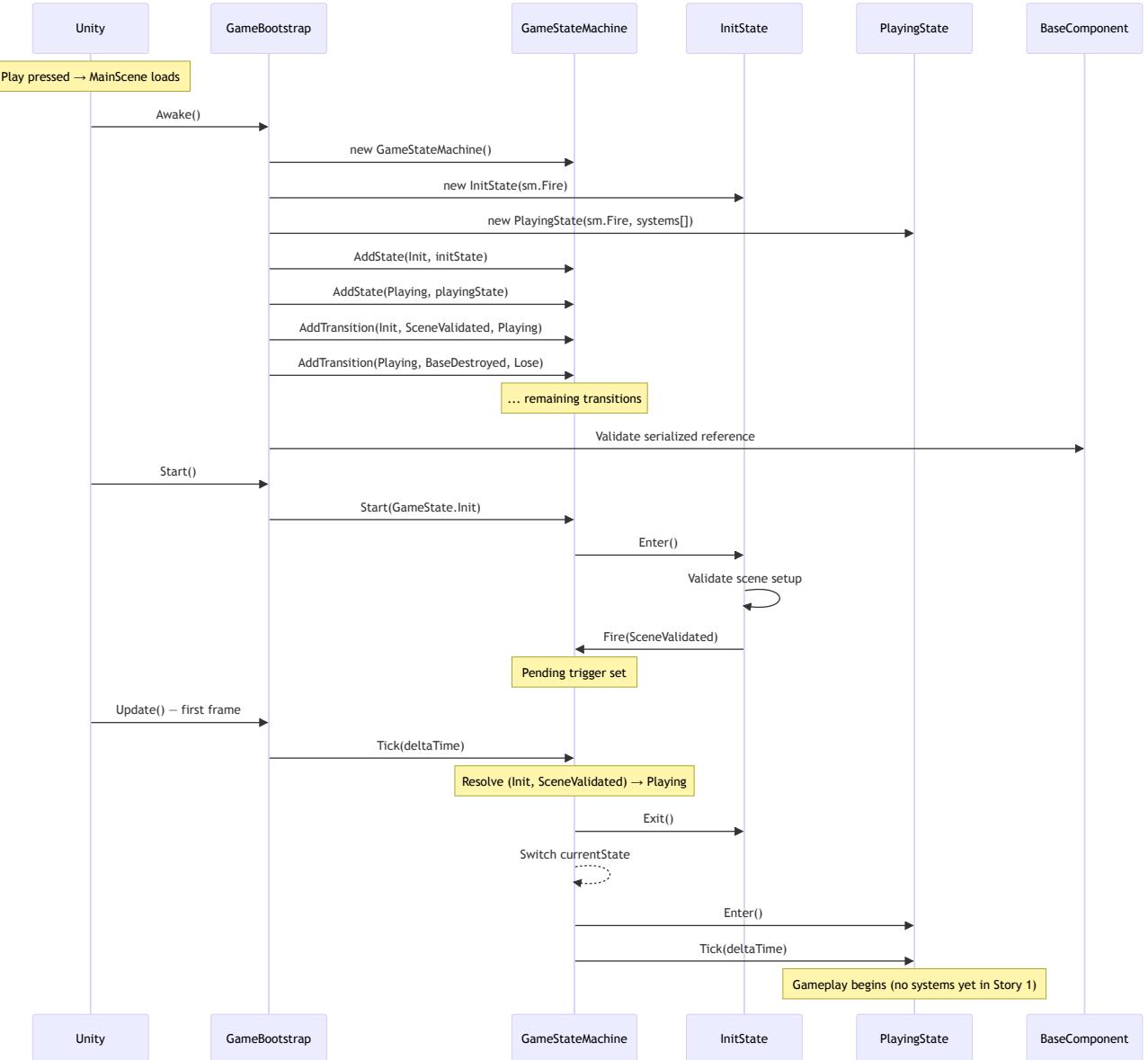
## Game State Diagram



**Story 1 scope:** Only `Init` and `Playing` are implemented. `Win` and `Lose` are placeholders in the enum — their `IGameState` classes come in Stories 3 and 9.

**Reset path:** Restart from `Win/Lose` transitions back to `Init`. `PlayingState.Exit()` tears down spawned objects and system state. `InitState.Enter()` re-validates and sets up a fresh game. No residual state.

