JUMP POINT

ISSUE: 07 04

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FROM THE COCKPIT

GREETINGS, CITIZENS!

You might as well call this one "the flight issue!" Instead of focusing on the development of a particular ship, this time we're looking at the development of flight itself. That's because Alpha 3.5, now available to the community at large, introduces a major revamp of *Star Citizen*'s complex flight model. The immortal Townes Van Zandt sang that "to live is to fly," and that couldn't be more literal in the case of *Star Citizen*. To say that there's been plenty of debate about the flight model since it first went public with *Arena Commander* back in 2014 would be an understatement. While the community has regularly provided invaluable feedback and the developers have continued to refine the system with each patch, the Alpha 3.5 update is the biggest change yet.

Building a flight mode is a complex and difficult thing, but I'd be lying if I said I ever had any doubts. Just look at two of Chris Roberts' previous releases: he built a more arcade-oriented flight model intended to make you feel like you were really flying a spaceship in Wing Commander and followed it with the most realistic F-16 simulator on the market in Strike Commander. Both managed to create the experience they wanted along with pure fun. *Star Citizen*'s promise of combining realism and fun has always seemed like an inevitability to me. To find out more about this latest update we spoke to programmer David Colson, who was kind enough to give us a whole load of detail on the work that went into this one. Enjoy!

We've been bouncing around ideas on how to relaunch the RSI Museum in **Jump Point** and hit on an idea that seemed like it could be an interesting one: a look at both the real-world history of something and how important it is to the makeup of the 'verse. So, this month's Museum looks at the history of the HOTAS through its real-world development in the 1950s for jet fighters, its adoption as the high-end flight setup of choice for gamers in the 90s, and then its use in Human starships of the 30th century. Feedback is especially welcome here as we continue to try out new content directions, so please let me know what you think.

Finally, we have some excellent lore straight from the experts. In typical *Star Citizen* fashion, this means in-depth looks at a weapons manufacturer and one of the unusual animals that inhabits our world. As always, there's something for EVERYONE in the 'verse.

So hit the button, activate your drive, and I'll see you... through the **Jump Point**!

Ben

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ALPHA 3.5 FLIGHT MODEL UPDATE

A flight model isn't something most casual players ever think about, as there's an expectation that simulations are attempting to emulate real flying. The reality, though, is much more complex, especially in the case of simulating 30th-century spaceships! Continually updating and re-imagining *Star Citizen*'s flight model has been an intentional part of development since players first left their hangars in the initial release of *Arena Commander*, with the systems that govern flight continuing to improve and adapt as the game becomes more complex. The game's flight model intersects with so many other gameplay systems, some of which are still in development, so the challenge to make it work is very real. What's more, the team behind it is responsible not just for getting players into space, but also for making sure the experience is fun and compelling. Alpha 3.5 sees the most significant update to the flight model to date. We sat down with programmer David Colson to learn how it all came about and what's still to come...

BEGIN TRANSMISSION →

Jump Point: *Please introduce yourself, give us your title, and let us know what you work on.*

David Colson: My name is David Colson, I'm a gameplay programmer, and I work primarily on the flight model and other related vehicle features. I began working on the flight model shortly after starting at the

DAVID COLSON

company as I arrived with a degree in physics and an interest in flight.

JP: *What was the high-level goal in reworking* Star Citizen's *flight model? Were you charged with making the game more realistic, more fun, smoother?*

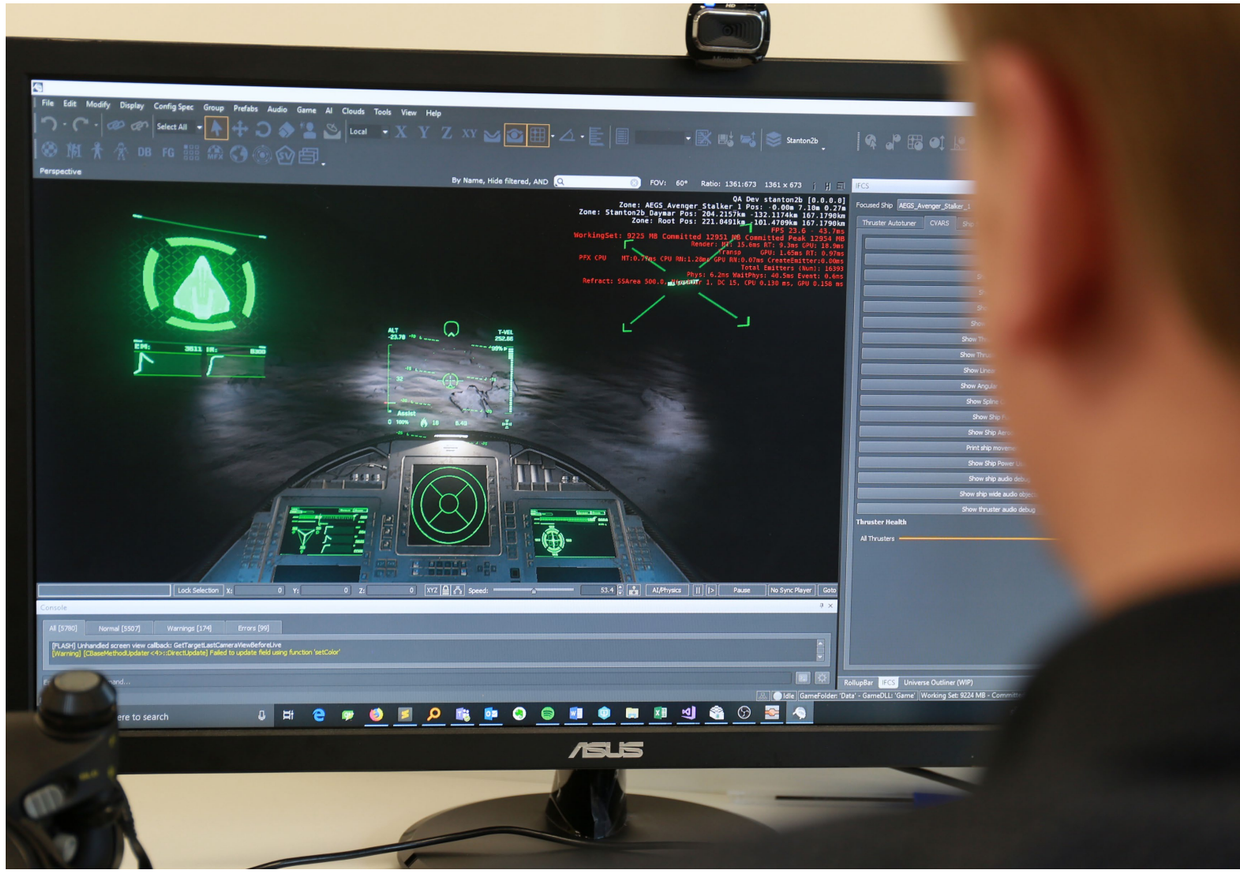
DC: We had two high-level goals. The first was improving the internal technical implementation to make it more robust, easier to maintain, and better able to scale to the hundreds of ships flying around in the universe. The second, which has been more obvious to players, was re-evaluating the design to bring it closer to the long-term goals for how flight (and combat in general) should be. Throughout this process, we brought a lot of clarity to the direction we want to take the flight model.

