

## 2 On Giving Thanks

*a Sermon for the Holidays  
by Pastor Manul Laphroaig.*

The turkey is ready and waiting, neighbors, and so are the traditional arguments with loved ones around the dinner table. But let us spend a few moments reflecting on the few things besides the turkey and the family that we are thankful for, the things that shine on our sunny days and make the rainy ones possible to stand. Let us think of what keeps our worst nightmares at bay.

A wise neighbor once said, “I value Mathematics so highly because it leaves no place for hypocrisy and vagueness, my two worst nightmares.” You might think, “How are these things the worst? I can think of a lot worse than those!” But it is so concise and true! Imagine a world where there would be no corner to hold against hypocrisy and vagueness, where any statement whatsoever could be twisted and turned by those who thrive on such twisting and turning to gain advantage of and power over their neighbors, where  $2 + 2$  would indeed be, as an old Soviet joke put it, “whatever the Party orders it to be.” Imagine a world where no false promise could be ever taken to account because the lying liars who gave it would fall back to the vagueness of their words every time. This would be a miserable world, neighbors, a nightmare world.

We get a taste of this nightmare every time politics forces its way into places that used to manage to keep it out—merit and skill no longer matter, demagogues get to run the place, sooner than later its original creators get thrown out, and then it collapses into mediocrity and pent-up unhappiness. Imagine that there would be no tool that would lay better to our hand than to that of the aggressors, that we had nowhere to retreat and nothing to fight them with that they could not suborn. Why fight if there is no chance to win, ever, anywhere?

Lucky for us, in every age there are things in the world that resist hypocrisy and vagueness, things that create the oases where we gather and hold.

We are doubly lucky because for us Mathematics has taken physical form. It has clothed itself in silicon and electricity, and now we can wield it not only among ourselves but also show it to others who need not understand its language, but are content to see its results. To see just how much luckier we

are, neighbors, than the geeks of Leonardo da Vinci’s times, just read his resume that he sent to the ruler of Milan. To support himself while exploring the niftiness and awesomeness of nature and math, he had few other options than promising to construct superior war machines. We are damn lucky, neighbors, that we can build machines that deliver better privacy rather than better war if we so choose!

No sooner did I write this, neighbors, than real life<sup>TM</sup> provided a case study, as if on cue. Tor is run by evil scientists in the pay of the government! News around the clock, on this website only! Ominous geek conspiracy unmasked!

Tor, as you already know if you read its *About* page, was originally funded as a US Navy research project, and is still occasionally funded by some clueful parts of the US government that care about people getting news and other info that their governments happen to not approve of. Given that this sermon got to you neighbors by traveling for at least some of its path along a series of tubes ordered by another US military research agency, it is not surprising that such clue still exists; let’s hope that it persists, neighbors, as we sure could use more of it, the way things are generally going in those quarters these days.

Thanks to this clue, and also to the selfless dedication of Tor developers who made this project go the way few government-funded projects ever do, we have the Internet-scale equivalent of a Large Hadron Collider for low-latency onion routing. Unlike the LHC, this experiment is not just open to the public, but also immediately useful. Which is where the “revelations” come in: are “evil scientists” tricking the public?

Luckily, Tor is science, and totally open science at that—the best kind that hides nothing. It requires no permission or special access to be attacked in the only meaningful way that scientific claims are questioned and their subject-matter is improved—by experiment. Indeed, many good neighbors did so and helped improve it—and you should read their papers, because their work is nifty<sup>1</sup>. And when you hear someone attack open science not with experiments or calculations but with FUD about money or attitude, either

<sup>1</sup>Especially because it’s all open-access. Please enjoy the Freehaven Selected Papers in Anonymity.  
<http://www.freehaven.net/anonbib/>

that someone doesn't understand how science works, or has another angle.

There's a bar analogy for everything in life (it's a more fun cousin of the car analogy), so here's one for how this hustle works. Imagine that someone is loudly embarrassing himself and annoying neighbors in a bar with a foolish story. Being good neighbors, wouldn't you be moved to step in (hey, it's a bar *and* a good deed!) and gently correct him? Except, you discover that the bar has a hefty cover charge, and the loud silliness is actually quite profitable.

That's one bar it's good to pass, neighbors, because it's not in the business of enriching minds with good stories while cheering hearts up with a hearty drink. All it's serving is the poisoned Kool-aid of clickbait.

A clickbait purveyor<sup>2</sup> who happened to read the *About* section of the Tor website must have thought he struck a mother lode. An "evil scientist" story with a garnish of government conspiracy—what a clickbait oil well!

The "evil scientists" trope is a like perpetual motion machine for clickbait. Scientists aren't the most glib and suave communicators to begin with; they tend to become annoyed when bullshit is heaped upon them, letting their annoyance show. This in turn is clear proof that they are evil and holding something back! Quick, attack them again, and spare no personal detail, because there are hundreds of ways that the geeks are geeky, and for each one there are some folks that will be persuaded that geeks can't be trusted because of it.

