Abilian
ECON LAB

Measuring the Stack

Paths, exit costs and the instruments that reach them: a position on technology stacks for digital sovereignty

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About this position

The Commission's Tech Sovereignty Package of 3 June 2026 made the technology stack the unit of policy. Its Communication uses the word "stack" more than thirty times and promises, for the Cloud and AI Development Act (CADA), action "to develop a sovereign cloud and AI stack"; the Open Source Strategy commits to scaling up the Open Internet Stack [1, 2]. Industry has followed with stacks of its own: the EuroStack initiative, the Deutschland-Stack, the Sovereign Cloud Stack.

The word names the right object. Three questions about it remain open: what a stack measures, where in it the cost of dependence sits, and which instruments reach that cost. This position answers them from the lab's published work: proved where a theorem is claimed, measured or classified where a number is, with each paper stating which and publishing its data and code. It is written for policymakers; every technical term is defined where it first appears.

Summary of position

1. **Dependence composes along paths.** A stack is a set of layers that depend on each other. Exposure accrues along the whole path a workload traverses. A criterion satisfied at every layer can leave a single controller able to stop the path. Measure the paths: a count of layers misses a controller that sits on several of them.
2. **The layers differ; the measurements say how.** The silicon chain is a floor that only capacity investment moves. Cloud is plural below the managed tier and nearly empty above it. Identity has the highest exit friction the lab has measured. Operations and development tooling are captured through the stewardship of open-source substrate Europe could fork. The AI constraint sits at the deployment layer, where no budget line exists. The productivity exit is demonstrated; its order is known.
3. **The cost of dependence is the cost of leaving.** An incumbent's markup over the alternative is bounded by what leaving would cost the buyer. That cost decomposes into transport, re-integration, downtime, retraining and contractual timing. An instrument lowers the price only through the component it touches. Egress fees are the smallest component; re-integration is the largest.
4. **A bundle suppresses the decision.** A component that arrives inside a bundled licence at no incremental price has no budget line, so no renewal event, so no comparison. Subsidy is inert against that; itemised pricing, an evaluation duty and price disclosure restore the decision at near-zero cost.
5. **Subsidy is the weak lever.** European providers are several times cheaper for raw compute and lost half their market share; co-funding ratios identify the funding schedule and nothing about behaviour.

The strong levers are demand that verifies effective control, award criteria that can decide and a second supplier on the interface.

6. **Interoperability multiplies European supply.** Lowering exit costs lets a buyer move an estate piece by piece; buying European and mandating interoperability are one programme.
7. **Instruments are upper bounds.** A provision names the most protection it can deliver; delivery depends on enforcement. Design surfaces that are not publicly legible get captured. A European technology stack observatory should publish path measures, one substitution series and the reach of each instrument.

