

# GENERAL ZERO HOUR

A Brief Technical Overview



This document provides a brief overview over the technical state of Command and Conquer Generals Zero Hour. The aim is to educate on its core issues and how to potentially tackle them. It will also give an insight into the way typical players and developers interact with it.

All pages have been designed for native 1920 x 1080 resolution.

Enjoy.

# Blocker bugs

The blocker bugs are the most problematic and deserve to be highlighted first. Blockers prevent the player from launching or running the game, which is a major problem for casual players.

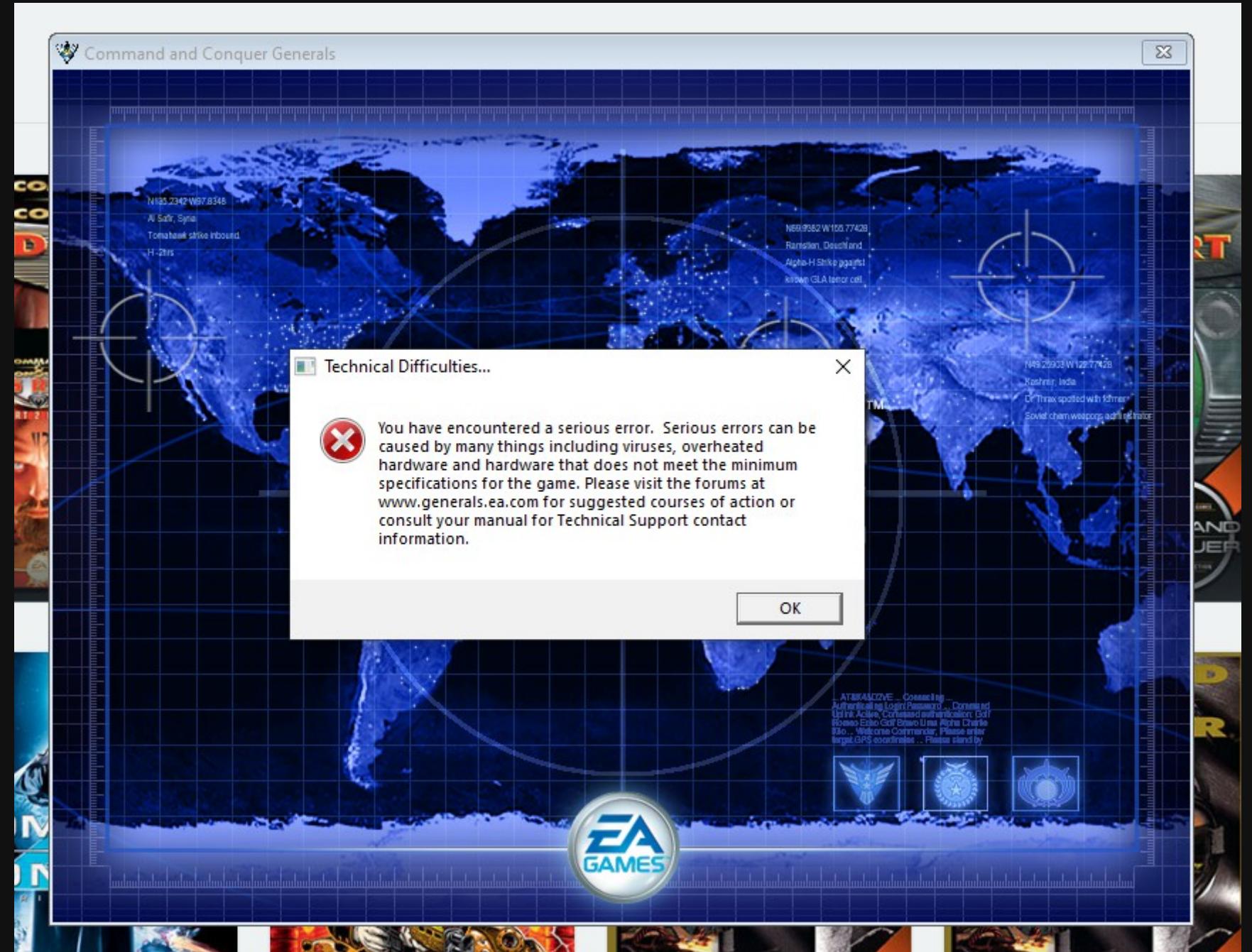
In 2022, a common modern PC running Windows 7 or higher will likely run into one of many technical difficulties when launching the game from EA Origin or from older Retail CD's. The user will be presented a crash dialog with no way of knowing how to resolve the issue on his own.

