

Analysis

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# The Robot Is Not the Problem

Physical AI and the value of data architecture  
in critical infrastructure

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## **The Robot Is Not the Problem**

*Physical AI and the value of data architecture in critical infrastructure*

### **The Devices and the Data**

Autonomous robots are being deployed across U.S. infrastructure at scale. Pipeline inspection crawlers run inside crude lines. Substation patrol robots run scheduled inspection rounds at closed industrial sites. Autonomous haul trucks cross private mining roads. Bridge inspection drones map structural details across state Department of Transportation (DOT) programs. Container straddles handle cargo moves at the largest U.S. ports.<sup>1</sup> Each emerging robotic application runs under a contract that names what the technology will deliver.

Data exfiltration risks, surveillance backdoors and the possibility of remote hijacking are regularly raised as concerns about robots and their associated commercial contracts. These concerns are legitimate. But giving priority to the question “who manufactured the robot” is evidence of thinking in terms of a 2010s threat model. Today’s pressing questions are about the data collected across all phases of operations and the fact that these rapidly expanding scopes, on the backs of autonomous platforms, will eventually, in aggregate, create high bandwidth, near real-time perceptions of all U.S. environments. This data collection and availability is not simply a function of intent; it is at its core a function of operation. Every physical-AI that moves to perform a task will perceive its environment. And every AI that perceives its environment produces a perceptual record, regardless of the task that it was actually hired to do.

In this piece, we refer to the operational relationship between what an autonomous robot perceives, where the perception flows, and what records result as the robot’s data "architecture". The architectural argument in this piece is that these structures and implicit sensitivities are determined by what the autonomous robot does, not by who built it or by the contracts that govern the deployments.

In December 2025, the FCC issued a National Security Determination blocking new authorizations for foreign-made aerial drones across categories including surveillance, transmission-line inspection, pipeline monitoring, post-storm survey, etc.<sup>3</sup> The FCC's reasoning rested on supply-chain and data-transmission risk applicable to every foreign-made unmanned aircraft regardless of mission. The architectural reasoning and risks for autonomous robots are similar to drones but run much deeper. In contrast to human-controlled teleoperated devices, perception data in autonomous systems is mandatory, continuous, and independent of the

mission. This makes operations of physical-AI structurally indistinguishable from intelligence-collection especially when foreign and foreign-influenced operating systems are ingesting the perception data.

### **The Architecture Produces the Exposures**

Robots in surveillance and security are the application categories that will draw the most OEM and AI-company commitment, not because the deployments are uniquely valuable but because they generate data at scale, and the unique fact that the data are collected on private property, outside of most consumer-data and public-space regimes. This is where the data architecture shows up first. The permission structure and operating environment make data capture in surveillance and security applications easier to scale than in any other category. In the AI industry, this is what is known as “the data flywheel” and more deployed robots means more training data, and more training data means models improve faster, and better models unlock broader deployment.

These surveillance and security applications are also where political attention has landed first. The same data collection conditions and sensitivities are present at the pipeline operator, the port authority, the state DOT and the major airport authority. All are deploying autonomous systems into critical infrastructure under the same architectural conditions and on timelines that are part of the coming surveillance and security wave.

But the records that feed these autonomous robot training pipelines are not unique to surveillance. Every deployed system generates an operations record that the manufacturer naturally wants to aggregate into the same architecture because this accumulated record is what gives the original equipment manufacturer (OEM) its next physical AI product and its competitive advantage.<sup>5</sup>

Within this architecture there are two streams of data to account for. The first data stream connects directly to the product or the service: the inspection records, the haulage logs, the security feeds, the inventory counts. These are the actual deliverables named in the contract. The second data stream is the operations record: the environmental maps, the personnel detection, the route memory, the acoustic signatures, the Bluetooth and WiFi device signatures the sensors pick up, and more. Together these elements include everything the system perceived in order to perform its deliverable, plus everything its sensors pick up as a function of simply existing. Robot OEMs then do three things with these two data streams.

The first output category is the deliverable. These items are named in the contract, evaluated in procurement, tracked on dashboards and accounted for in the operations budget. A pipeline inspection crawler delivers a wall-thickness map and a defect log. An autonomous haul truck

delivers tonnage moved. A substation patrol robot delivers thermal anomaly reports and intrusion alerts. An autonomous baggage tug delivers turnaround timing and bag-cart routings. A container straddle delivers cargo move counts and yard positions. These are the data the customer specified. The procurement officer has a clear view of it. The contract governs it and it is the part of the deployment that the customer fully understands and expects.