1. Dependence composes along paths

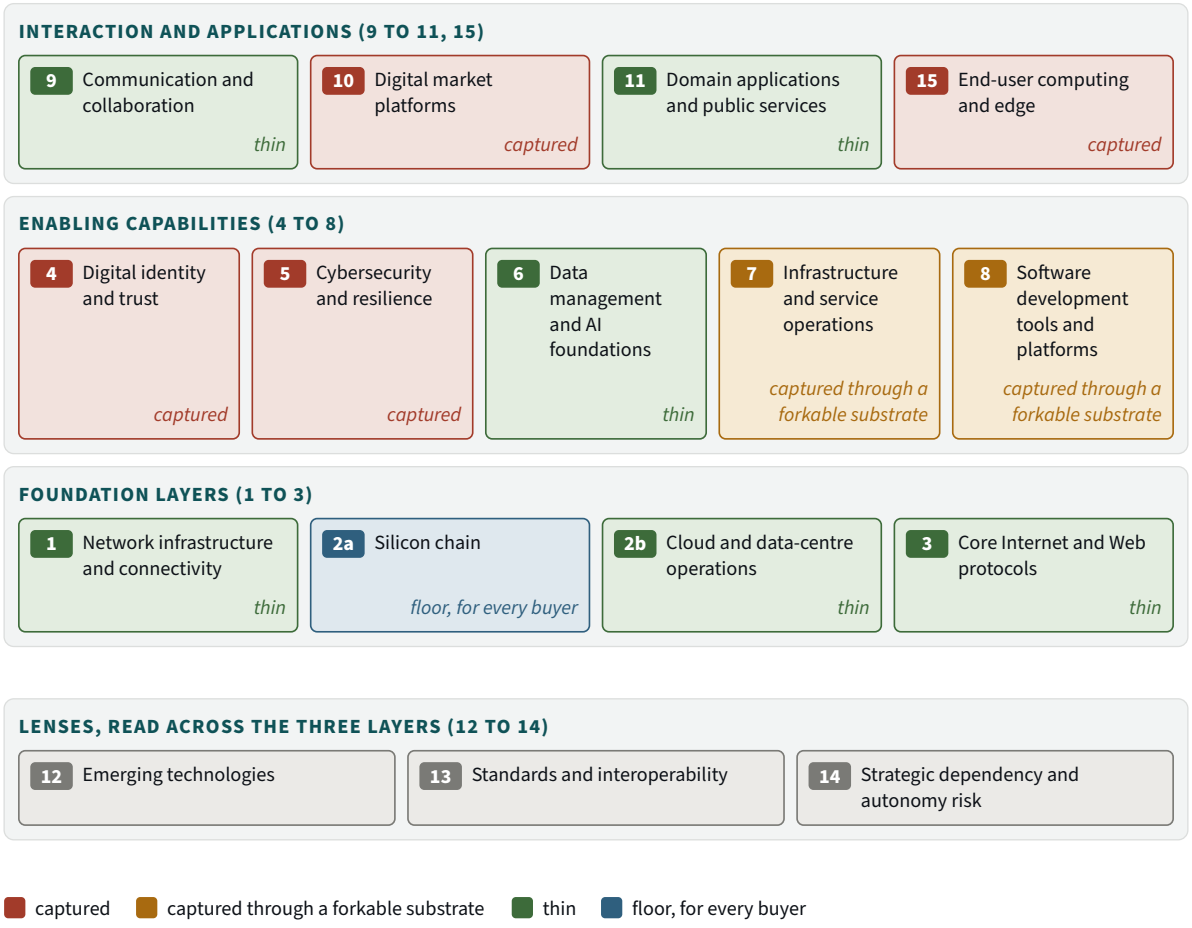


Figure 1. The stack as a map: the fifteen technological building blocks of the Open Internet Stack in their three layers, each with the class the build-order paper gives it under a rule frozen before any number was computed [24]. Captured: foreign reach covers every category in the block, or concentration or capture risk sit at their worst level on every category; two of those verdicts (blocks 7 and 8) rest on open-source substrate that Europe could fork and does not maintain. Thin means that a single controller-disjoint way runs through the block, that a single category is unreached, or that no forkable substrate exists. The silicon chain, classed thin under the rule, is drawn as the floor because every buyer faces it. The three lenses read across the layers and have no market of their own. The 52 categories of the measured dependency graph fold into these blocks [24].

A digital service is produced down a deep vertical chain: application code, cloud platform and infrastructure, silicon, fabrication, materials, and out through distribution channels such as app stores. The tests policy and procurement use (who owns the provider, where the data sits, which certificate the service

holds) each inspect one node of that chain. Exposure does not stay in one node. A compliant provider can run a third-country control plane. That control plane can depend on a third-country identity provider, which can in turn be built on a software component whose upstream maintenance is controlled elsewhere.

Two quantities make this measurable [3]. The *coercion number* of a buyer is the size of the smallest coalition of controllers able to cut every feasible way of producing its service. The *option number* is the largest family of ways sharing no controller. Coercion is a weakest-link quantity: it composes across the input classes a producer needs. The central theorem is a certification failure: system-wide diversification can be strictly below every per-layer count, with the gap opening exactly where the same controller appears at more than one layer. A per-layer independent-suppliers criterion, which is the form regulation takes, therefore certifies a quantity that can equal two at every layer while a single controller cuts everything.

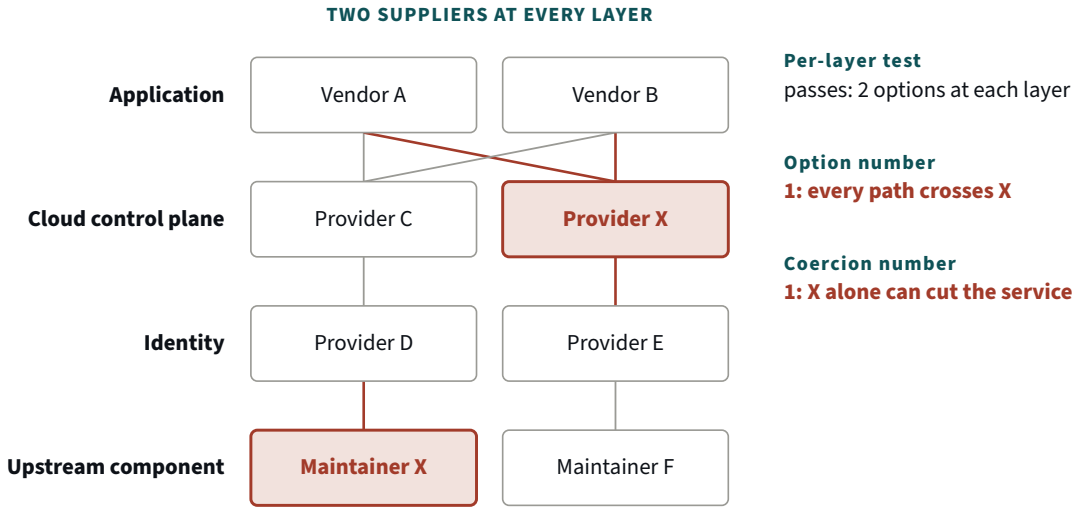


Figure 2. Two suppliers at every layer, one way to produce the service. Each option depends on one option in the layer below (the applications run on either control plane; Provider C's control plane is built on the component Maintainer X maintains; Provider X's identity option is built on Maintainer F's). A per-layer test counts two options at each of the four layers and passes. The option number is one, because every path from an application to the bottom (the red lines) crosses X, at the control-plane layer or at the upstream layer, and X alone can cut the service. This is the certification failure of Cuts and Options [3]. On the measured graph the same failure appears inside the public-sector buyer's cloud layer, where a count of three independently controlled suppliers hides an option number of one [3, 4].