Typical blocker bugs are caused by SafeDisc being no longer compatible with Windows 10, some optional game files crashing modern AMD Graphics drivers and some game code being severely outdated and unstable to run.

Workarounds do exist, but they require web searches. The game community does provide instructions to fix all known problems by hand. Additionally there is a tool to fix these kind of issues. If applied correctly, the player can run the game afterwards.

Ideally no blockers are present by default to give players an easy entrance.

**Requires C++ Programmer to fix.**



# Crashes & Mismatches

The game hosts a generous amount of problems that result in frequent crashes or mismatches. A crash refers to the prompt termination of the game, and a mismatch refers to the prompt interruption of a Network match between two or more players.

For these kind of issues we estimate a hit in 1 of 10 matches played, or 10%. Various sources of game crashes are known. Some of them have community made fixes, but require third party tool installation(s) on top of the original game.

Crashes are typically straight forward to test and analyze. Some of them are caused by erroneous setups in script files (INI) and others by game code.

For Mismatches there is currently no meaningful way to investigate from community standpoint. Potentially the original game code did provide debug tools for this, which certainly would be required for proper investigation.

**Requires C++ Programmer & Technical Designer to fix.**



# Non-functional Multiplayer Lobby

GameSpy has been EA's server choice for most of its Command and Conquer releases. The shutdown of GameSpy in 2013 with all its servers inevitably meant the sudden death to the Multiplayer Lobby of this game.

There have been GameSpy replacements built by community developers, but to date there is no stable or feature complete solution that restores the original experience.

As of 2022, players use different Networks to match with other players, each operating entirely separate of each other. Popular are GameRanger, C&C Online, Radmin and Hamachi.

C&C Online did have a bit PR support from EA and looked like a promising project - and while the webpages and servers do work today, technically the experience is disappointing with frequent outages, performance issues and broken features. The development has been long abandoned by their author(s) unfortunately.

Most players are not satisfied with the third party Networks available. A polished new Backend to restore the original Multiplayer Lobby experience would be the best way to unite all players on one platform.

Implementing a new Backend from scratch would very likely be an unreasonable approach, given the complexity of such system. Afterall, it does need to manage User Accounts, Chat Messages and Match Staging. A more reasonable approach could be to repurpose existing technologies.

**Requires C++ Programmer & Backend Programmer to fix.**



# Lack of native Widescreen Monitor support

The game was created at a time when Widescreen Monitors were not a thing yet. Instead the game was designed for 4:3 resolutions (800 x 600). All UI graphics abide to this resolution, and so do a few core mechanics.

Fortunately, the community has solved this problem by patching Resolution Settings, Camera System and a few GUI Elements, that effectively allow the player to enjoy the game in a Widescreen setup as if this was a modern game.

A few minor problems were not solved to better support very high resolutions such as 4k, but the game is very presentable in Full HD (1920 x 1080). This is good for most players and broadcasting on platforms such as Twitch and YouTube.

The Rendering code of the game is very capable and can handle various setups, so from a technical level it is straight forward to make the game presentation suitable for Widescreen Monitors. The User Interface may be an exception to this.

**Requires C++ Programmer to fix.**





Improved game visuals for modern setups with wide-screen fixes and some art adjustments applied.

# Exploits & Cheats

Just like any other Multiplayer game, this one is not exempt of exploits and cheats that players can abuse to gain an unfair advantage in a competitive match. Exploits describe game flaws that can be abused if found, and cheats describe third party programs, that change the game in a way that creates unfair advantages otherwise not possible on a regular game install.

The game has a number of big exploits that need fixing. Exploits are typically straight forward to solve, by fixing the underlying broken logic in the script files (INI) or in the game code.

Cheats are more complicated to tackle, as it generally is impossible to prevent a user from exploiting the programs that run on his/her Computer. However, it is possible to decrease the effectiveness of cheats by strengthening the peer-to-peer protocols and by implementing methods to detect the consequences of malicious activity from the game session of a remote machine.