JP: *Tell us a little bit about the task ahead of you when this process started. This certainly feels like a major update. What disciplines were involved and how much work went into these changes?*

DC: These changes started early in 2018 and effectively took a year to complete. A lot of the early work, which wasn't shown to players, was on the system to make it easier to make large-scale changes further down the line. As we went on, we ended up redoing a lot of the related systems too. A great example of this is how we had to redo some of the internal audio systems for ships but ended up taking the opportunity to improve the audio itself. The same thing happened for ship VFX. Many departments ended up helping bring this to release: design, UI, countless hours of engineering and ship setup, as well as audio and VFX.

JP: *What kind of reference do you start from? Do you look at real spacecraft or is something like this based on the overall needs of* Star Citizen *specifically?*

DC: Right at the beginning, we started by coming up with the fiction for how ships work in our universe, building on the real-life technology of Variable Specific Impulse Magnetoplasma Rockets (VASIMR), which are these futuristic thrusters that work by creating and firing ions using strong magnetic fields. The goal was to start with something realistic and develop our systems to encourage the type of gameplay and experience we wanted to bring to players. A lot of the design work involves trying to extrapolate how things would work in real life and then deciding if that's the experience we want. If not, we make adjustments until we get closer to where we want to be.



JP: *Is it more difficult to develop a flight model from scratch or to work from an existing base?*

DC: We created the new model from the base of the existing iteration, so I'd say it was easier than creating it from scratch. Particularly with regard to technical challenges, many had already been solved in the existing flight model and we didn't need to reinvent the wheel. It's almost like creating something with hindsight as we had already learned so much from the previous model that we could take into the new one.

JP: *How do you prototype changes to the flight model?*

DC: A small agile team was created to build the new flight model, so we were able to undertake quick throwaway trials with each other to determine whether we were heading in the right direction. If we felt we were, we'd proceed to develop the feature to a more release-ready standard.

JP: *What is the testing process like? Was it done by your team or was it a company-wide effort?*

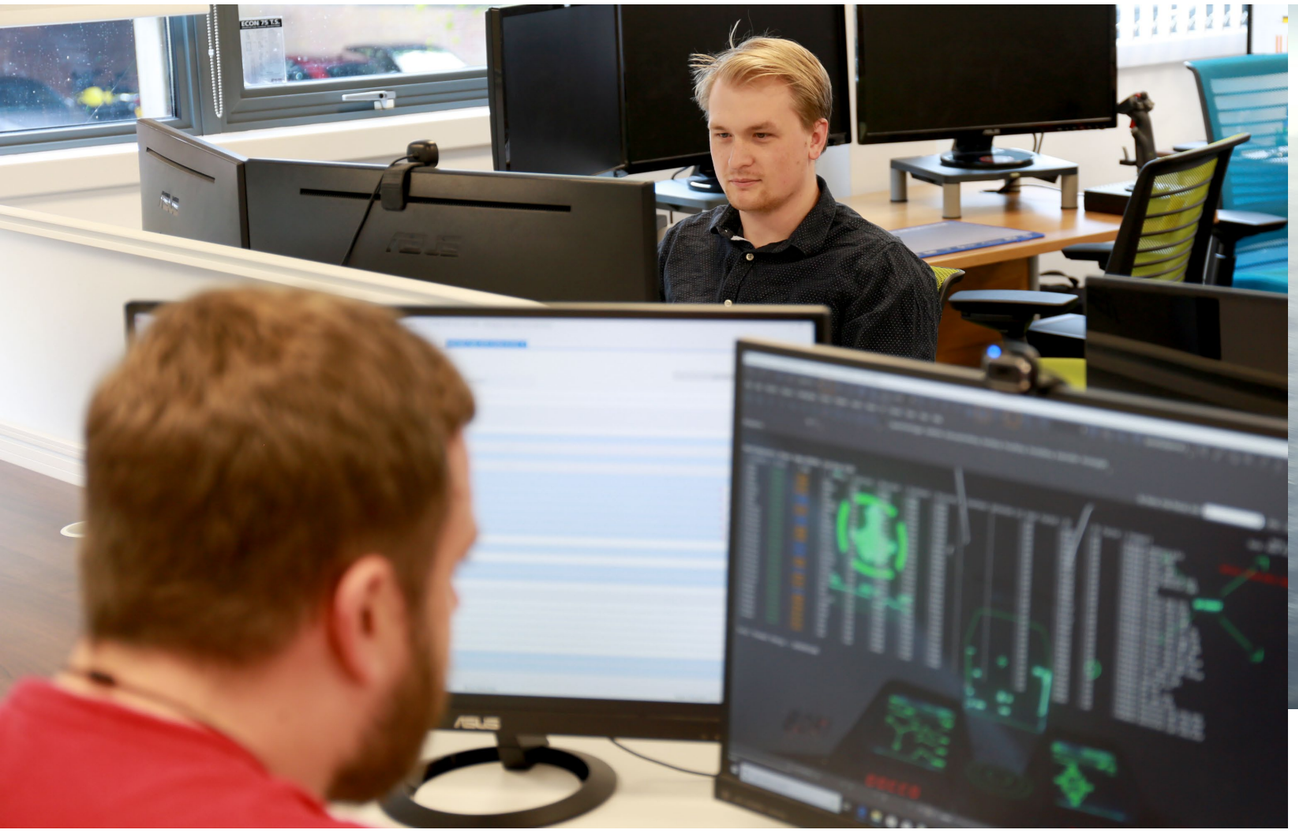
DC: For the small prototype tests, it was just our little team, but as time went by and the flight model developed, we expanded to QA too. Then, the rest of the company had access and it was tested on a much larger scale. The run-up to Evocati was the most intensive testing we've ever done.

JP: *The updated flight model further integrates some of the more complex systems into the game, like heat, power, and fuel. How do these systems work?*

DC: One of the core changes was making the flight model deal better with dynamic thruster strengths. Heat and power can dynamically change the output of thrusters and the flight model will now react to these changes and modify the behavior of the ship. However, we ultimately decided not to go *too* realistic in this aspect as it was difficult to control the experience in some ships. In the end, ships will see their handling capabilities change, but shouldn't become completely unflyable if the setup is unbalanced.

JP: *Are there further subsystems like these still in the works or yet to be included?*

DC: The only remaining system is misfiring, which goes hand in hand



with item degradation. Over time, items will become worn and less efficient and, in these situations, there will be a likelihood of the thruster misfiring and a momentary loss of control. Other than this, all we need to do is improve the communication of the systems to the players through UI and gameplay.