On the lab's measured graph of the European digital stack, 52 categories from raw materials to app stores with control, funding and jurisdiction overlays, every European demand node has a coercion number of one. Five distinct blocs, under either controller coding, can each cut alone at full stack depth, with the US bloc above the semiconductor floor for every buyer. Every buyer already fails a per-layer test at its own single-supplier layers, and where one passes, the count overstates: the public-sector buyer's cloud layer counts three independently controlled suppliers while its option number at full depth is one, and above the silicon floor the United States alone can cut it [3, 4]. The modelled levers, bundled together and even with a wholesale re-homing of the US-owned categories added, leave a residual floor of dependence on Asian materials and fabrication, which no European stack removes and which policy should price rather than promise away [4].

European regulation already contains the path criteria. The Commission's Cloud Sovereignty Framework defines its top level by "no critical non-EU dependencies" [5]; France's SecNumCloud requires that a service be maintainable from the provider's own competences or from at least two third companies

[6]. No published methodology assesses either at ecosystem scale. The official dependency index in the Commission's evidence base for the 2028 to 2034 programming counts, for each technology area, the dimensions rated high on a two-level scale. Threshold counting and weakest-link exposure are different functionals and rank the same profiles differently; where every area scores high on some shared dimension, the count does all the ranking work. Reconstructed from its own cells, the index reproduces twelve of thirteen printed totals; applying its stated rule to its own tables contradicts its published prose [7].

2. Layer by layer

A framework is only as good as its components. The map of Figure 1, read layer by layer, gives for each layer what the lab has measured and which instrument follows, from three measurement papers and two migration guides whose market figures cite their own sources [4, 12, 24, 30, 31].

The silicon chain is the floor. On the Commission's own count the EU holds about 10% of global chip production against a 20% target for 2030, with nearly 80% of the suppliers it depends on headquartered outside the Union; the one EU-controlled chokepoint is lithography [24]. Five blocs, the United States, China, Japan, Korea and Taiwan, are each able to cut every block of the stack alone through this floor, which is why no per-block checklist can certify the stack [24]. At the floor, procurement cannot re-route and conduct rules cannot cheapen exit. Adding an option is the only instrument left, one that is capital-intensive by nature. That is the case for capacity investment, and also its boundary: at layers where options already exist, the same euros buy a capture target or feed the incumbents' loop [4].

Accelerators are a floor at the training margin and a market at the inference margin. Nvidia shipped about 98% of data-centre GPU units in 2023 and its CUDA ecosystem fences translation layers; the supply beneath it is Taiwanese and Korean fabrication, packaging and memory [4]. A second supplier is exercisable: AMD runs EuroHPC's LUMI at training scale, and on inference eight MI300X came within 3.3% of eight H100 on a public benchmark. Exit at the inference margin is cheap and getting cheaper, while exit at the training margin still pays the full ecosystem toll. Every exercisable supplier is a US firm under US export law, which the 2025 AI Diffusion Framework exercised against seventeen Member States before its rescission was announced, two days ahead of the compliance date and with no replacement published [4]. Buy inference on the open margin; treat training-scale dependence as part of the floor.

Networks are Europe's largest position, with the dependence below the service layer. European telecoms services turned over EUR 407 billion in 2024, a layer Europe supplies to itself. The exposure is in equipment and trust anchors, where the top three radio-access vendors are Ericsson, Nokia and Huawei. Chinese-vendor 5G equipment reached 41% of European mobile subscribers on 2022 installed-base counts [24]. The 5G toolbox of 2020 screened that layer structurally, on ownership and home-state control. The design held; enforcement was national and partial, with ten of twenty-seven Member States having imposed restrictions three and a half years in [25]. The January 2026 revision of the Cybersecurity Act, which would make the derisking of high-risk suppliers binding, is the instrument to support.

Cloud is plural at the commodity level and empty above it. OVHcloud, Scaleway, Hetzner, IONOS and StackIT are independently controlled European options for virtual machines, storage and networking, comfortably clearing SecNumCloud's two-suppliers test, and OVHcloud builds and runs its own stack across 44 data centres [4]. Breadth collapses as the buyer moves up: OVHcloud's whole public-cloud line is EUR 219 million of revenue against hyperscaler catalogues of hundreds of managed services, so the option set that is plural for virtual machines is nearly empty for managed platforms [4]. The trustee ventures do not change this. Bleu runs Microsoft's stack and S3NS runs Google's code on Thales infrastructure, so roadmap and feature velocity stay with the licensors [4]. The 35 Amazon Web Services offerings the lab scored [12] sort, in the lab's reading of those scores, into four cells (Figure 3); the scoring covers one

vendor's catalogue, and its replication on the others is queued. The control plane (identity, keys, secrets, monitoring, deployment tooling) is shallow in application code and expensive to leave; there the exposure removed per euro is largest, so every migration should start there. In commodity infrastructure, European supply exists and is cheaper; substitution there is free. Portable interfaces (object storage, container orchestration, event streaming, search) are substituted at the endpoint. The proprietary platform tier (serverless, proprietary NoSQL, workflow orchestration, managed AI) falls under the rule to stop adding [12]. Procurement preference works at the commodity layer now; the next targets of conduct rules are the managed-service and identity layers, where the option set collapses [4]. Two instruments sit high on the lab's ladder of interventions, far above the subsidies and egress caps at its foot [12]. Specification-first procurement buys the standard and never the product. Mandatory disclosure of coupling and exit friction per service costs little and restores the information a buyer lacks. The win condition is a commodity interface that no one owns [12].