The second output category is training data. Every hour the deployed fleet operates, the robot OEM takes in what its systems perceive. A pipeline inspection crawler in West Texas improves the in-pipe locomotion and weld-recognition models for crawlers deployed in Alberta. The manufacturer aggregates data across its entire deployed fleet. The original customer paid for the work delivered in their own facility, but the operational improvements driven by OEM understanding compound and are deployed across the physical AI platform.<sup>6</sup>

The third output category sits at the manufacturer level. This is what the deployed fleet has observed and aggregated from every operating environment it ran through. Where the second output improved the manufacturer's models, this third record is the asset itself: equipment configurations across an industry, operational tempo across a sector, infrastructure layouts across a country, acoustic baselines, RF signatures, thermal footprints of an entire category of facility. The acoustic baseline distinguishes a specific compressor model in operation; the RF signature specifies a control-system protocol family; the thermal footprint indicates a specific transformer load profile. The human-behavioral subset of this category ranges from simple foot-traffic and facial recognition to heart rate and blood pressure metrics, all currently sold as commercial products.<sup>7</sup>

Boston Dynamics now markets fleet-management software (Orbit) that aggregates data from all of its deployment sites into centralized dashboards. The company also markets a consulting practice that draws on its test fleet and deployed robots to build bespoke machine-learning systems for customers. These separate offerings show the viability and value of turning these companies' accumulated records into services.<sup>8</sup>

Customers consent to this. Many service agreements grant the manufacturer training rights as a condition of deployment.<sup>9</sup> Every facility that hosts a robot contributes to collective AI training that the OEM owns. As a result, most of the third output category today sits as an unpriced asset on the OEM's books, and the customer of the AI has no default right to participate in the decisions about whether and how to productize this category of data.

The customer of the autonomous robot has no natural visibility into where the training data runs: what cloud infrastructure processes the data, in what jurisdiction, and under whose legal authority. The big three U.S. hyperscalers (AWS, Microsoft, Google) hold roughly two-thirds of

the global cloud infrastructure services market.<sup>10</sup> U.S. legal authorities can reach this data through several instruments. Subpoenas compel compute providers to produce information through the courts. The CLOUD Act compels providers to produce data they hold, regardless of where the compute sits.<sup>11</sup> National Security Letters can compel data from communication providers without judicial review. Other foreign states do the same.

Even an OEM operating in good faith does not control the full stack (the cloud service, the orchestration layer, the firmware, the silicon) beneath its product. The data collected by physical AI moves through layers the contracts do not name and the vendors cannot warrant. The same collected sensor data flows into the deliverables, and the training data, and the manufacturer's accumulated record. These three outputs are architecturally inseparable in their basic default design. On-device-only processing is technically possible; edge compute literature treats local inference on platforms like NVIDIA's Jetson as a mature deployment pattern.<sup>13</sup> But none of the major commercial OEMs yet offer it as a default.<sup>14</sup>

A parallel commercial market for these data also operates without subpoena. In 2024, the New York Times reported that General Motors had been transmitting per-trip driving behavior (hard braking, late-night driving, speeds above 80 mph, etc.) to data brokers LexisNexis and Verisk, who in turn sold the data to insurance companies who used it to set rates. Drivers only learned they had been tracked when their premiums rose or they ordered a LexisNexis report.<sup>15</sup> The parallel pattern in robotic infrastructure surveillance footage is straightforward: an auto insurer could purchase airport parking-lot footage that captures the entrance to a large adjacent sports bar, track which vehicles and drivers visit the bar, and price those people's policies from inferred behavior. The policyholders never know the footage exists. The same pathways will carry data to competitors, activist groups, and law firms literally building their own cases to book from observable patterns. The legal mechanism is one data on ramp; the market is another. The original customer of the physical AI services controls neither.

Three categories of exposure flow from this operations record: national security exposure to the country (the equipment configurations and operational tempo of every facility the autonomous robot fleet observed), commercial exposure to the customer (process intelligence and throughput patterns competitors would pay for), and personal privacy exposure to every individual the system perceived while operating (workers, contractors, members of the public). None of these depend on the system being deployed for surveillance or security. All three exposures flow simply from the system being deployed and "on."

## **The Ratchet**

This kind of architectural unfolding is not new. It is a recurring pattern in the history of surveillance technology. The pattern has a consistent outcome: major commercial surveillance capabilities deployed at scale for a narrow, defensible purpose often expand well beyond their original scope.

Two cases illustrate the pattern.

