// WHY WE BUILT IT

Your building has been talking. No one is listening.

A history of how the building controls sector arrived at its current, stagnant state, and a description of the collaborative effort we envision to move us forward.

JUNE 2026

Every commercial building in this country is broadcasting its own health in real time. Compressors labor; pressures drift; coils freeze; motors draw more current today than they did last week. The equipment is telling you something is wrong long before the space gets hot, a customer complains, or a technician is dispatched on a Saturday at overtime rates.

We hear very little of it.

For the small fraction of buildings that can afford legacy controls, the signal reaches a server in a mechanical room and dies there—locked behind a JACE, a proprietary protocol, and a service contract designed to keep the data in and the owner out. For the overwhelming majority of the commercial building stock in North America, there is no signal at all. The owner finds out the equipment failed when someone notices the store is hot, or the grocer discovers the walk-in cooler thawed overnight and the morning crew throws out the inventory.

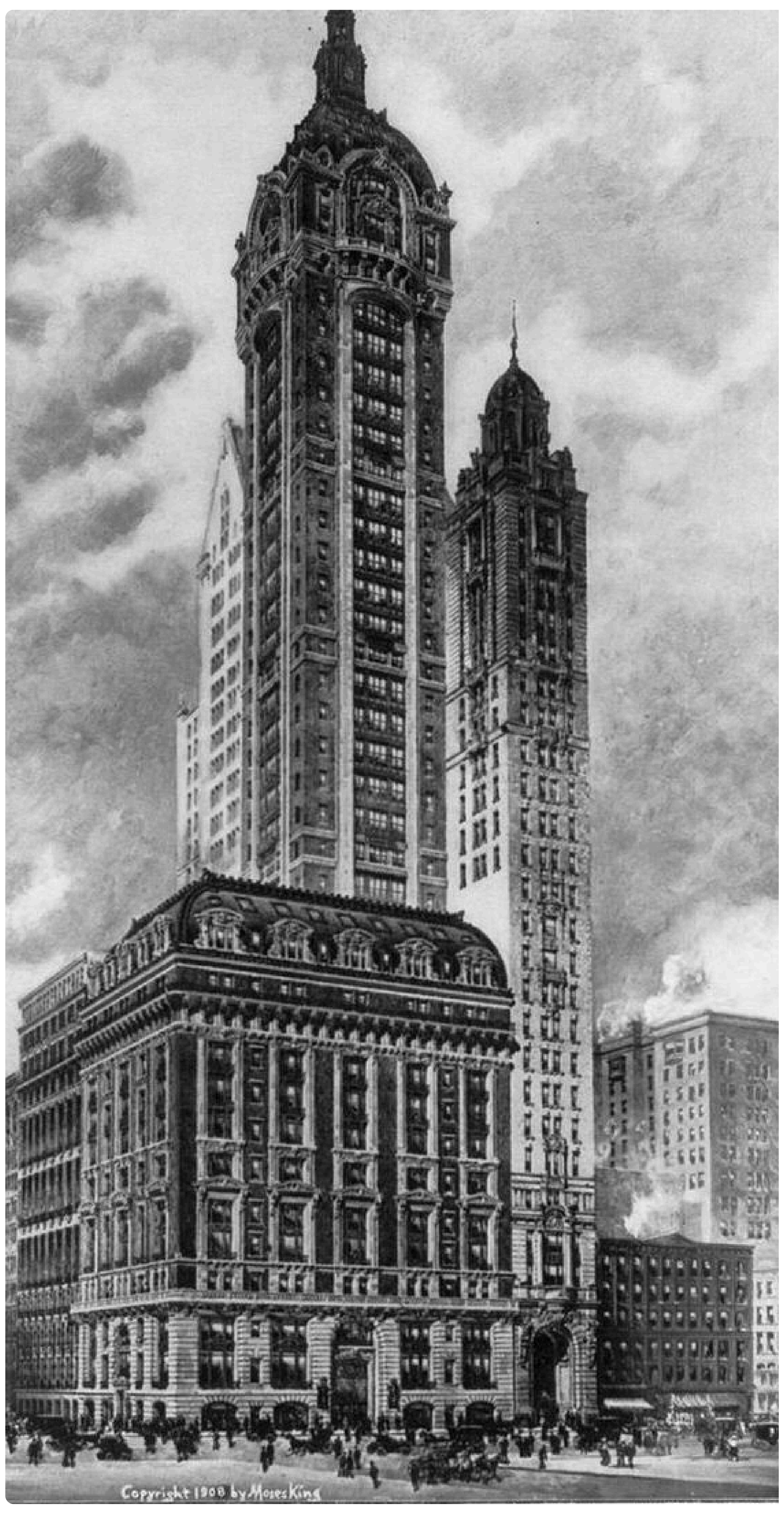
This is not a technology problem. The sensors are cheap; the microprocessors are cheap;the cloud is cheap. This is a business-model problem wearing a technology mask, and it has been one for four decades.