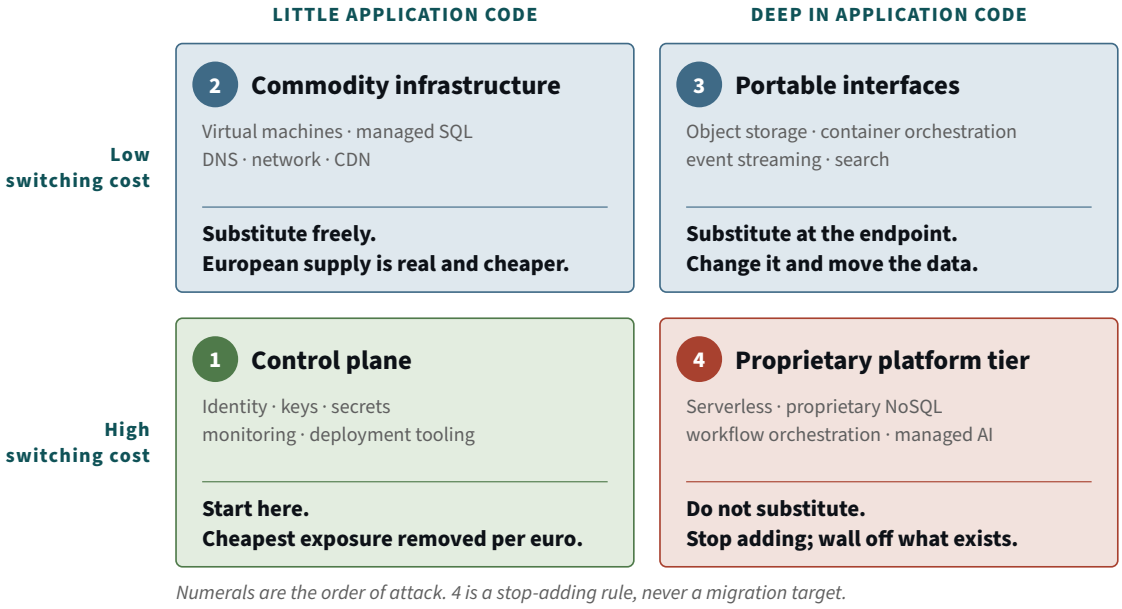


Figure 3. Where the exposure sits in a cloud estate: 35 managed services scored on architectural coupling and exit friction under a published rule [12]; the action per cell and the order of attack are the lab's reading of those scores. Identity comes first inside the control plane, because everything else authenticates against it. Numeral 4 is a stop-adding rule, never a migration target.

Core protocols are public goods with no European implementer at the browser. Chrome takes 62.7% of European page views; no EU-headquartered browser-engine vendor appears in the table [24]. Standards are non-rival rule-books whose value is adoption; the lever is royalty-free, simple standards that lower the barrier to competing European implementations [12].

Identity is the lock-in locus. Every application requires authentication at near-zero marginal cost. Identity shows the highest exit friction the lab has measured anywhere, a mean of 0.77 on the crosswalked services. No EU-provider share is published at all. The public option, the EU Digital Identity Wallet, is due in every Member State by the end of 2026 [24]. Identity is one of the four captured blocks with no forkable substrate, where the instrument is build-or-buy [24]. Three procurement decisions hide inside it (the directory of record, authentication, device policy); the lab's migration guide separates them so that no single product is asked to cover all three [30].

Cybersecurity supply is a risk market in which certification stands in for observation. Buyers cannot observe product quality, so certification substitutes for it and regulation creates part of the demand; 60% to 70% of the European civilian market is held by non-European players [24]. The instrument is build-or-buy. The certification schemes are the design surface where capture concentrates, to which section 7 returns.

Data and AI: the money is aimed one layer too low. More than 85% of generative-AI value-chain funding goes to US companies [24]. European public money goes to compute and facilities, with EUR 20 billion earmarked for AI gigafactories. Two assessments of summer 2026 locate the failure two layers up, Mozilla's developer survey and the Commission's own AI technology report. Between a third and a half of teams stall between a trained model and a working application, whichever models they buy [28, 29]. The inputs the money targets are no longer scarce. For a given capability level the price of inference fell from about $20 to $0.40 per million tokens in 36 months; the best open-weight models sit about three percent behind the best closed ones on preference ratings [28]. The missing layer is orchestration, memory, tool access, agent permissions and retrieval over the organisation's own documents that enforces each user's permissions; it has no budget line [28]. It needs one, ahead of further compute.