Amazon's Ring doorbell camera was originally deployed as a home security product. Amazon later launched the Neighbors app, aggregating footage from millions of Ring devices into a neighborhood surveillance network. Law enforcement agencies in more than 2,000 jurisdictions partnered with Ring to request footage through user-targeted requests rather than through warrant processes.<sup>16</sup> The architectural fact that matters is not the partnership with law enforcement. The issue is that a Ring camera records everything within view (visitors, houseguests, children, etc.), none of whom consented to being recorded by an Amazon-owned device or to having that footage stored on Amazon's servers. The data sits available for Amazon's business purposes and is subject to any legal instrument that compels third-party data disclosure.

Cell phone location data followed a similar trajectory. Wireless carriers collected location data for network management and billing. Data aggregators purchased this data from carriers and resold it to commercial buyers, including bail bond companies and bounty hunters. In 2018, a sitting Missouri sheriff was found guilty of using such a service to track a judge and fellow law enforcement officers.<sup>17</sup> No cell phone client consented to these downstream uses when they signed their original wireless contract. The data was collected for one original purpose, then monetized in dozens of others and regulation has not caught up.

Deployed robots will follow the same trajectory, faster and across the entire commercial robotics market. The data is richest in the security and surveillance segments where a continuous record of human movement, equipment-level detail and three-dimensional spatial coverage captures a massive amount of detail and variability. Every robot produces some form of this data structurally as a function of its baseline. A warehouse humanoid, a delivery vehicle, an inspection crawler and a patrol quadruped feed the same data architecture. The ratchet cannot go backwards. So the question becomes, how far the ratchet advances before governance catches up.

## **Exposures and Contemplated Legislation**

The American Security Robotics Act, introduced in March 2026 by Senators Cotton and Schumer, is the first federal bill specifically addressing unmanned ground vehicle systems in terms of national security.<sup>2</sup> It is a sound piece of industrial policy and a credible response to one

specific risk. Unfortunately, the bill is also a repeat of a recurring template where a government response to a legitimate threat is roughly one technology generation behind the operational reality, and probably one and a half generations behind where the commercially relevant frontier will be within the next 12-18 months.

The Cotton/Schumer bill prohibits federal procurement and operation of unmanned ground vehicles manufactured or assembled by entities controlled by China, Russia, North Korea or Iran (using "unmanned ground vehicle systems" as the regulatory term for autonomous ground robots). This is one subset of one risk (manufacturing) and is presented in the form of an individual category of physical devices (UGVs). The bill is silent on the broader questions dealing with the fact that most compute that powers physical AI today is increasingly delivered as a service and synchronized to the cloud because foundation-model-class robotics policies are usually too large to run entirely onboard the robot itself.

The national security framing also restricts foreign-built autonomous systems while permitting American-built ones to operate with the exact same data architecture. An American flag on the autonomous ground vehicle gets read as a guarantee about the data security of everything downstream of the device. This creates a projection of false security. A U.S.-manufactured chassis running a foreign-trained or foreign-hosted program is, from a perception-data exfiltration standpoint, indistinguishable from a foreign-manufactured chassis running a domestic policy. The bill bans the chassis, but doesn't say anything about the really interesting question: Which autonomy stack is the perception data actually flowing through?

The bill's industrial policy and supply chain objectives are sound, but another major gap is the fact that the bill does not speak to the obvious issue of foreign-trained models embedded in U.S. platforms. If Unitree the company is banned in the U.S., but Unitree's model weights and training data and policy infrastructure are acceptable for licensing by a U.S. OEM who then integrates those weights into a domestically manufactured chassis, then the bill as drafted is a false positive for U.S. national security.

In earlier work on compute sovereignty, I proposed SAAFE-7, a seven-dimension framework for evaluating risk and exposure in compute. The same framework's application to physical AI and the AI training stack is clear. Comparing the Cotton/Schumer bill against the framework's seven dimensions surfaces what the bill does and does not cover. The SAAFE-7 dimensions are power, data security, air-gap, physical isolation, supply chain integrity, jurisdiction alignment and trust. The Cotton/Schumer bill addresses one face of supply chain integrity: manufacturer origin. The bill is silent on everything else, even though each dimension has application with autonomous robotics in critical infrastructure. The current bill is not a partial solution to a seven-dimension problem. It is a complete solution to one face of one dimension.

## What to Do Now

This emerging procurement decision is not a security decision. It is a data lifecycle decision, and it applies to every autonomous system that is deployed (not just the ones marketed as "security" or "surveillance"). Every autonomous system generates a continuous record of the facility as a byproduct of operating within the facility. The contract on your desk decides who owns that record, where it is held, who can access it and what the vendor is permitted to do with the record. A contract that does not name these terms surrenders them by default.