The way the game network is implemented already prevents a large array of cheats. This is good. For example it will not be possible to teleport a vehicle from one position to another, as that would invalidate the game state within the peer network.

For other kind of cheats the community developed tools over the years to help detect them. For example the native Replay system has been repurposed to scan for suspicious activity and present it to the Reviewer. More techniques in that direction would be possible to implement, for example recording camera movements of all players into Replay files.

**Requires C++ Programmer & Technical Designer to fix.**



# Network connection issues

A major issue on the original Multiplayer Server has always been the mediocre connectivity between clients. You could try to connect 6 players to a match, and one time it would work just fine and a few minutes later it would just keep failing for no apparent reason. Technically it is not always straight forward to establish a connection with a remote peer, if that peer sits behind a firewall blocking incoming traffic. This game is quite susceptible to these kind of problems, as it appears to have no advanced techniques implemented to help mitigating such problems.

Ideally the game client and matchmaking server can do as much as possible to smoothly establish a connection between all peers, and if not, at least show a warning before match start whether or not there are connection problems to be expected between certain clients. Given such a warning, a player is notified and can check his Internet Router and Firewall settings to try fix his setup.

Another problem is the lack of IPv6 support. The game was build to support IPv4 natively, and any attempts to connect with IPv6 to a match session for IPv4 will fail. It appears third party Networks such as GameRanger and Radmin work around this issue by tunneling the client connection into an IPv4 Network that the game supports.

It likely is possible to upgrade the game's Network to support IPv6 natively.

**Requires C++ Programmer to fix.**



# Performance issues

The game was created for very low system spec requirements by today's standards. Therefore, the overall game performance is good, but it does underperform in certain scenarios.

Known sources of performance degradation are some kinds of particle effects, AI pathfinding and UI elements. Proper profiling will be necessary to find the biggest offenders. There likely are many optimizations possible to reduce frame time.

In code, some optimizations could be simple, such as using more CPU processing and cache friendly data structures and algorithms. Another area can be the introduction of multi-threading for expensive jobs, however, this can be very complicated and risky to do, depending on the complexity and state of a system. As of right now, most logic is run on Main thread and thus it does not leverage modern Multi Core CPU's for best performance.

**Requires C++ Programmer to fix.**



Frames per Second dropped from 300 to 99, or 66%,  
by deploying particle effects from 6 tanks in this test.

# Gameplay fixes

Overall the game mechanics and the gameplay is good and players enjoy the game for what it is. However, there have always been complaints about the imbalance of faction strengths. The game has 12 factions to choose from, and not every factions is equally capable with its available weapon arsenal.

Over the years, many issues and potential solutions have been identified and collected, but yet it is highly controversial to tweak one thing or another. Although technically this is one of the easiest problems to tackle, logically it is one of the most challenging, because many changes can have significant impact on how the game is played.

Naturally different community members have opposing opinions on certain designs, and there has always been a lack of authority to drive design properly. Therefore gameplay discussions are vast, but decision velocity is slow.

The slow movement of design decisions is not necessarily a bad thing. It invites to gather and evaluate more valuable input. It is possible that gameplay changes are best served in chunks, where the most severe problems are tackled first, and the feedback on a new release is re-evaluated for further tweaks.

**Requires Game Designer & Technical Designer to fix.**



# Art fixes and enhancements

Overall the game textures and models look okay, however, when looking closely many minor issues can be spotted. Some of them affect gameplay, but most of them are purely cosmetic. Over the years, hundreds of them have been identified and addressed by community members. Today we have a large catalogue of art issues and fixes.

Common art issues include texture and UV mapping errors, missing or broken particle effects, missing polygons / bones / fireports on 3D models and animation errors.

There has also been a multitude of enhancements that make various art pieces look much better than the original, which can be classified as a visual improvement.

The current plan is to merge various appropriate fixes and enhancements from different projects into the new Game Patch project to benefit from all the accomplished polishing work.

