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OPERATING SYSTEMS

macOS: a polished workshop with tools chosen by its owner

The Operating Systems Fleet's central spaceport was unusually busy. **USS Windows** had arrived with its crew and three carts of spare parts, while **NCC Linux** brought a squad of engineers already welding something on the loading ramp that the drawings described as a coffee machine. Between them docked a third ship. Sleek. Silver. So elegant that even starlight seemed to reflect off its hull with impeccable taste. The name on the side was **HMS macOS**. At the entrance stood a man in a perfectly tailored uniform: the captain of HMS macOS. He could say “no” in seventeen languages, but always preferred “that's how shipboard regulations specify it”. Today we're going to find out what lies beneath all that polish. 🤣

Three buttons and one extremely nervous captain

— BEAUTIFUL SHIP! — cried the captain of USS Windows. — HOW MANY BUTTONS DO YOU HAVE ON THE BRIDGE?
— As many as we need — replied the HMS macOS captain.
— WHERE'S THE ENGINE START BUTTON?
— The system starts the engines at the appropriate time.
— AND THE OFF BUTTON?!
— It's available in the appropriate place.
— WHERE IS THAT APPROPRIATE PLACE?!
— In the menu.
— SO YOU DO HAVE A BUTTON?!
— Certainly. You simply don't have to stare at it for the entire voyage.

The chief engineer of USS Windows leaned toward his captain.
— See? A ship can have fewer buttons.
— BUT I LIKE BUTTONS!
— I know, Captain. On our ship even a coffee mug was identified as an input device.

The HMS macOS captain led the guests inside. On macOS, hardware, the operating system and the interface are developed with close cooperation in mind. That's a key part of Apple's philosophy: the company controls both the Mac hardware family and development of its operating system. This doesn't mean third-party programs and devices don't exist. It means the designers can tune many elements together instead of supporting virtually every conceivable combination of components. **Consistency and convenience are deliberate design choices here.**

Under the beautiful floor is a very serious engineer

The captain of NCC Linux looked increasingly suspicious.
— Very pretty, but what's under the floor?
— The operating-system architecture — replied the HMS macOS captain.
— SPECIFICALLY.
— Darwin.
— Is that a crew member?
— The system's foundation.
— And the engine?
— The XNU kernel.
— That sounds familiar. May I see the console?
— Of course.
— Aha! So you DO have screwdrivers!
— Please don't use them to dismantle the lobby furniture.

Below macOS's graphical surface lies **Darwin**, a Unix-based foundation that includes the **XNU** kernel and parts of the operating-system environment. XNU combines ideas associated with Mach and BSD. macOS is a Unix operating system, but it isn't simply a Linux distribution in a fancy case: it has a different kernel, its own interfaces and Apple's technologies. Some Darwin components are open source, but macOS as a whole — including much of Apple's interface and its applications — is not entirely open source.

— So NCC Linux and HMS macOS are cousins? — asked the Windows captain.
— Think of them as living on different continents in the broader Unix family of systems — replied the Linux engineer.
— And Windows?
— You came to the family reunion by a different highway.
— THE IMPORTANT THING IS I MADE IT!

Finder, Dock and a warehouse where nobody shouts

On the bridge, a huge display glowed. Icons lined up neatly at the bottom, a menu bar sat at the top, and every window looked as if someone had straightened its collar before opening it.
— Where's my desktop? — asked the Windows captain.
— You're looking at it.
— WHERE'S THE FILE MANAGER?!
— Finder.
— AND THAT THING AT THE BOTTOM?
— Dock.
— SO YOU HAVE A BAR FULL OF PROGRAMS!
— Yes.
— THEN WHY GIVE IT ANOTHER NAME?!
— Because you're aboard a different ship, Captain.

Finder helps organize files and folders, **Dock** provides fast access to applications and windows, while the menu bar and **Spotlight** search make everyday work easier. macOS has its own graphical environment, but its purpose is familiar: help people launch software, find documents and control the computer. Trackpad gestures, keyboard shortcuts and window management are part of the user experience. Habits learned on Windows or Linux don't always transfer exactly.