Below are three actions to do, in order, for facility owners deploying autonomous robotic systems:

1. Audit the existing footprint within 90 days. Before negotiating the next contract, inventory the autonomous systems already deployed across your sites and pull the contracts that govern them. Most will be silent on the six terms below. Assign a single accountable owner (deputy GC or CISO with a procurement counterpart) and report findings to the board's risk committee. You cannot negotiate the next contract intelligently without knowing what you have already conceded in the prior ones.
2. Make two contractual provisions non-negotiable on every renewal and new agreement. These are the two that, if won, make the others enforceable:
  - a. **Operations record ownership.** You own everything the system observes in the course of operating at your facility, not only the deliverables you contracted for. The contract names the record explicitly and assigns title to the operator.
  - b. **Training rights.** The vendor may not use your facility's operations record to improve models deployed at other facilities (including peers and/or competitors) without an affirmative, scoped, time-limited license that you can revoke. Default is no.
3. Require four additional provisions and treat them as the negotiating range. A vendor that agrees to (1) and (2) but refuses these is telling you something.
  - a. **Compute and storage location.** Where data is processed, where it is held, which jurisdictions the pipeline touches at every layer.
  - b. **Manufacturer's accumulated record.** What the vendor may do with aggregated fleet data and what notice you are owed if that use changes.
  - c. **Retention and deletion.** Storage duration, deletion protocols, and what survives in derived models after the contract ends.
  - d. **Legal-compulsion access.** The conditions under which the vendor will share your data with government agencies — domestic or foreign — and the notice you are owed.

**A test for vendor architecture, not just vendor contracts.** Contract terms are only as good as the architecture behind them. A vendor that ships data sovereignty as a default (on-device-only processing as a real configuration option, training opt-outs the customer can actually exercise, jurisdictional disclosure as a standard datasheet field) is built for the regulatory environment that is arriving. A vendor that treats these as bespoke engineering work is built for the environment that is leaving. The architecture question is one your CIO should run in parallel with the procurement negotiation, not after it.

**Governance.** This is not procurement's problem to solve. The operations record is generated by operations, governed by IT and security, exposed by legal, and material to the board's risk committee. Institute a quarterly standing review that brings these four functions to the same table on every autonomous-system contract above a materiality threshold you set. The first meeting reviews the audit from action 1.

A vendor that will not agree to provisions (1) and (2) in the master agreement (not a side letter) is telling you which of the three outputs they are actually selling and which of those they expect to keep.

### **What This Means for OEM Product Strategy**

The provisions above are about to become procurement standard. The infrastructure operators that adopt them (and they will, on a calendar set by the Cotton-Schumer bill, the first state-level Physical AI Surveillance Act, and the first adverse court ruling on platform-collected data) will evaluate OEMs on a different set of dimensions than they did last year. The dimension that will matter is which of the three outputs an OEM's product architecture treats as the deliverable, which as a byproduct, and which as a strategic asset the customer was never told existed. Every OEM with a serious enterprise sales motion in the next 24 months (think Tesla, Figure, Apptronik, Agility, Boston Dynamics, and the next tier behind them) is answering that question now, whether they know it or not, in the master service agreement template that goes out with the next deal.

The strategic choice is whether data sovereignty is the default configuration or an opt-in feature. Default-on means the OEM has internalized the regulatory direction and built the architecture for it: on-device-only processing as a real option, training opt-outs the customer can actually exercise, jurisdictional disclosure across the stack, explicit handling of the manufacturer's accumulated record. Opt-in means the OEM is hedging (selling sovereignty as a SKU to the enterprise customers who ask for it while preserving the data flywheel that everyone else feeds).

The hedge is rational on a 12-month view and dangerous on a 36-month view, because the procurement standard, once it shifts, will not shift back.

The honest tension underneath is that the data flywheel is the moat. The operations record an OEM's fleet generates is what trains the next generation of model and the OEM that constrains that record at the buyer's request is constraining its own product roadmap. There is no clean answer. There is only the choice of which side of that tension your architecture is built around, and that choice, once embedded in the platform, is hard to reverse.

The OEM that has shipped a defensible answer in the default configuration has a story to tell in enterprise procurement. The OEM that has not is going to hear the question for the first time from a procurement officer who has read a piece like this one. The contract is the governance decision either way; the only question is who wrote it.

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