JP: *Tell us about the update to enhanced stick precision (ESP).*

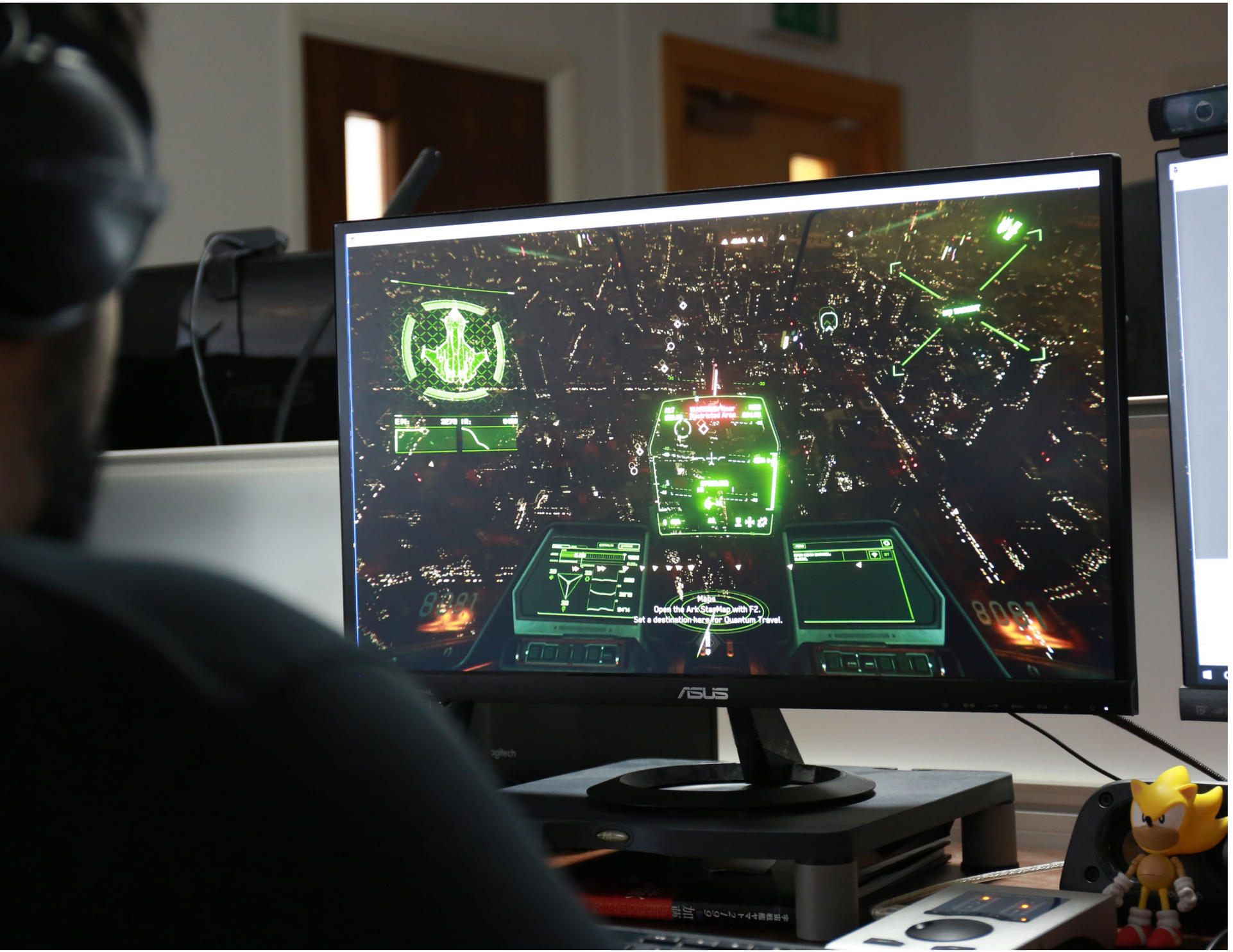
DC: ESP has been one of the most difficult aspects of the new flight model to get right and we're still working on it. We've been working hard to enable it to help the player enough by stabilizing their aim without it being intrusive. Under the hood, we redesigned the algorithm taking the best aspects of the previous version and made it easier to tune and improve on. We're also focusing on making it predictable for players so they can learn to work with it when aiming.

JP: *Tell us about the changes to the afterburner and cruise mode.*

DC: Previously, afterburner was a mechanic that allowed you to travel faster. It had many issues and was generally poor at doing what it set out to do. The goal for the new model was to create a high-speed travel mode that wasn't easy to abuse in combat. So, we now have what we call cruise control, which is a bit like the system in cars. You turn it on and the ship will fly at a speed you set without your input.

JP: *The throttle control has also been updated. What does that mean?*

DC: This goes hand in hand with cruise control. The throttle mechanism is how players ask the ship to move and we've worked to make it simpler and more straightforward than before. The main difference is that, in the absence of input, the ship will attempt to stop moving. For people using a HOTAS, this hasn't changed much as they can still set their throttle where they like and the ship will fly at that speed. But, this same throttle mechanism maps to dual stick controls and keyboards just as well. We also give the player the ability to set the speed range they're flying in so



they can simply set an appropriate speed for the moment and command their ship to move in whatever direction they like.

JP: *Can you talk about some of the bugs and issues with the previous flight model that you've addressed in this update?*

DC: One issue we had with the previous flight model was that it didn't scale well to the size of the universe. When a hundred ships were flying, it was a bit too taxing on the CPU. The new flight model addresses this problem and having a hundred ships is now a fraction of the cost.

JP: *Players have had access to the new flight model for a few weeks now, how has the feedback been?*

DC: The feedback has been one of the most positive and helpful experiences we've had throughout the entire process. From the original release to Evocati to now, the flight model and ship balance have moved forward leaps and bounds into something far better than we had originally. Players have really helped us learn this new flight model and how to get the best out of it. We're still not where we want to be, but we're preparing to make some slightly larger changes for the next major patch.

JP: *Is there anything you hit on during development that was unexpected or that you're especially proud of?*

DC: Personally, I really love how dynamic it is. We really got that right. When thrusters overheat, it's immediately obvious that something is wrong. You can dynamically underpower all your thrusters and the ship just naturally flies slower. We even have the ability to swap out thrusters for others and the system just works as you'd expect. We've never had that sort of flexibility.

JP: *Did you run into any interesting bugs while testing?*

DC: One of the most infamous bugs we encountered was an issue where you'd be flying around in-atmosphere and your ship would occasionally, seemingly at random, just rotate a large amount in a single frame. One second you'd be facing forward, the next you'd be going sideways. This took about two months to track down and ended up being a different CPU thread accidentally overwriting the ship's moment of inertia in the middle of some calculations.

JP: *Do you consider this the final flight model or is there still work to be done?*

DC: This is much closer to the flight model that we want in *Star Citizen*, but it's absolutely not done. There's more to do to balance ships towards the specific type of combat we want to create. And there's also the hover mode which I'm really excited about. Ships will transition into a mode similar to a Harrier Jump Jet when going slowly, with all thrust directed downward, meaning you have to hover a bit like a helicopter.

JP: *Do you have any message for the* Star Citizen *community?*

DC: Interacting with the community has been the most amazing and humbling experience I've had working on this game. Together with the community we've really learned in detail what makes combat and flight special and, going forward, we'll be able to make better decisions and make a better game. I thank them all for their help.

JP: *Finally, the roll of honor! Who worked together on this update?*

DC: Myself as the programmer, Andrew Nicholson and Richard Towler as designers, Yogi Klatt and Josh Bell as audio programmers, and Danny Colclough as the producer.