— Open the file — ordered the captain.
— Which file?
— THE IMPORTANT ONE!
— Name?
— “Final”.
— Fourteen documents contain “final”.
— THE REALLY FINAL ONE!
— Six documents found.
Greg, visiting as a technical adviser, sighed.
— Gentlemen, consistent filenames are not tied to any particular class of ship.

Terminal. Please don't touch unless you know why

The engineer from NCC Linux spotted a small door marked “Terminal”.
— Ah! Now we're getting somewhere!
The HMS macOS captain adjusted his cuff.
— Most guests prefer a more convenient interface.
— I'd rather know what's going on underneath.
— Be my guest.
— Can I type `pwd`?
— Yes.
— `ls`?
— Yes.
— My own script?
— Also yes.
— SO THIS SHIP ISN'T COMPLETELY WELDED SHUT!
— We never said it was. Please don't call opening Terminal “dismantling the décor”.

macOS supports command-line shells, utilities, scripts and a wide range of tools familiar to users of Unix-like operating systems. It includes **Terminal**, and the default shell for new accounts is **zsh**. Developers can write code, run development tools, connect over SSH and install additional software. However, not every Linux application will run unchanged: similar commands and shared standards do not mean identical kernels, libraries or system interfaces.

— Where's the “fix everything” button? — asked the Windows captain.
— There isn't one.
— THEN IS THERE A COMMAND FOR IT?!
— First, please describe the problem.
— I THINK I'D RATHER HAVE A BUTTON!

The shipyard that builds the engines too

The HMS macOS captain took the delegation to the engine room. The machinery occupied surprisingly little space.
— Where's the enormous processor cabinet? — asked the Windows engineer.
— Here, in an integrated chip.
— Graphics?
— Also here.
— Memory?

— It works with the chip through a unified-memory architecture.
The Linux captain frowned.
— What if I want to swap the processor before departure?
— Please specify your requirements when ordering the ship.
— And after I've ordered it?
— Then we recommend becoming fond of the configuration you chose.

Modern Macs use **Apple silicon** chips built around the ARM architecture. Integrating the CPU, GPU and other components can improve energy efficiency and coordination with macOS. **Unified memory** lets different parts of the chip access a shared memory pool, although it doesn't magically make every application faster. On many models, upgrading RAM or internal storage later is severely restricted. That's one trade-off of this approach: choosing the right configuration at purchase time matters more.

— How much RAM have we got? — asked the captain.
— What was ordered.
— AND HOW MUCH DID I ORDER?!
— You wrote “lots, but cheap”.
— THAT WAS A PRECISE SPECIFICATION!
— For the wish department, perhaps.

A program from another galaxy and a translator named Rosetta

An older officer rushed into the engine room holding a software box.
— I've got a program from our previous ship!
— Which processor architecture? — asked the HMS macOS captain.
— Intel.
— We have Rosetta 2.
— WONDERFUL! — the USS Windows captain cheered. — SO EVERY OLD PROGRAM WILL WORK!
— No, Captain.
— WHY NOT?!
— Because the translator translates processor instructions. She doesn't repair the entire history of software.

The transition from Intel-based Macs to Apple silicon also meant changing processor architectures. **Rosetta 2** allows many Intel Mac applications to run on compatible Apple silicon Macs by translating their code. It is not a complete emulation of an old Mac, and it doesn't guarantee that every program, driver or legacy technology will work. When available, an application built for the platform in use is generally the better option.

— Will Rosetta translate the instructions for my old coffee machine? — asked the engineer.
— If they are processor instructions and meet the requirements, perhaps.
— And its user manual for the captain?
— I'm afraid no software guarantees comprehension by the reader.

An app store and a security guard with a guest list

A security guard stood outside the software gallery.
— Please confirm where your application came from.
— The internet — answered the Windows captain.
— That's quite a large place.
— BUT IT'S FREE!

