

Adaptive Level-of-Detail System for “End of Nations”

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1. Introduction

One of many challenges in making a massive online RTS such as “End of Nations” is how to maintain a smooth framerate at all times without completely compromising on the visual quality of the game. Because “End of Nations” supports over 50 players in a battle together, there is a wide range of load on the graphics engine. Game developers have been employing many well-established Level-of-Detail (LoD) techniques when trying to solve the performance problem. We will show how we incorporated many of these existing techniques into a single over-arching LoD system that can monitor the game framerate in real-time and adapt to it to ensure a playable experience with the best possible visual quality.

2. Exposition

The number of units on screen is often the most important factor to affect performance of a real-time strategy game. Techniques such as restricting the camera zoom, geometry LoD, etc can generally help keep the graphics engine’s work load constrained as much as possible. While we do make extensive use of a “screen-size”-based LoD scheme, for “End of Nations” more is needed to have the game run fast. This is primarily because players are free to amass units at any location within the game world. On top of that, our camera is designed to zoom out quite far to give an epic feel to battles. What we need is a way to constantly monitor the framerate and dynamically adapt the work load over time.



2.1 Elaboration

At run-time, many systems can modify the graphics engine’s feature set, some of them even overlapping each other. For example, the user can, at any time, change the video settings via the UI, the camera-zoom system can decide to fade out a certain class of props or effects (e.g. footsteps are not needed/desired when the camera zoomed out) or the game-level projectile system can decide to reduce the spawn rate to 75%. We needed a middle

man to regulate the conversation across systems. The “Dynamic LoD Interface” does exactly that. It acts as a voting system in which different systems in the game submit their vote on how they think the graphics features set should be in a given frame. The “Dynamic LoD Interface” will then evaluate the votes, decide the best actions to take (generally those that increase the performance the most and degrade the visual quality the least) and execute them.

While the “Dynamic LoD Interface” counts votes and acts on them, the “Tactical LoD System” watches the game performance closely and casts much of the votes in an effort to maintain a playable framerate at all time. This system uses a simple ring-buffer to track framerate within the last N frames, from which it can average out and guess how fast the game is running. It then needs to decide on what action to take.

3. Results

The biggest danger with this type of adaptive LoD scheme is unstable visuals. The system could constantly degrade and upgrade features, creating a “flickering” type of effect as the framerate fluctuates. To prevent this problem, some hysteresis is needed. The system is not allowed to rapidly “change directions”. For example, it can rapidly execute several downgrade actions but some minimum amount of time is required before it can then execute an upgrade action. Extensive and on-going testing is critical. Once the system was thoroughly tested and fairly well-tuned, we observed that the engine was able to hold itself well under heavy battles without giving away much of its internal trickery. When you have a large number of units moving, shooting and exploding, it is quite hard to notice that bloom and heat distortion has been turned off or that 3 out of 10 times this one tank shot, the muzzle flash didn’t show up. And because the game feels smooth and playable all the time, the overall experience is a better one.

4. Conclusions

We have presented what motivated us to create an adaptive LoD system for “End of Nations”. We have shown the design as well as the algorithm to implement such a system. With careful tuning, the system can adjust the graphics engine’s work load to produce significant performance boost without jarring “flickering” in the visual and create a better play experience.