JP: *Thank you very much! This update really breathes new life into the game. Learning to master flight again has been a very rewarding experience!*

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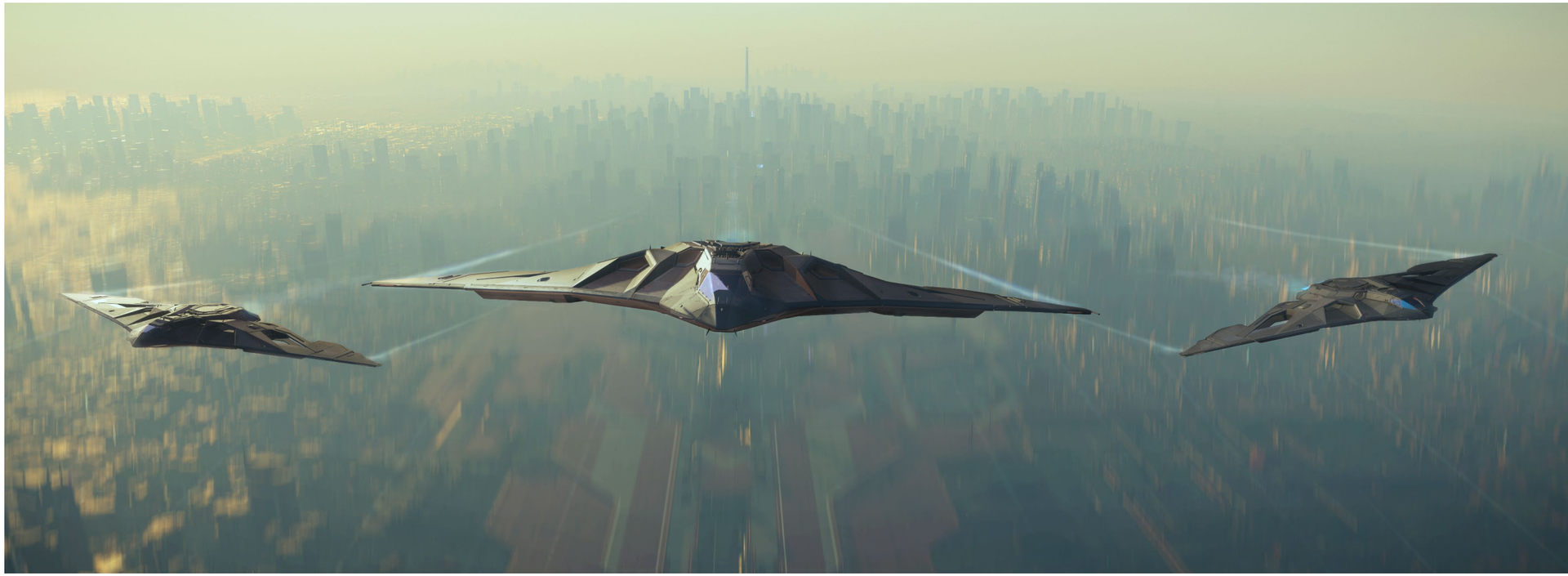
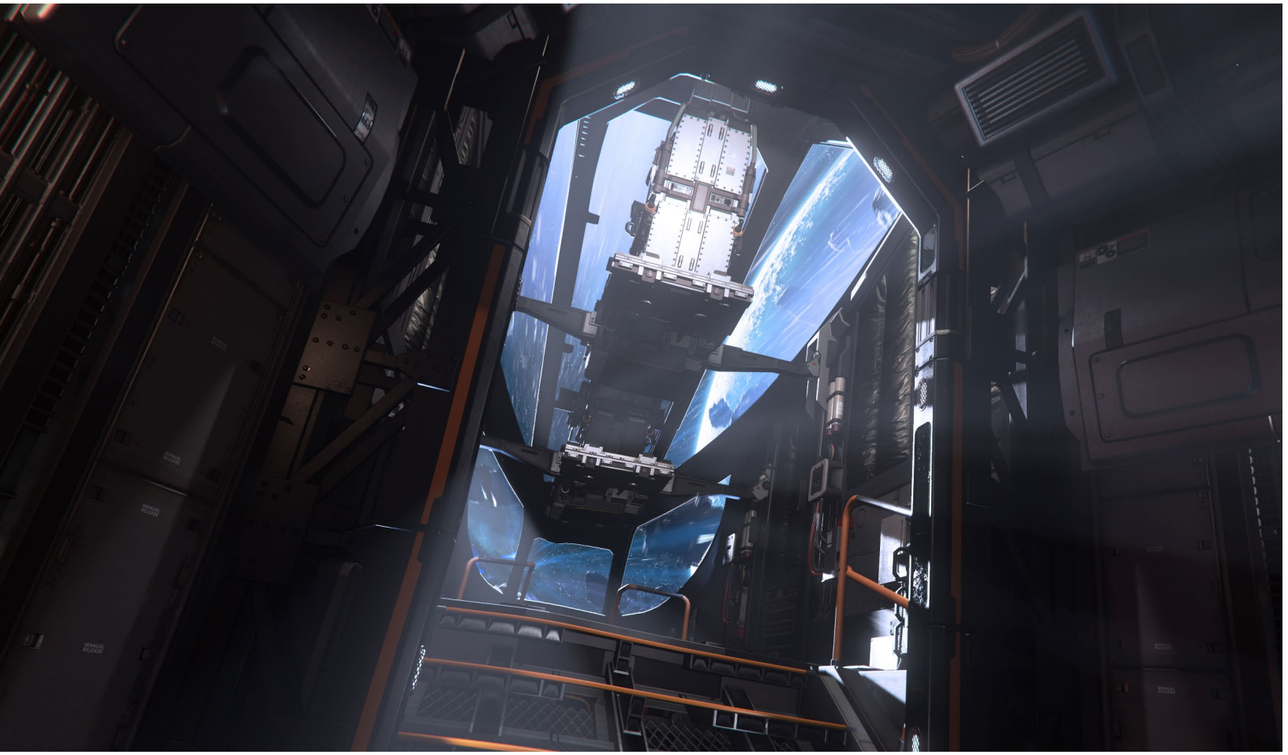