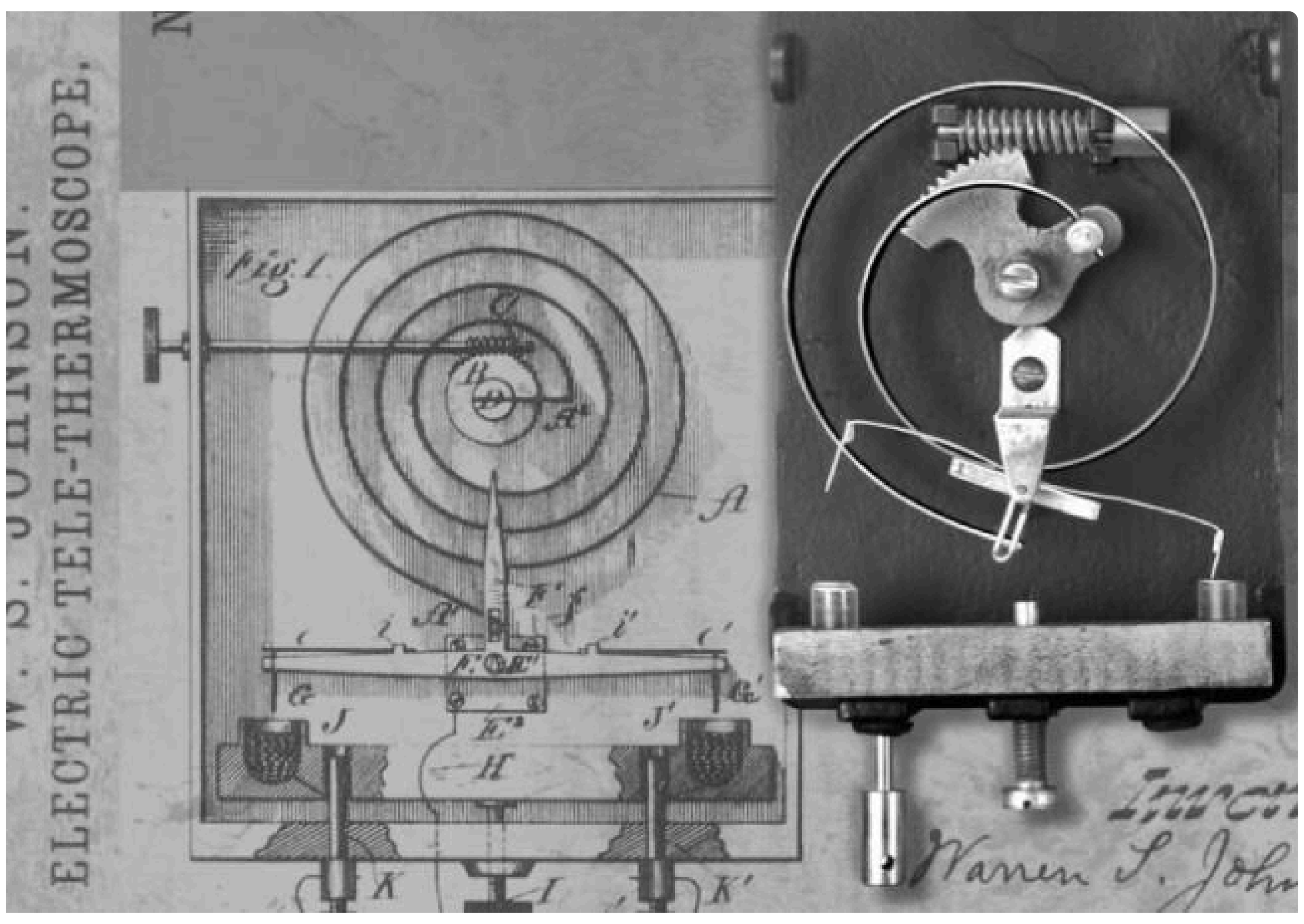
It's time to take the mask off.