**Requires 2D & 3D Artist to fix.**



Original



Fixes and improvements applied

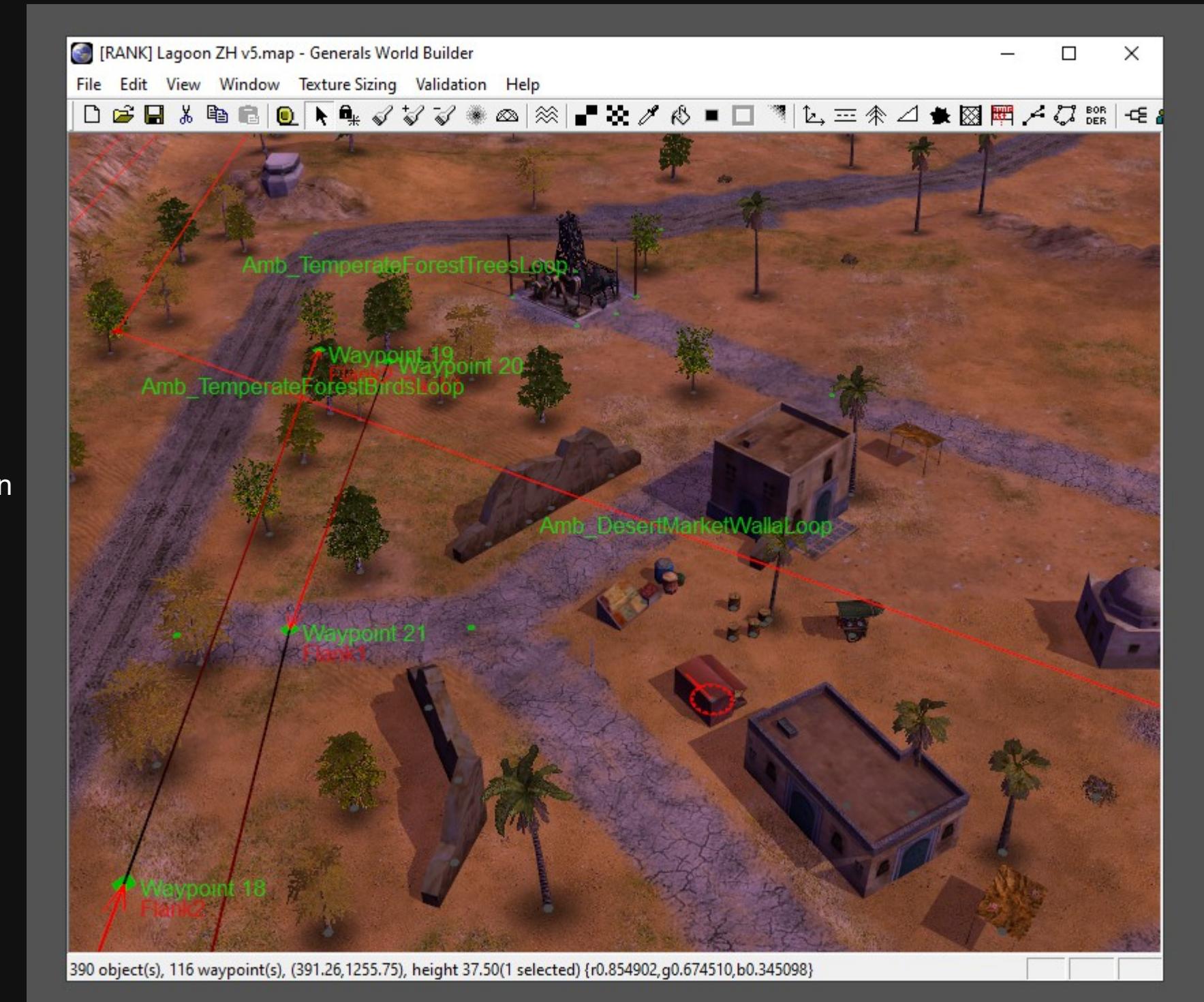
# Map fixes and enhancements

Many maps have issues. Minor issues are typically just visual or audible, and can be fixed easily. Other issues are more severe and can lead to detrimental gameplay. For example uneven terrain can cause a player to be unable to build a structure around a supply depot.