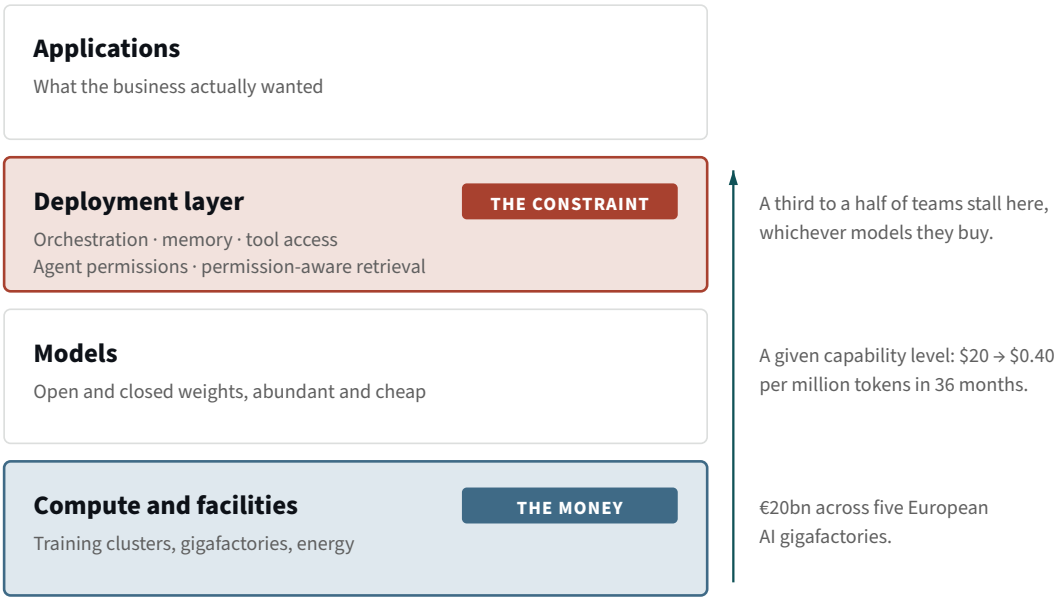


Figure 4. The AI stack as the money sees it and as the constraint sits. European investment is directed at the bottom band; a developer survey and the Commission's own assessment put the binding constraint two bands above it, where no programme line exists [28, 29]. The bands read those two documents and measure nothing.

Operations and development tooling are commons, captured through their stewardship. Their substrate is open-source software, a shared and unpriced input maintained by a concentrated set of maintainers, the textbook under-provision configuration; no defensible European market size exists for either block, because the value never passes through a price [24]. The proprietary margin above the substrate prices its rents. VMware held about 45% of virtualisation when Broadcom acquired it; European providers have since reported licence costs rising tenfold at renewal, in complaint documents that are interested-party evidence [24]. The forge layer concentrates on one US-controlled platform with more than 180 million accounts [24]. These are the two verdicts that rest on substrate Europe could fork and does not maintain. The instrument is substrate stewardship (European hosting of forges and distribution, governance participation, a maintained fork capability), the cheapest gap class on public cost records [24].

Productivity and collaboration: the exit is demonstrated; its order is known. The lock is formats plus identity coupling. The option set holds two to three independent European controllers (Nextcloud, ZenDiS with openDesk, Open-Xchange). Schleswig-Holstein has shown it exercisable: close to 80% of state-administration workplaces (outside the tax administration) on LibreOffice by December 2025, and has almost 44,000 mailboxes moved from Exchange to Open-Xchange in about six months [4, 14]. Munich's reversed migration is the standing caution that an exit needs institutional durability as well as feasibility [4]. The lab's two migration guides give the order: stateless single-purpose tools first, then the office suite and mail client, where the format entanglement lies, then the operating system, after every layer above it has moved [30, 31]. Credible open-source options exist in every domain examined. No source supports a claim of cost savings; the most rigorous concludes cost parity over a long horizon. The case rests on exit cost, price-escalation exposure and optionality [30]. Supplier depth is a selection criterion in its own right, because a single-vendor product replaces the identity of a dependency without changing its structure [30]. The only field evidence on resistance finds it strongest in the IT department, and the work the sources treat thinly sits in the layer that manages the estate: provisioning, policy, packaging, client identity [31].

Market platforms and end-user computing are captured at the door. The platform block supplies nothing in production terms; its position is distribution, the priced door between applications and users. The DMA's 22 core platform services have no EU-headquartered gatekeeper; international card schemes process about 61% of euro-area card payments, with thirteen countries entirely reliant on them [24]. Client operating systems set the defaults for everything above them. The measured structure is a US duopoly at 99.97% of European mobile usage, with community Linux at 4.7% of desktops the only non-US entry [24]. Both are build-or-buy blocks. The workstation guide treats the Linux desktop as the destination and open-source applications on the incumbent systems as a stage to complete on its own terms, since it removes dependencies by itself [31].

3. The cost of dependence is the cost of leaving

European organisations spend about EUR 400 billion a year on cloud and software services, on the estimate of a study commissioned by a buyer association [8]. In the UK, where the Competition and Markets Authority (CMA) measured it, fewer than 1% of cloud customers switch provider in a year, while the two largest providers earn returns sustained above their cost of capital [9]. A holdup model is one where the supplier can raise its price once the buyer has sunk the cost of adopting it. In such a model with exit costs that differ across buyers, the incumbent's markup over the alternative equals the marginal buyer's exit cost under a posted price and each buyer's own exit cost under negotiated prices. The rent is the exit cost [10].