— Free and safe are not synonyms.
— CAN I INSTALL APPS FROM OUTSIDE YOUR STORE?!
— Yes, subject to security checks.
— SO WE'RE NOT TRAPPED IN A GOLDEN CAGE?!
— No. But we'd appreciate it if guests stopped trying to open these doors with coffee-machine cards.

On macOS, software comes from the **Mac App Store** and also from independent developers. Security features such as **Gatekeeper**, code signing and notarization help reduce the risk of running unknown or malicious software. Built-in **XProtect** helps detect known threats. These tools are not infallible, and users still need sensible habits and updates. Where appropriate, macOS also provides deliberate ways to allow a trusted application outside the standard flow.

— So the guard checks identification but can't read an app's mind? — asked Agnes, who had arrived to check the ship's invoices.
— Exactly — replied the HMS macOS captain.
— The Manager claimed expensive security equipment could predict the future.
— Please tell him our sales department does not accept liability for fortune-telling.

The FileVault safe and a floor that mustn't be swapped

The security officer took the guests to the data vault.
— Here we have FileVault.
— An armored storage locker? — asked the captain.
— Encryption for data on disk.
— WHAT IF I LOSE THE KEY?!
— You need an appropriate recovery method arranged beforehand.
— AND IF I HAVEN'T?!
— Then the protection may keep your data safe even from you.
— THAT IS NOT A FEATURE I ASKED FOR!

FileVault helps protect user data if a computer is lost or stolen through **encryption** and controlled access to keys. Modern Macs also use important hardware-backed security mechanisms. **System Integrity Protection** restricts modifications to protected system components even by privileged processes, while the **signed system volume** helps detect unauthorized changes to system content. These defenses serve different purposes. None replaces backups, common sense or control over what an already signed-in user is doing.

— Can I turn those protections off? — asked the NCC Linux engineer.
— Some settings can be changed in appropriate modes with suitable authorization — said the HMS macOS captain. — But you need to understand the risk.
— So I can, but shouldn't do it for sport?
— Precisely.
— FINALLY, SOMETHING I UNDERSTAND! — declared the Windows captain. — I NEVER TURN THINGS OFF FOR SPORT!
The engineer stared at him.
— Yesterday you disabled the fire alarm because it flashed red.
— IT WAS FLASHING IN AN ANNOYING WAY!

APFS: a warehouse that remembers yesterday

In the documents hold stood an enormous shelving system, but no paper index could be seen.
— Where do you keep files? — asked the captain.
— In the APFS file system.
— WHAT IF I CHANGE SOMETHING AND AN HOUR LATER REALIZE IT WAS STUPID?!
— Snapshots or backups may help in certain circumstances.
— THEN GIVE ME A SNAPSHOT OF EVERYTHING I'VE EVER DONE!
— We'd need a significantly larger warehouse — replied the HMS macOS captain.

APFS (Apple File System) is a modern file system used by macOS. Its features include snapshots, file cloning and mechanisms supporting encryption and efficient storage management. A snapshot captures a file-system state at a particular moment, but **it is not automatically an independent backup**. If the entire **storage device** is lost, snapshots stored only on that device can disappear too.

— How do you make backups? — asked Agnes.
— Time Machine.
— AN ACTUAL TIME MACHINE?! — the captain almost jumped.
— An automated backup system.
— SO CAN I GO BACK TO YESTERDAY BEFORE I SIGNED THE CONTRACT FOR THIS SHIP?!
— No, Captain. We can restore data, not purchasing decisions.

Time Machine creates backups of a Mac's data and can restore older file versions or content from a backup. It needs a properly configured destination, such as an external drive or compatible network storage. Like every backup system, it calls for restore checks, appropriate retention and separation of risks. For more on why one backup sometimes isn't enough, visit our **backup warehouse**.