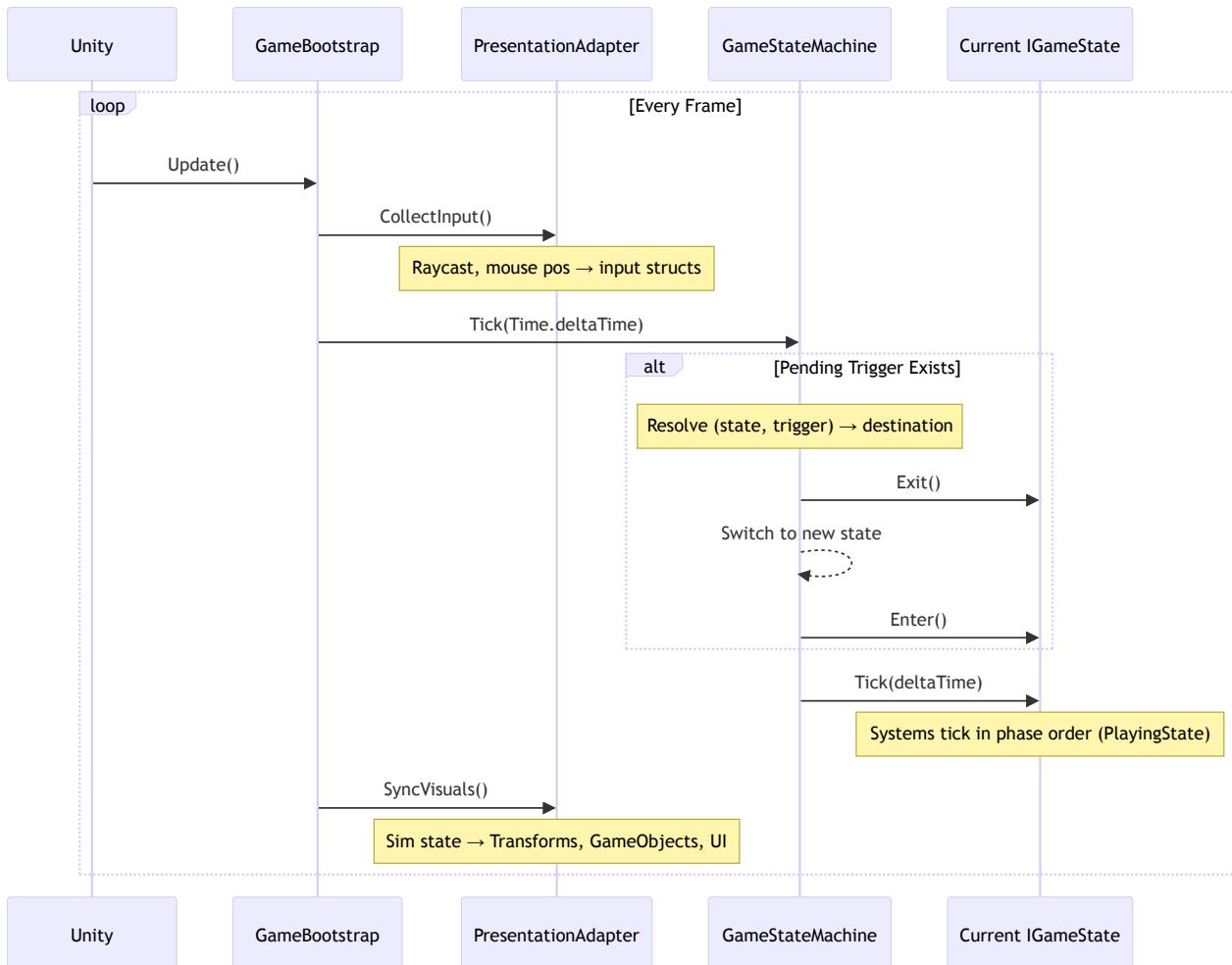
## Startup Sequence



### Key points:

- `GameBootstrap.Awake()` constructs everything and configures the transition table. `Start()` kicks off the state machine.
- `InitState.Enter()` fires `SceneValidated` — it does not know the destination. The trigger is **pending** — not resolved until the next `Tick()`.
- The state machine resolves triggers at the **start** of `Tick()` : lookup (`currentState, trigger`) in transition table → `Exit()` old → switch → `Enter()` new → `Tick()` new. This guarantees one clean frame boundary between states.
- States only depend on `Action<GameTrigger>` — no reference to other states or to `GameStateMachine` itself. This makes states independently testable.