The exit cost decomposes into five components: transport (moving the data), re-integration (rewiring what depends on the supplier's interfaces), downtime, retraining and contractual timing (a contract cut mid-term saves nothing until it ends). An instrument lowers the price only through the component it touches. Egress fees, the transport component, are below 1% of most customers' annual cloud spend on the CMA's UK measurement, which is why Amazon, Google and Microsoft could waive them for departing customers in 2024 without the switching rate moving [9, 11]. The lab scored 35 Amazon Web Services offerings for architectural coupling and exit friction, a measure of how much of a system would have to be rewritten to leave [12]. On that set, an instrument acting on data transport alone reaches on average a fifth of the scored exit friction under the calibrated weight, under 30% on the deeply locked services where the policy problem lies. Of the 35 services, 23 have an exit friction above 0.5, and in 20 of those the proprietary-interface score exceeds the data-gravity score. The switching chapter of the Data Act (Regulation (EU) 2023/2854, Chapter VI) reaches transport and timing [13]; the commitments the CMA

accepted from Amazon and Microsoft in March 2026 reach the same components [27]. Nothing in force reaches re-integration.

	Egress waivers 2024 *in force*	Data Act Chapter VI *in force*	CMA commitments March 2026 *in force*	Second supplier on the interface *proposed*
Transport moving the data; egress under 1% of spend	●	●	●	○
Contractual timing notice periods, the switching window	○	●	●	○
Re-integration rewiring what depends on the interfaces	○	◐	◐	●
Downtime the switch itself	○	○	○	○
Retraining the people	○	○	○	○

Figure 5. Which component of the exit cost each instrument reaches; a filled circle means the instrument acts on that component, a half-filled one that it touches it in part (the Data Act's functional-equivalence duty, the interoperability mechanism promised in the CMA commitments). The 2024 egress waivers act on transport; the Data Act's switching chapter and the CMA's March 2026 commitments act on transport and contractual timing. Re-integration, the largest component, is reached only by a second supplier serving the same interface, which no instrument in force provides [10, 11, 12, 13, 27].

Re-integration is reached by one thing: a second supplier serving the interface on which the buyer's estate depends. A standard nobody else implements changes no exit cost. Whether a second supplier serves the interface is the operational content of "stack interoperability".

A buyer can put a floor under its own exit cost from its own bills. A buyer that stays through a price increase reveals that leaving would have cost more than the present value of the gap the increase opened. On the Microsoft 365 E3 price path the floor is of the order of half a year of annual spend for a five-year buyer [10]. Public migration accounts bound the same quantity from above. Schleswig-Holstein reports about 25,000 workstations and almost 44,000 mailboxes migrated to open-source software, with licence savings above EUR 15 million a year and EUR 9 million of investment planned for 2026; the migration cost itself is not itemised [14]. The decision to leave at that saving reads as a ceiling of two to four years of licence spend on the exit cost, which is consistent with the floor [10].

4. A bundle suppresses the decision

An organisation does not replace a free component with a paid one, however much better the paid one is. The standard models of switching costs and network effects do not contain the sentence, because they act on the terms of a decision and say nothing about whether it occurs. A component that arrives inside a bundled licence at zero incremental price generates no budget line, hence no renewal event, hence no comparison: the decision the entrant's price would enter is never convened [15]. Three results follow. Some buyers would evaluate the entrant and still reject it, because dropping a component that has no price saves nothing; the others, for whom the entrant is worth its price, never evaluate it whenever the internal champion's stake falls short of the cost of initiating a decision. Conditional on non-initiation, adoption is invariant to the entrant's price, so a subsidy buys nothing at a given buyer until it covers that buyer's whole gap, while an event unrelated to price (a reorganisation, an audit, a mandate) converts every such buyer at once. Instruments that re-create the decision event (line-itemised pricing, a periodic

evaluation duty, disclosure of the imputed component price) restore the price margin for all buyers at once at near-zero resource cost.

The record already contains the instrument. The Commission's acceptance of Microsoft's Teams commitments on 12 September 2025 requires suites without Teams at an appreciably lower price, with the corresponding offer displayed wherever the bundled one is advertised [16]. The Digital Markets Act designated Microsoft a gatekeeper on 6 September 2023 for Windows PC OS and LinkedIn, and for neither the productivity suite nor the cloud [17]. The Teams remedy came under competition law. The productivity-and-cloud bundle has no designation yet.

5. Subsidy is the weak lever

European cloud providers are several times cheaper than the US hyperscalers for raw compute on list prices, and one of them leads an independent price-performance benchmark. Their share of their own cloud-infrastructure market nevertheless fell from 29% in 2017 to about 15% in 2022 and has held there, while the three US firms hold about 70% [18, 19]. The two facts sit on different perimeters. Buyers sort by the differentiated share of their estate (platform and AI services against commodity infrastructure). Europe is cheaper and present in the commodity basement, while in the differentiated layer the components of a European offer exist near price parity and the integrated breadth of a hyperscaler has no European counterpart. A commodity subsidy saturates over realistic budgets when firm types are distributed bimodally; a subsidy aimed at the differentiated layer meets a network constraint that capability funding alone does not clear [19].