Unfortunately most original multiplayer maps have one fundamental design flaw: They were not built with mirrored base layouts, meaning different player start positions have different distances to resources and important points on the map, which typically gives some player an advantage by default. This is such a big problem, that players have adopted custom community maps over the years to widen the map pool for better quality maps. This was possible, because EA did release the original WorldBuilder tool to create and edit maps for this game.

In all of this game's history, most players used - and still use - a very small set of official maps only. Most maps are simply not good enough. Fixing and polishing official maps can help to make them attractive and therefore make the game less repetitive.

**Requires Level Designer to fix.**



# Poor menu visuals

While functionality wise the game menus are okay, visually they have never been exciting. The menu pages were put together chaotically. There is no uniform positioning within and across pages and the UI elements look plain.

Technically it is not challenging to design better menus, however, it requires careful planning and execution. There is no public tool available to design the menus comfortably, so as of right now all element parameters such as, size, position, style and color have to be edited in a Text Editor by hand.

A full improvement pass on all menus is a considerable effort, but certainly worthwhile if done correctly.

One major consideration for the menus is the resolution stretching. No matter the game window resolution, the menus will stretch from one screen corner to the other. Therefore designing a menu for 4:3 resolution will look different for 16:9. It is not clear yet if new code feature(s) are preferred to avoid certain stretching, or if all menus can be designed elegantly to serve stretching into different aspect ratios and pixel sizes.

Requires UI Artist (& maybe C++ Programmer) to fix.



# Poor Ingame UI visuals

Similar to the menus, the Ingame UI suffers from an outdated look, especially when playing in higher resolutions. The low texture quality on the Control Bar, originally designed for 800 x 600 resolution, is the most obvious graphical problem.

Simple improvements involve upscaling the original textures for larger resolutions. This already gives a much better presentation. More sophisticated improvements would require new code features for the Control Bar system to support multiple elements that do not stretch with aspect ratios, similarly to what Blizzard's StarCraft II does.

**Requires UI Artist (& maybe C++ Programmer) to fix.**



# New features

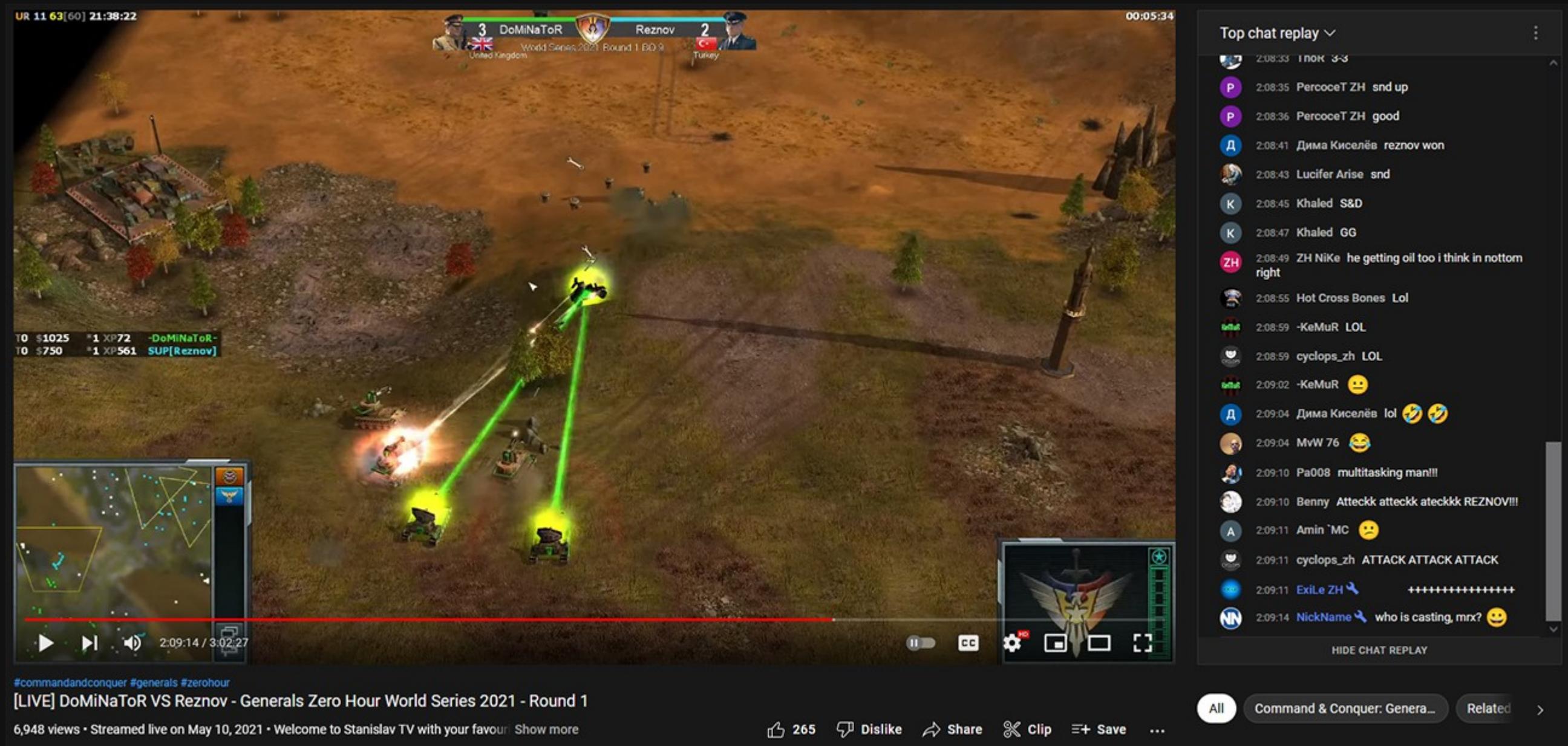
While the majority of necessary changes for a good game update consist of fixes, it certainly is also reasonable to think about new features.