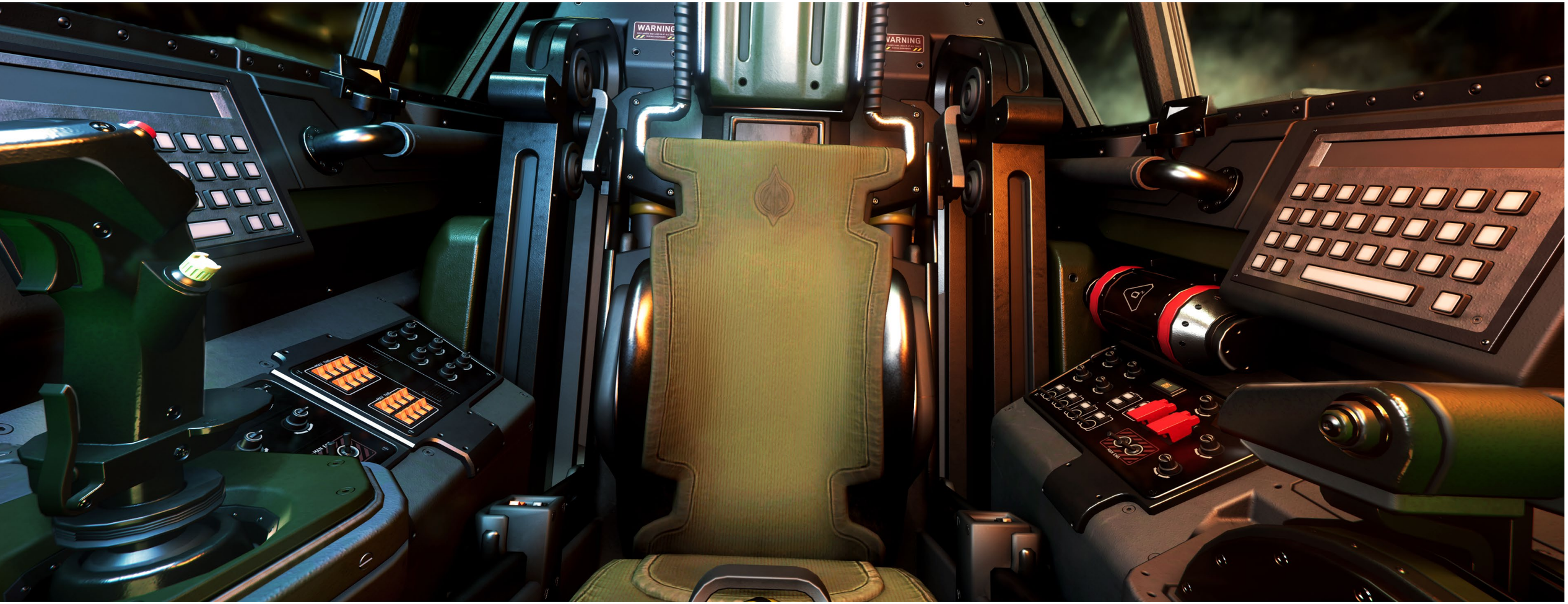
RSI MUSEUM: THE PAST, PRESENT & FUTURE OF FLIGHT CONTROLS

Star Citizen is full of big things with lengthy backstories. Fighters, bombers, freighters, tankers, space stations, distant colonies, alien cultures... things both physical and conceptual with modern and historical origins immediately recognizable by players. But Chris Roberts has known from the start that it isn't necessarily big things that capture the imagination; it's the tiny details, expertly done with the level of detail and thought no one else is willing to put into them.

In this feature, we examine three parallel histories to find out how aircraft controls have evolved in the real world, simulation, and fiction. Each influences the next and has culminated in making the 'verse more believable and more realistic than any game that has come before.

PAST - FLIGHT CONTROL

Flight stick, joystick, control column. While there are a number of words used to define the control mechanism for aircraft, there is surprisingly little variation across history for the working of the standard joystick. An aircraft pilot controls their vehicle with a vertical joystick that manages the roll and pitch. Pulling back or pushing forward signals the plane's elevators to fall or rise, while moving to the left or right shifts the ailerons. In even easier terms, pulling back directs the plane up while pushing forward aims the nose down. This essential system has been the de facto method of flight control for over a century, beginning with the French Blériot VIII in 1908. Flight sticks were initially purely mechanical, with electronic versions beginning to appear in the 1930s. As pilots are trained on this system regardless of aircraft, even planes with non-traditional control surfaces use the same essential interaction.



World War II brought a major focus on the development of aerial warfare and most warbirds operated via a joystick positioned between the pilot's legs (or a flight yoke for larger transports and bombers).

In the late 1950s, aircraft controls underwent a single significant change that would carry them straight through to the 30th century: the development of the Hands On Throttle-And-Stick (HOTAS) system. This new concept allowed fighter pilots to operate faster and more complex aircraft that, thanks to advances in radar and missile technology, would be required to enter engagements that took place entirely outside of visual range. The HOTAS concept moved the WW2-vintage center stick to the right of the pilot and adds a throttle to the left. Where earlier pilots would be expected to move their left hand around the cockpit to access anything beyond the flight control and trigger on their joysticks, HOTAS layout features buttons, switches, and dials carefully positioned to allow pilots to control all normal aircraft operations while keeping both hands on the joystick and throttle.

The system was initially developed for the Ferranti AIRPASS radar, the original in-flight radar weapons system developed by the UK's Royal Air Force. The first warplane to make active use of the layout was the English Electric Lightning interceptor, a jet built to quickly intercept Soviet bombers in the event of a third world war (and coincidentally the actual aircraft used by Chris Roberts to build the Rapier cockpits for the *Wing Commander* film). As more advanced jets called for more advanced weapon systems, HOTAS layouts became increasingly necessary. Today, all major fighter aircraft have some form of HOTAS combined with a head-up display that puts all possible information right in front of the pilot. With this combination, a fighter pilot's hands can rest on their throttle and joystick while their eyes remain on the horizon.

PRESENT - GAME CONTROL

What began as advanced technology for warfare and commerce was soon adapted for entertainment. The first gaming joysticks were developed in the late 1960s alongside a wave of electronic arcade cabinets. The credit for the first joystick to include a fire button goes to the 1969 Sega cabinet *Missile*, while the first analog joystick (the ancestor of those used today) appeared in 1976. Although functionally similar to those used on aircraft, early joysticks had a very different appearance, instead resembling what would be considered an "arcade" or "fight" stick today. The earliest gaming joysticks were digital, with simple electronic contacts that gauged when the player was selecting one of four or eight directions. While this technology would continue to serve games consoles throughout the 32-bit generation of the mid-90s, PCs adapted analog joysticks much earlier. Instead of simple electrical connections, analog joysticks use two potentiometers (voltage dividers which measure electrical potential) to track the exact position of the stick's axes.

The modern PC joystick owes its success to the fact that the need for such an input was included as part of the initial specification for the IBM PC. The original IBM 5150, released in 1981, was offered with an optional Game Control Adapter to give owners the option of attaching joysticks. As the PC developed, the addition of a "game port" (first an expansion

THRUSTMASTER: FLIGHT CONTROL SYSTEM AND WEAPONS CONTROL SYSTEM - THE WORLD'S FIRST HOTAS FOR GAMING WAS RELEASED IN 1991

THRUSTMASTER: F22 AND TQS - THESE REFINED AND FULLY PROGRAMMABLE CONTROLLER DESIGNS ATTEMPTED TO SIMULATE THE REAL AIRCRAFT CONTROL SYSTEMS USED ON THE F-16 FIGHTING FALCON

CH PRODUCTS: VIRTUAL PILOT PRO - AS COMPETITION FOR THE FLIGHT STICK MARKET INCREASED, MANUFACTURERS BEGAN SIMULATING OTHER TYPES OF AIRCRAFT CONTROLS LIKE THIS YOKE INTENDED FOR CIVIL AVIATION SIMULATION