The point of all this noisy commotion, neighbors, is to make the public forget that science and technology are in the business of making things that can be judged on their own, regardless of their creators' or detractors' motives, personalities, employers or lack thereof, or in fact any other circumstances where FUD, vagueness, and hypocrisy may be brought to bear. A scientific artifact stands on its own, the same way a formula is either correct or meaningless, regardless of whose hand wrote it. Trying to guess what directed that hand is worse than pointless if the point is to know if we should put our trust in the artifact—because good motives don't make good science, and suspecting the scientist of a conspiracy adds precisely zero bits of information, and clouds thinking.

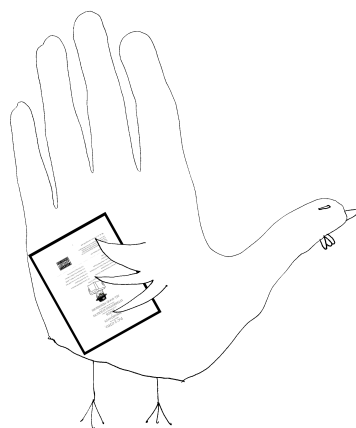
Over what criteria should one evaluate Tor, then?

As one should any other engineered artifact: whether it does what it says on the label, whether it does anything *not* specified on the label, and whether the operating conditions under which it can successfully function are present. Are the operators of the nodes that make up your Tor circuit actually independent and uncompromised, or are Sibyl attacks an important concern—and from whom? Is there enough mutual information between packets entering and exiting Tor to deanonymize users—and from what perspective on the network is that information available?

In clickbait, you will not find these questions asked, much less their answers. Not sure whether an article's clickbait or not? Try suggesting to those responsible for it what questions they *could* have asked. If the answer is a wave of harassment rather than a follow-up, congratulations, you've found clickbait. Worse, you are in the land of hypocrisy and vagueness; get out fast.

Once we remember that, neighbors, the FUD clouds of zero-information verbiage dissipate, and the saving light shines through. Technology is not magic that must be judged only by the kind of witches and wizards who create it, tainted by evil or doom unbeknownst to mere mortals. It is knowable and dissectible, and our predecessors left us the greatest gift of understanding that, and of approaching it just so.

If we got any further out from under the shadow of vagueness and hypocrisy, it was thanks to that legacy and to that principle. And so we will walk out of this Valley of clickbait and bullshit, and we shall not fear, because they will hold no power over us. And for this we are thankful.



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<sup>2</sup>Astronomy and astrology are not in the same business even though they both have to do with stars; so with journalism and clickbait generation. Be kind to good journalists, neighbors! They are few and far between, and their battles with bullshit tend to be a lot more uphill than ours.

# 3 Gekko the Dolphin

by Fiora

## 3.1 The Porpoise of Dolphin

Dolphin is one of the most popular emulators, supporting games and other applications for the GameCube and Wii game consoles. Featuring a highly optimized just-in-time (JIT) compiler and graphics unit that translates GPU opcodes into vertices, textures, and shaders, Dolphin is able to emulate almost all GameCube and Wii games at high speeds on a modern x86 CPU.

Instead of trying to do a detailed anatomy of the entire system, much of which is beyond my current understanding, in this PoC||GTFO article I'm going to focus on some particularly evil assembly optimizations and interesting bug fixes in the Dolphin JIT from the past two months—some large and dramatic, others small and elegant (or horrifically hacky, depending on your perspective!) But first, let's do a quick overview of how Dolphin works and some of the biggest difficulties inherent in Gamecube/Wii emulation.

Dolphin's JIT is superficially similar to a typical PowerPC emulator, but things are not nearly so simple as they appear. The GameCube Gekko CPU (and the extremely similar Broadway CPU on the Wii) has a number of particularly odd features that aren't present on a typical PowerPC.

- A “paired singles” SIMD unit, somewhat similar to 3DNow! but complicated by some of PowerPC's inherent weirdnesses with floating-point (32 bit floats are represented as 64 bit internally, similar to x87).
- Built-in “graphics quantization” registers, which allow quantized loads and stores based on runtime-variable parameters, up to and including the data type to be converted to and from.
- A complex memory layout with mirrored regions and a slew of MMIO features, including a memory-mapped FIFO usually connected to the GPU, but which can also be repurposed for other uses by games.
- The ability to directly access—and modify—the active GPU frame buffer.
- Complex cache manipulation features, such as the ability to enable a “locked cache” and access memory as cached or uncached.
- A floating point unit with its own very unique definition of the word “multiply.”

Making emulation even more difficult, games tend to abuse every aspect of the system imaginable, from the precise rounding of every floating point instruction to self-modifying code to behavior that isn't even defined in IBM's specification for the CPU. Additionally, games typically run in supervisor mode, giving them the ability to abuse a wide variety of features user-mode applications can't. All of this leads to severe limits on the shortcuts Dolphin can take; the most benign-seeming optimization often results in a slew of unintended consequences. Dolphin can't even reorder memory loads; an attempt to do this resulted in a real game failing because of exception handling semantics not being maintained.<sup>3</sup>

<sup>3</sup>Dolphin-Emu issue 5864

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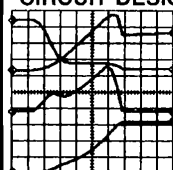
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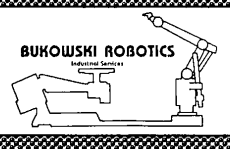


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