## Per-Frame Tick Flow



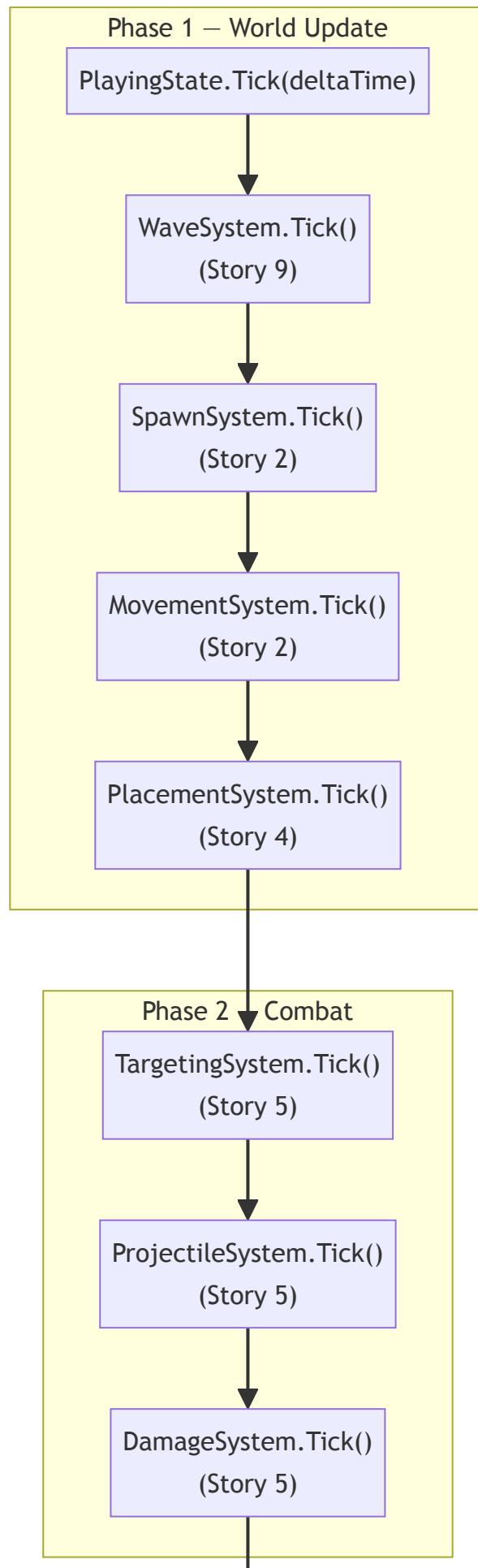
**Frame boundary contract:** Each frame has three phases with unidirectional data flow:

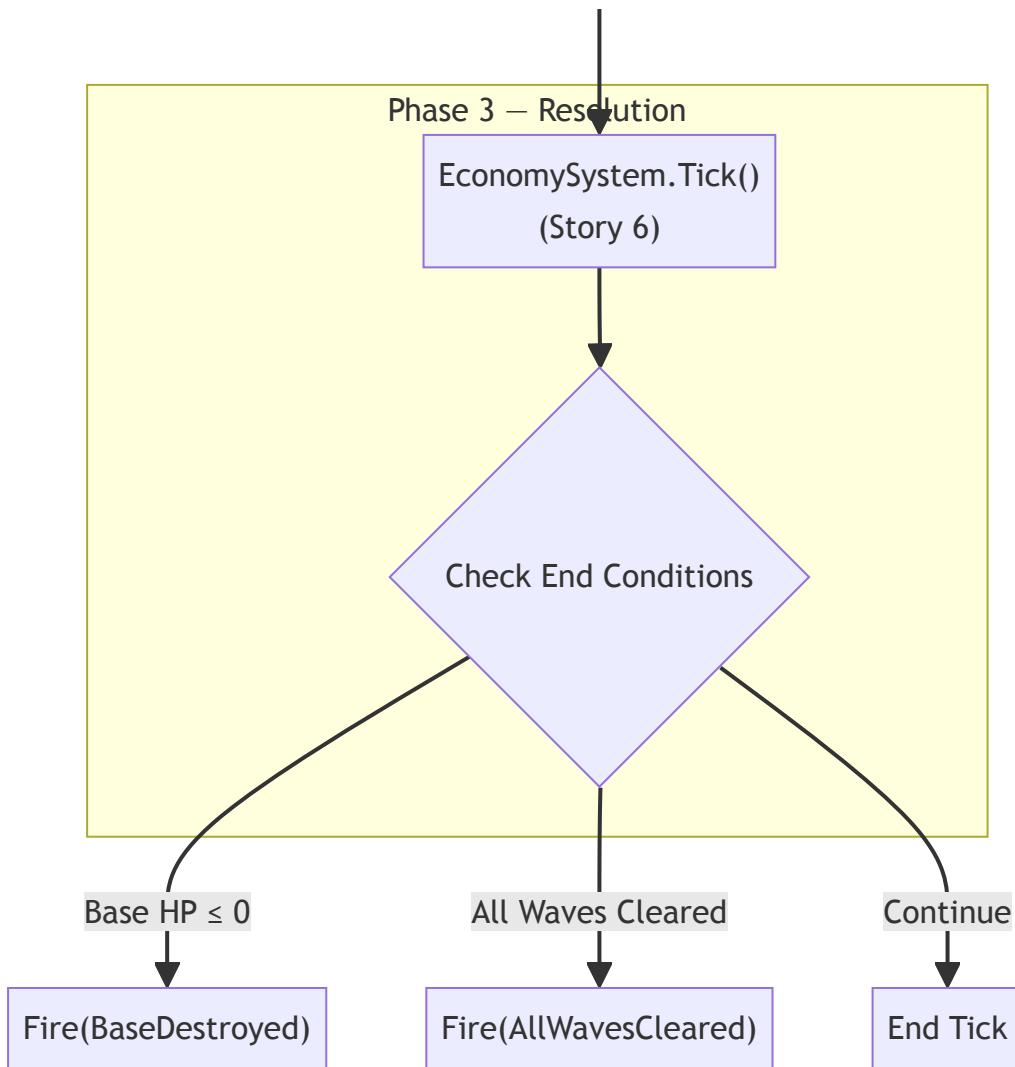
- 1. Input collection** — `PresentationAdapter.CollectInput()` reads Unity inputs (mouse position, raycasts, keyboard) and writes them into sim-readable input structs. Systems never call Unity input APIs directly.
- 2. Simulation tick** — The state machine ticks the current state, which ticks systems in deterministic phase order. Systems read/write only simulation data (structs, arrays). No Unity API calls.
- 3. Visual sync** — `PresentationAdapter.SyncVisuals()` reads simulation state and writes to Unity objects (`Transform.position`, enable/disable GameObjects, UI updates). The sim is unaware this step exists.