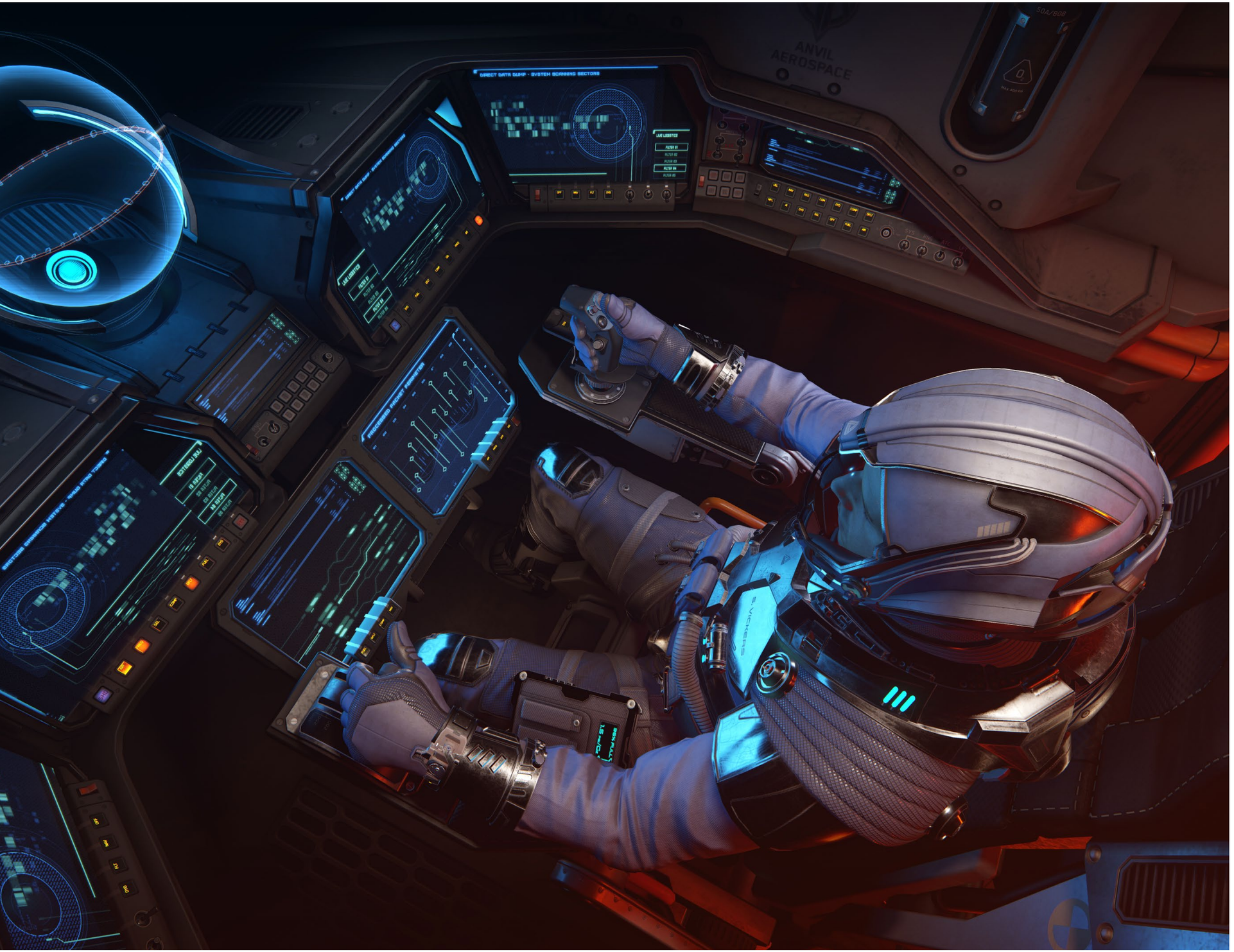
CH PRODUCTS: FLIGHTSTICK PRO & PRO THROTTLE - SEVERAL MANUFACTURERS DEVELOPED THEIR OWN LINE OF COMPETING HOTAS SYSTEMS FOLLOWING THE POPULARITY OF THRUSTMASTER'S DESIGNS; UNLIKE THE FCS/WCS COMBO, THESE ARE NOT PROGRAMMABLE

card and then part of the motherboard) became an industry standard. The inclusion of this dedicated port allowed the input of four analog axes and four buttons, intended to support two two-axis, two-button joysticks at once to allow early forms of head-to-head multiplayer. For the first decade of their development, PC joysticks resembled their smaller, rounded arcade counterparts, typically mounted on square bases and were molded in bright colors meant to signify the fun inherent in video games.

In the late 1980s, Robert Carter (founder of simulator company Flight Dynamics Inc.) began experimenting with adapting PC gaming joystick technology to create more realistic flight simulators. Initially intended for the high-end simulator market, Carter's team soon saw the potential of making such controllers available to the burgeoning hobbyist market. The plan was spun off in 1990 to newly-formed company ThrustMaster (now styled Thrustmaster). ThrustMaster's first product was the Weapon Control System (WCS), the first commercial PC throttle. Like the first joysticks, the initial model of WCS was completely digital. In practice, it was nothing but the internals of an AT keyboard molded into a special design. Moving the throttle forward would tell the computer that the user was pressing "plus," moving it back "minus," and pressing additional buttons would input commonly used flight simulator commands like fire or activate chaff. The product's real breakthrough was its external design; instead of looking like a colorful gaming device, it was modeled in black ABS plastic and shaped to replicate the throttle of the F-4 Phantom jet fighter.

SUNCOM EAGLE (RIGHT): INSTEAD OF USING SOFTWARE TO PROGRAM BUTTONS FOR A PARTICULAR GAME THIS UNUSUAL FLIGHT STICK WAS PROGRAMMED EXTERNALLY USING AN AT KEYBOARD CONNECTION BEFORE FLIGHT

MICROSOFT (FAR RIGHT): SIDEWINDER PRO - MICROSOFT ENTERED THE MARKET AS USB TECHNOLOGY BEGAN TO ALLOW WIDER SUPPORT FOR UNUSUAL CONTROLLERS; TECHNOLOGY DEVELOPED FOR THIS 'FORCE FEEDBACK' STICK WENT ON TO INFORM THE XBOX CONSOLE



In 1991, ThrustMaster completed their goal of offering a complete gaming HOTAS with the launch of the Flight Control System (FCS). Unlike the first WCS, the FCS featured a major innovation over earlier joysticks: the addition of a second pair of axes which allowed the user to double the number of useable buttons and add a directional hat on top of the joystick. Since the IBM PC's game port was already designed to support two joysticks at once, adding an FCS required no additional upgrades. The four-axis, four button ThrustMaster joystick would become the industry standard for high-end joysticks, with competitors like CH Products and Suncom soon offering their own versions. Next, the WCS throttle was reworked into something resembling its modern form with two major innovations. Firstly, the up and down throttle movement was switched to potentiometers which the computer could track as an additional analog input. Secondly, the number of buttons was expanded and given much greater functionality by a software loader that allowed full customization. Players were no longer reliant on game designers to support specialty joysticks. Instead, they now had the freedom to rework any control scheme to be used with their HOTAS.

ThrustMaster and its competitors continued to develop more advanced flight simulation setups throughout the 90s with additional generations focusing on greater durability and more accuracy in matching the appearance and feel of military-grade aircraft control columns. While initial releases sold primarily to hobbyists investing in higher-end systems, the new standards they set quickly trickled down to all types of flight controllers. The eventual widespread adoption of USB ports simplified the process significantly, with most manufacturers phasing out game port sticks by 1999. USB and Windows 95's native support for button mapping meant that designing, installing, and using a HOTAS was significantly simpler than the early days.

FUTURE - STAR CONTROLLERS

When Chris Roberts released the original *Wing Commander* in 1990, reviewers focused on one distinct hallmark that well expressed his philosophy towards immersion: if enough extended memory was available, a gloved hand would be displayed on a futuristic joystick at the center of the screen that would match the movements of the player. Space combat games were not new, first-person flight simulators were not new, but this was the first time anyone had thought to spend effort and thought on such a seemingly small yet immersive feature. The game's design was full of such touches and it quickly became a classic, with the hand on the moving joystick specifically sticking in the minds of players for many years.