The statistic used to justify such programmes says nothing either. A co-funding "leverage" ratio is a deterministic function of the published co-funding schedule. The Digital Europe Programme's headline leverage of 0.79 lies below the ceiling of one that its lowest funding rate, 50 percent, implies, so it says nothing about whether public money mobilised private money; what it recovers is a bound on composition, at most about a fifth of the envelope disbursed at full funding rates. The private component, the only part addressed to a capital-market friction, is a minority of reported leverage in nine of the twelve areas where both are published [20].

The strong levers are on the demand side, and three conditions make them work.

- **Procurement must verify what is expensive to fake.** A requirement that screens on an attribute which is cheap to fake and expensive to verify (a documented mitigation, a local partner, a data-location clause) cannot separate supplier types at any price or audit intensity; verification of effective control screens once its accuracy clears a characterised threshold [21]. CADA's Article 30(3) accepts "Union assurance level 2, 3 or 4" for the Union's public-order workloads; at level 2 a provider under third-country control qualifies by documenting mitigations, at level 3 that control disqualifies (Annex II, 2.1(g) and 3.1(g)) [1]. The same 3.1(g) then lets such a provider be audited for level 3 "where the Commission has adopted an implementing act under Article 19", an article that confers no implementing power; the derogation is either inoperable or the route back in. "Level 3 or 4", with that derogation deleted, is the amendment. During the transition the public-order workloads run where the option set already exists, on commodity infrastructure and on the European productivity stacks, while conduct rules create supply at the managed tier.
- **Award criteria must be able to decide.** CADA's Article 32(2)(d) makes every non-price award criterion "ancillary and not decisive in the award of the contract", so contribution to European supply can be scored and can never determine an outcome. Delete it. State the criteria to be scored in terms an award criterion can lawfully use under Article 67 of Directive 2014/24/EU and the Government Procurement Agreement, linked to the subject matter of the contract: verified effective control, exit

cost, and the plurality of independently controlled suppliers on the interface, in place of a bare “European supply”. Use division into lots (Article 46 of the same Directive) so that the subscription and support lot goes to the publisher or maintainer [22].

- **Demand must be pooled behind a second supplier.** Under a posted price, one buyer’s investment in its own portability changes its price by nothing unless it crosses the supplier’s margin, so portability is a public good among the customers of one supplier [10]. The instruments that have moved anything in the record have been collective: statutory switching rules, exit tests imposed on a sector, buyers pooling demand. A buyers’ club for the open-source flow, whose members pay in code or in cash and whose fee falls as it grows, is the institution that pools it [23].

6. Interoperability multiplies European supply

Lowering exit costs lets a public buyer un-bundle an estate and move it to European providers piece by piece, where moving it whole is infeasible; each move lowers the cost of the next. The realistic European position in cloud infrastructure is a loosely coupled secondary beachhead whose value is reversibility, the property the demand-side screen presupposes [19]. Buying European and mandating interoperability are one programme; the second makes the first deliverable at scale.

On the supply side, the Open Internet Stack the Strategy promises to scale up has a build order. Figure 1 shows fifteen building blocks: the fourteen published in 2025 plus end-user computing, added in the 2026 revision. Under a rule frozen before any number was computed, five of the published fourteen blocks classify as captured and seven as thin; with the revised block set, which includes a block defined after the data were seen, six classify as captured (identity, cybersecurity supply, operations tooling, development tooling, market platforms, end-user computing) [24]. Two of the captured verdicts rest on jurisdictional reach into open-source substrate that Europe could fork and does not maintain; the stewardship gap is priced per component three orders of magnitude below a build-or-buy programme. The anchor prices a per-component engagement; four of the six captured verdicts rest on one or two reach edges that no second coder has replicated [24]. With those caveats, funding the flow of maintenance is the cheapest sovereignty purchase on the list.

7. Instruments are upper bounds

A provision is an upper bound on the protection it names. Delivery depends on the willingness of the enforcing coalition; qualification regimes impose fixed compliance costs that fall hardest on small suppliers [4]. The EUCS cloud certification scheme lost its ownership and immunity criteria in 2024, at technical level, after those criteria had cleared the political stage [25, 26]. Capture concentrates where a design is not publicly legible; a delegated power over an annex is the least legible design surface a regulation contains. CADA’s Article 16(2) lets the Commission amend the assurance levels of Annex II by delegated act. A non-regression clause, under which technical adaptation may raise a criterion and never lower one, is two lines. The Commission’s reason for the delegated power, keeping technical criteria current, is served by the two-way eighteen-month review that Article 16(3) already provides.

8. A technology stack observatory

An observatory of the European technology stack is the natural instrument for a policy that has made the stack its unit; the idea will occur to every actor in the field. Its value is decided by the object it measures. A dashboard that scores each layer on a list of indicators (market share, technological maturity, investment,

resilience, skills) is the per-layer checklist of section 1: it can report two suppliers at every layer while one controller cuts everything. Three published series would measure the object.