Popular community requests are improved matchmaking and detailed player statistics. Players like suitable competition and they like to see their progression in numbers. The original game did provide a limited set of statistics - accessible within the game only. It never supported leagues, ladders or divisions.

Also, improved interfaces and information for match observers and broadcasters are a favourite. When the game was created in 2003, broadcasting was not a thing. YouTube and Twitch did not exist. Today there are many live streams and broadcasters naturally want to present the game action in the most compelling way possible. Natively the game provides an Observer mode and the Replay System, which is excellent for this. However it lacks detailed information about player progression during matches and a clean interface to present with.

Another interesting feature could be a reconnect feature, that allows a player to rejoin a match after the internet connection was dropped and restored. This is a complex task, but certainly a welcome addition for all players who do not want to rely on the mercy of their Internet Service Provider.

Another big topic could be cross platform support. Originally this game was released for Windows PC and Macintosh. There are developers who are motivated to support a wider range of operating systems.



# Development, Distribution & Risks

As of today, the vast majority of players play with the same base version that was last created by the original game developers in 2005. However, due to the blocker bugs present, many players have to seek for additional resources and files to make it run on their modern machines. Under normal circumstances, where no blocker bugs were present, the distribution of an update would be a risk by default. Reason being, that all original game installs, including the Original CD Release (2003), The First Decade bundle (2006), and the Ultimate Collection bundle (2013), are technically fully compatible with each other. That means players could connect and play with all 3 versions in one Network.

Providing an update for fixes as ambitious as outlined in this document would inevitably make it incompatible to the legacy version of 2005. Pushing that to players can still be considered a risk, because the status quo is that all players are compatible given the established workarounds for blocker bugs.

An update would have to be a worthwhile improvement to make the classic game install obsolete. Given the abundance of problems it has, it certainly is possible to improve it a lot. However, the effort required to get there is not particularly tiny.

In a purely community driven effort, the development scope and pace will be limited by the publicly available development tools and resources. Furthermore, any distribution would have to take place through third party installer(s), that install new content on top of the original game install. A program that allows to discover and manage Patch, Addon and Mod contents would certainly be a worthwhile addition for most players who just want to hop in and play without fiddling around with new game files.

If development was tied with or supported by EA, it very likely would help tremendously to build and distribute an update. This game is a real classic and there is no comparable alternative to it on the game market. The players are very loyal to this game and it has a growing community on Twitch, YouTube and Co. If this game was fixed and maintained, it is possible it could pull a significant pool of new & old and casual & competitive players - very likely not in the dimensions of League of Legends & Co, but certainly a worthwhile player base of tens of thousands that can be built upon further.