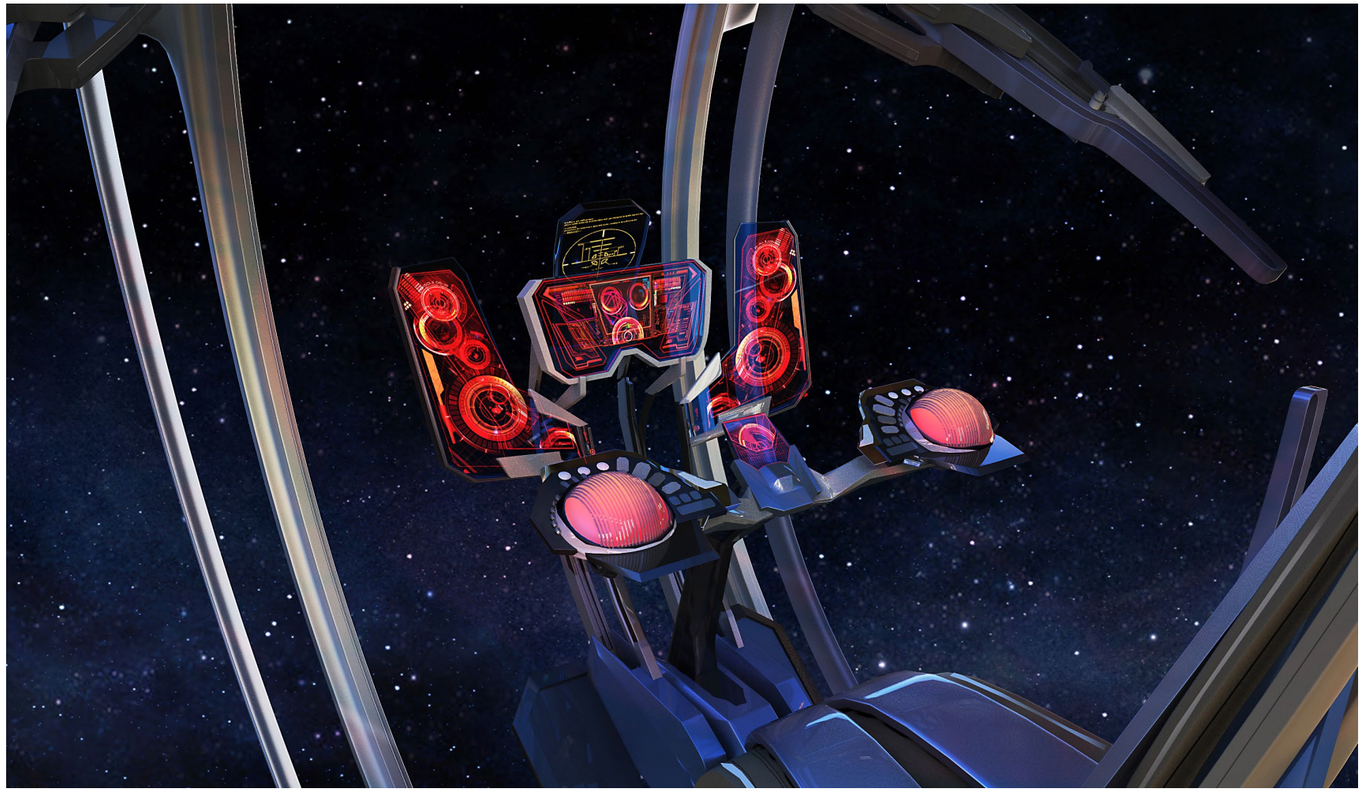
For 1994's *Wing Commander III*, which used live actors for cutscenes, the hand on the joystick was something of a bridge between the seeming reality of the cutscenes and the fully computer-animated space flight engine. To connect these worlds, second unit footage of gloved hands on real controllers was shot and digitized to play during flight. The design also called for one more level of immersion: instead of the now industry-

standard hand on a joystick, different ships had different control mechanisms with similarly accurate movements. Speedy interceptors would have on-screen HOTAS systems, heavier fighters would have a central stick, and lumbering bombers a control yoke.

Star Citizen would, from day one, use these same rough ideas to create an even more realistic experience. In the 21st century, making this work would require more than animated bitmaps or carefully arranged still photographs. *Star Citizen* was designed from the start for a unified first and third person perspective, which necessitated actually building 3D spacecraft controls and recording and adapting animations showing that interaction. And by the time Chris Roberts took the stage at GDC Online in 2012, there was already an implementation. During the first live demo, eagle-eyed players noted the 3D joystick and throttle as he boarded the prototype F7C Hornet and launched into space. Midway through, as he explained his plans for the project, he paused to swing the first-person camera down. "Of course," he explained, "like Wing Commander, you can see your hand on the flight stick... your feet moving the pedals." Indeed, the early Hornet already had a realized and functioning HOTAS prototype!

As *Star Citizen*'s full design took shape, so did the plans for the in-universe flight controls. Early on, the designers and animators developed a broad system for placing ship controls in a similar way to those found on real aircraft. The animators came up with a list of potential options that could be animated for any given ship including the familiar throttle, flight yoke, and a variety of different stick positions (center, right, and left). With these archetypes in mind, ship designers could plan for a military-style HOTAS, a more commercial yoke, or even a six-degrees-of-freedom-style twin stick setup. As part of the ship design pipeline, each new ship is specified with what control scheme is needed in its initial design rubric. And like real military aircraft, the modeled components can be shared between ship designs (which reduces the overall number) or easily adapted for custom needs.

Players got their first taste of this variety with the launch of *Star Citizen*'s *Arena Commander* in 2014. While all of the included ships have since been updated, their original HOTAS systems made an impact on players who were eager to debate the best "real world" control scheme to set up in preparation for the game. With this level of customization available at the initial design point, *Star Citizen*'s ships can use their flight controls to not only immerse the player in a futuristic world through parallel movement, but to also immediately define the overall feel of a particular spaceship. Military craft like Roberts Space Industries' Hornet lineup or Drake's Buccaneer retain the traditional military-inspired HOTAS familiar to gamers with high-end equipment, while ships like the 300 series or the enormous Starfarer would reinforce their experience with varied flight yokes (the former feeling like the steering wheel of a high-end automobile, the latter a commercial airliner). Specialty ships like the M50 would share the HOTAS, but instead of a martial feeling, their design could focus on the movement of the throttle to get across the thrill of pushing them to their maximum speed. More unusual craft like the Xi'an Scout would use the twin stick setup to reinforce their alien nature. Just as hundreds of hours of planning and thought would go into the exterior appearance of *Star Citizen*'s ships, so too would careful planning on the part of the developers let the interior controls tell their own story.



GALACTAPEDIA

LEYLAND'S TORTOISE

Leyland's tortoise is a species of tortoise indigenous to Earth (Sol III). They have glossy shells with minor color variation around the scutes and the edges of the shells. Extremely docile, they are kept as pets by Humans, especially long-haul spacers. Over-collection and habitat destruction have made them nearly extinct in the wild.

DESCRIPTION

Leyland's tortoises have smooth, domed shells in shades of green, yellow, and brown. The shell is relatively smooth; even if the tortoise matured in harsh conditions, the shell shows little to no scute pyramiding. The edges of the shell flare out slightly at the sides. The plastron is usually yellow, with green edging where it connects to the shell. The back end of the plastron is indented in a V-shape, underneath which is a small, nubby tail. Each of the tortoise's four legs ends with five claws.