1. **Path measures by buyer class**: option and coercion numbers computed on a maintained dependency graph with control and jurisdiction overlays, recomputed every year and read at supplier resolution where the pilots have reached. Supplier resolution needs one disclosure the series cannot do without: for each option at each class, the supplier and its ultimate controller, to the depth at which controller sets merge [3].
2. **One substitution series**: the share of European public-sector spend on cloud, software and AI going to suppliers recognised at each Union assurance level, by Member State and by year, with the Cloud Sovereignty Framework's SEAL levels as the proxy until CADA recognitions exist [5]. In the interim SEAL levels are assessed procurement by procurement and not published, so the proxy needs contracting authorities to report the level of each award; the observatory would compile those reports, and CADA's Article 15 monitoring duty is where the obligation belongs [1]. Neither CADA nor the Strategy's fourteen monitoring indicators measures substitution [1, 2].
3. **The reach of each instrument** on the five exit-cost components, so that a rule acting on egress is not scored as if it acted on re-integration [10, 12].

What exists to seed it. The lab has built, and published with data and code, the instruments the three series need. A 52-category dependency graph of the European stack has control, funding, influence and jurisdiction overlays, with the cut calculus that computes option and coercion numbers on it [3, 4]. A pilot prices option sets and exit costs on three layers from public material, with 38 sourced cells, 28 options and 22 exit-cost items, every key claim re-verified against primary sources [4]. A scoring rule measures the coupling and exit friction of managed cloud services, applied to 35 of them under a two-coder protocol [12]. A revealed-preference floor puts a number under a buyer's exit cost from its own price path and the switching rate [10]. A ceiling test tells whether a reported co-funding ratio says anything [20]. A block-level classification of the Open Internet Stack holds under a rule frozen before any number was computed and is stable under perturbation of every coding [24]. None of this yet runs at ecosystem scale or recurs annually. An observatory would add both.

What it would take. Two vehicles and three programme lines are needed. The substitution series is a reporting duty and belongs in CADA, in Article 15, which has the Commission monitor capacity and demand, or in the Article 7 national strategies. The computation is a funded action whose vehicle is the Digital Europe Programme. On the lab's estimate it is a programme of a few million euros a year, one to two orders of magnitude below the demand-side instruments the lab's cost anchors price at EUR 10 to 100 million [24]. First, the graph and the block classes are recomputed every year, with supplier-resolution profiles extended from the three pilot layers to all of them. Second, the substitution series is assembled from procurement data by Union assurance level, which Member States hold and no one collects. Third, a supplier-side scoring channel measures a supplier's sovereignty claims on the properties that decide exposure (control, maintainability, exit cost); the lab has designed it and not yet fielded it. The lab offers its instruments as the seed and would join a consortium to build the rest; the methods are public, so any consortium can start from them. The lab declares its interest: it would be a candidate to run part of that programme.

9. What we ask

1. **CADA Article 30(3): "level 3 or 4", and delete the level-3 derogation in Annex II 3.1(g).** The sovereignty framework turns on that word, and the derogation is the route back in.
2. **CADA Article 32(2)(d): delete.** A criterion that cannot decide is no criterion.

3. **CADA Article 16(2): a non-regression clause.** Technical adaptation may raise a criterion and never lower one.
4. **CADA Articles 14, 13 and 11(2): openness and portability as a condition of strategic-project and acceleration-zone benefits**, evidenced by a tested exit under Chapter VI of the Data Act.
5. **The Teams precedent applied to bundled productivity and cloud services**: itemised pricing, an evaluation duty, disclosure of the imputed component price, and suites without the component at a lower price, under competition law as in the Teams case, with a Digital Markets Act designation or market investigation sought for the productivity suite and the cloud, which the 2023 designation does not cover.
6. **A technology stack observatory that publishes the three series of section 8**: the substitution series as a reporting duty in CADA Article 15 or the Article 7 national strategies, the computation funded under the Digital Europe Programme and seeded with the public instruments of section 8, with the controller disclosure that supplier resolution needs. The lab offers to contribute its instruments and declares its interest in running part of the programme. The enforcement record is published beside each instrument.
7. **Funding for the flow**: stewardship of the open-source substrate that operations and development tooling depend on (European hosting of forges and distribution, governance participation, a maintained fork capability), through buyers' clubs and a maintenance instrument with an article in CADA's Title II funded through the Article 6(3) route, ahead of any new subsidy to capacity.
8. **Conduct rules aimed at identity and the managed-service tier**, where the option set collapses: interface disclosure, with a second supplier under independent control serving the interface as the test of compliance.
9. **Specification-first procurement and mandatory disclosure of coupling and exit friction per service**, so that a buyer sees the exit cost before signing.
10. **A budget line for the AI deployment layer** (orchestration, tool access, agent permissions, permission-aware retrieval), ahead of further compute, with inference bought on the open margin.
11. **Public-sector migrations in the order the lab's guides derive**: the control plane and identity first, then the stateless applications, the office suite and mail client at the end of the application queue, and the operating system after every application has moved, with the institutional durability that Munich lacked and Schleswig-Holstein has.

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