A family dinner for all the devices

In the communications room, the HMS macOS captain placed a phone, tablet and watch beside the Mac.
— Our devices can cooperate through the ecosystem.
— What does that mean? — asked the USS Windows captain.
— Conveniently passing certain tasks between devices, exchanging files and synchronizing selected information.
— CAN THEY FLY THE SHIP TOGETHER?!
— No.
— THEN WHY DO I NEED A WATCH?!
— To measure how much time you spend asking that question.

macOS works with iPhones and iPads through features such as **AirDrop**, **Handoff**, Universal Clipboard and synchronization services. Availability depends on devices, system versions, accounts and settings. Convenience inside Apple's ecosystem is a major advantage. The trade-off can be less flexibility when choosing hardware or services in some situations, and greater dependence on the vendor's decisions. That doesn't mean macOS cannot communicate outside Apple: it supports common network and file standards and many independent applications.

— How do I send a file to NCC Linux? — asked the captain.
— We can use standard data-transfer methods — replied Greg.
— And to USS Windows?
— Much the same.

— SO EVERYONE CAN TALK TO EVERYONE?!
— If they agree on a compatible way to communicate.
— Then why have we spent half an hour arguing about an adapter?
— Because you were trying to connect the printer to the coffee machine.

An adapter for the adapter and the grand quality inspection

Before departure, the inspectors requested a test with an old projector. The HMS macOS captain produced an elegant box.
— The correct adapter.
— AND FOR THE ADAPTER? — asked the captain.
— The correct cable.
— AND FOR THE CABLE?
— The correct connector.
— AND FOR THE CONNECTOR?!
— A compatible projector.
Greg pulled his own adapter out of a bag.
— Here. Works.
The HMS macOS captain studied it carefully.
— The color doesn't match.
— But it works.
— That is an important advantage — the HMS macOS captain admitted after a long pause.

That little scene illustrates the trade-offs. A Mac can be an excellent choice for people who value a consistent environment, creative applications, ease of use and hardware integration. For other needs, limits on upgrades, availability of certain applications and devices, purchase price and dependence on the vendor's choices may matter more. **There is no single best operating system for every person and every task.** Windows, Linux and macOS solve many similar problems in different ways, and the right choice depends on the job.

Final report: harmony doesn't come in a box

At the end, all three delegations stood together in the hangar. The captain of USS Windows held a list of buttons, the captain of NCC Linux a diagram of the engine, and the captain of HMS macOS a document entitled “User Experience”.

— I'll admit it — said the Windows captain. — This ship is comfortable.
— And it has proper Unix foundations — added the Linux engineer.
— Thank you — smiled the HMS macOS captain.
— BUT IF WE ADDED SEVEN BUTTONS...
— No.
— AND REBUILT HALF THE ENGINE ROOM...
— Also no.
— THEN CAN WE AT LEAST MOVE THIS CHAIR TEN CENTIMETERS?!
The HMS macOS captain considered it.
— I'd need to consult the industrial-design team.

— Computer, inspection report — ordered the Windows captain.
— HMS macOS runs an operating system built upon Darwin and the XNU kernel, with its own graphical environment, tools, protections and close integration with Mac hardware.
— SHORTER!
— A polished ship whose shipyard likes to choose the fittings.
— BUT CAN PEOPLE WORK ON IT?!
— Of course.
— THEN WHY ARE WE STILL IN THE HANGAR?!
— Because you've spent forty minutes looking for the “Approve My Personal Opinion” button.

macOS is a fully capable operating system with Unix foundations, a sophisticated interface and broad possibilities for work. Its character comes from the close relationship between hardware and software, Apple's design choices and a compromise between convenience and freedom of customization. That's why it's worth learning about different ships rather than declaring a single winner of the galaxy.

Operating Systems Fleet Command reports: HMS macOS has passed inspection. The captain of USS Windows requested more buttons. The captain of NCC Linux requested engine-room documentation. The captain of HMS macOS replied to both requests with the same sentence: “Thank you for your feedback”. Greg kept the adapter. 🚀🤣❤️