RANGE AND BEHAVIOR

The original habitat of Leyland's tortoise was limited to the South American continent, along the Andes mountains and into the central rainforest. Due to habitat destruction, the only remaining wild breeding population of Leyland's tortoise on Earth is found along the Amazon river in protected areas of rainforest. Attempts to establish Leyland's tortoise on other planets have been met with limited success; Saisei (Centauri III) and Locke (Idris IV) both sustain minor Leyland's tortoise populations. In 2875, conservationists attempted to introduce the tortoise to Lo (Corel III). However, Banu residents of the planet consumed it at an unsustainable rate. The population did not take hold.

The tortoises are foragers, most active in the late afternoon until sunset, with a smaller window of high activity from sunrise to mid-morning. Seeds, greens, fruit, invertebrates, roots, grasses, and fungi form the bulk of the tortoise's diet. Over 50% of its day is spent at rest in shared burrows with other tortoises. After consuming a large meal, a tortoise might rest, totally immobile, for up to a week at a time.

PET TRADE

Leyland's tortoises are popular pets due to their docility, low-cost diet, long lifespan, and adaptability to varying conditions. They are easily kept aboard most spacecraft in roofless enclosures 2 meters wide, 2 meters long, and 50 centimeters high. Plenty of shady spots and heated areas should be provided along with shelter and water. Ideally, a tortoise should not be kept alone. It is recommended that owners choose companions of the same sex to discourage unintentional breeding.

Because the tortoise is nearly extinct in the wild, it is illegal to own one that has been captured instead of captively bred. Any person within the UEE found with a wild-caught Leyland's tortoise in their possession is subject to fine and arrest.

MaxOx

Although MaxOx has long been a distinguished manufacturer of energy weapons, the company's path to prestige was unusual and controversial.

Ultimately, the company's success can be credited to founder Burl Hitchens. Unlike many of his contemporaries in the business world, Hitchens preferred to let his work speak for itself and never got in the way of the assumptions of others. Many mistook his laconism as ignorance, including Messer-era scientist Derivia Borel, who called him a "frontier bumpkin," a term Hitchens wore with pride and even claimed saved his career and company. When asked about it, Hitchens said the most important lesson he ever learned was when to keep his mouth shut. "If you're boasting about being the smartest person in the room, odds are that you're probably not."

THE BRILLIANT BUMPKIN

Hitchens was born on Charon III in 2747. He lived on what he deemed "a Dellin dirt farm," which downplayed his parents' sophisticated hydroponics operation. He spent his days fixing machinery and helping his parents manage the farm while studying on his mobiGlas at night.

Hitchens' excellent Equivalency score landed him a full scholarship to the University of Rhetor.

Yet, the rigid structure of a formal education didn't suit Hitchens, who didn't care about grades and ditched classes that bored him. Instead, he obsessed over lasers, auditing advanced physics and engineering courses and spending hours experimenting in labs. His cavalier attitude eventually got him expelled after he failed to attend several disciplinary meetings.

Luckily, an old physics professor recognized Hitchens' talent and secured him a job at a local research lab, where he distinguished himself with breakthrough theories on laser manufacturing. In an unexpected twist, his work proved so promising that the university that had previously expelled him offered him a research grant just years later. Hitchens would reject the offer and instead raise funds for a small staff and lab space on Reisse. Hitchens called the company MaxOx, a reference to a "maximum oxygen" warning sensor that his refined production method had the habit of triggering due to the atmospheric conditions it required to work. After various scientific spectrum outlets reported the lab's opening, MaxOx went quiet.

Six years later, Hitchens emerged with one of the most powerful and precise surgical lasers yet invented. The device won devotees for its sleek and simple design and multifaceted functionality. Demand outstripped supply almost immediately. Then, the UEE government came knocking and changed the company's course.

DUTY CYCLE

In 2778, Hitchens met with government officials and was shocked when they asked for help on a classified project. The officials were impressed with the superior power and precision of MaxOx lasers and claimed they could benefit the Empire in other ways. Thanks to poorly veiled threats from the officials, Hitchens realized that not accepting their offer would result in MaxOx's patents being seized by the corrupt administration, effectively crippling the company. He reluctantly agreed to help.

Leaving behind MaxOx's day-to-day operations, Hitchens and a few researchers relocated to a secret lab on Persei. Only then did military officials hand him the file for Project Vespa, a failed top-secret attempt to weaponize terraforming technology. Military officials wanted to repurpose MaxOx's tech to create the ultimate capital ship weapon for the Vanduul front - a Kingship killer. Multiple weapon manufacturers had already failed to achieve the desired results and the military hoped Hitchens' breakthrough laser tech might be the key.

Having grown up in Charon, Hitchens knew firsthand how the Messer government would do anything to stay in power and, once the weapon was developed, invariably turn it on those who opposed the regime. He pledged to make sure that couldn't happen. At great personal risk, Hitchens began a balancing act of keeping his team productive but not effective in achieving their goal, while also not angering Derivia Borel, the bureaucrat and Messer crony overseeing the operation.

Thankfully, Borel thought little of Hitchens. Having taught at the University of Rhetor when Hitchens was expelled, Borel frequently dismissed his work, regularly referring to him as a "frontier bumpkin." Hitchens played into this perception to explain project delays while presenting minor advancements to prevent his team from losing the project. After years of glacial progress and Hitchens' strategically inflated budgets, Borel cancelled MaxOx's government contract and hired a new

team. Prepared for this eventuality, Hitchens left behind terabytes of data (much of it misleading, mislabeled, or completely fabricated) to impede any future progress.

While Hitchens was relieved to be returning to the private sector, he soon faced a new challenge. As retribution for failing to deliver, the Messer government made good on their threat and revoked the patents associated with MaxOx's medical lasers. Hitchens would need a new product or face financial ruin.

MODULATION MODE

MaxOx quickly updated their medical equipment to distinguish themselves from the new field of lasers made from their formally-proprietary technology and maintained a brief advantage before competitors significantly cut into their bottom line. The company seemed on the verge of failing when they were thrown a lifeline: in 2792, the Messer government was overthrown.

Once again, Hitchens found himself at a crossroads. His team had spent years researching weaponized lasers for the government instead of researching new avenues. Making matters worse, now that their patents were public, other companies had begun weaponizing their technology. Hitchens believed the only way to save MaxOx was to make the very thing he'd been avoiding. Months of intense R&D produced a prototype for the AA-1, the company's first energy-based ship weapon. MaxOx's energy weapons quickly found fans for their high-tech look and dependable performance. Under Hitchens' guidance, MaxOx declined every offer to sell weapons to the military; their weapons would be for the people to defend themselves. Eventually, their line expanded to specialty weapons, such as EMP burst generators and personal protection. Meanwhile, scientists, researchers, and healthcare professionals expressed disappointment at the originally-medical technology's weaponization. After Hitchens retired, MaxOx shuttered their medical and laboratory laser divisions due to low profit margins.

Today, most know MaxOx only as a weapon manufacturer, but their legacy remains much more complicated. Eventually, after Hitchens' death, the executive board would reverse course and take government contracts for their products, yet many still associate their weapons with being the choice of private citizens. For better or worse, Hitchens always picked the survival of his company over everything else. Because of this, MaxOx still stands to this day.