**Story 1:** `PlayingState.Tick()` iterates over its `IGameSystem[]` array — which is empty in Story 1. The presentation adapter is a stub in Story 1 and gains responsibilities as systems are added. Future stories add systems to the array in `GameBootstrap`.

## Playing State — System Phases & Tick Order

Shows how `IGameSystem` implementations will be ticked by `PlayingState` as stories are implemented. Systems are grouped into three conceptual phases. All systems are plain C# classes implementing `IGameSystem`, registered in order via `GameBootstrap`.





#### System phases:

Phase	Systems	Purpose
1 — World Update	Wave, Spawn, Movement, Placement	Bring all entities to current-frame state; process player input
2 — Combat	Targeting, Projectile, Damage	Resolve attacks using positions settled in Phase 1
3 — Resolution	Economy, End Conditions	Process rewards and check win/lose after combat settles

#### Tick order within phases:

1. **Waves** decide what to spawn this frame
2. **Spawn** creates new creeps from wave data
3. **Movement** advances all creeps toward the base
4. **Placement** processes player turret placement input — placed turrets are available for targeting this frame
5. **Targeting** assigns turret targets using settled positions from Phase 1
6. **Projectiles** advance in-flight projectiles, check hits
7. **Damage** applies damage from hits, removes dead creeps, triggers base damage on arrival
8. **Economy** processes coin awards from kills
9. **Conditions** check win/lose after all systems have settled

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## Folder Structure

```
Assets/
└── Scripts/
    ├── Core/                      # Bootstrap, state machine, game loop
    │   ├── GameBootstrap.cs
    │   ├── GameStateMachine.cs
    │   ├── GameState.cs             # enum
    │   ├── GameTrigger.cs          # enum
    │   ├── IGameState.cs           # interface
    │   ├── IGameSystem.cs          # interface
    │   ├── InitState.cs
    │   └── PlayingState.cs
    ├── Base/                      # Base identification component
    │   └── BaseComponent.cs
    ├── Creeps/                    # (Story 2+)
    ├── Turrets/                  # (Story 4+)
    ├── Combat/                   # (Story 5+)
    ├── Economy/                  # (Story 6+)
    ├── Waves/                    # (Story 9)
    ├── Data/                     # ScriptableObject definitions
    └── UI/                       # UI Toolkit binding
    Tests/
        ├── Editor/
        │   ├──EditModeTests.asmdef
        │   └── GameStateMachineTests.cs
        └── Runtime/
            └── RuntimeTests.asmdef
    ├── Prefabs/                  # (provided, unchanged)
    ├── Scenes/                   # (provided, unchanged)
    ├── Materials/                # (provided, unchanged)
    └── Terrain/                  # (provided, unchanged)
```

No project-wide namespace. Feature folders group related components, systems, and data.