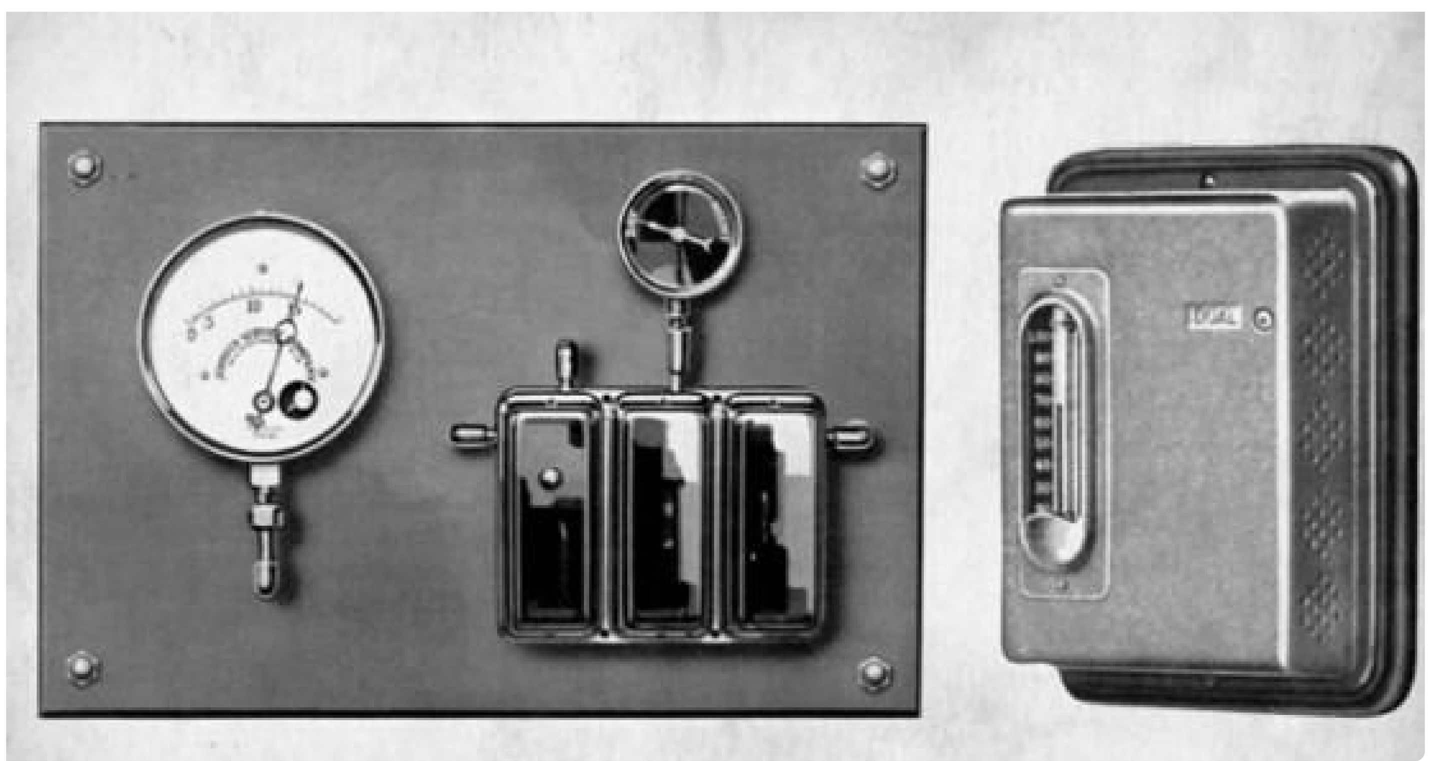
How we got here

The story of building controls started with a single idea that was radical in 1883 but has hardly been improved upon since: if you put a sensor in a room and wire it to a valve in a boiler, the building will regulate itself.

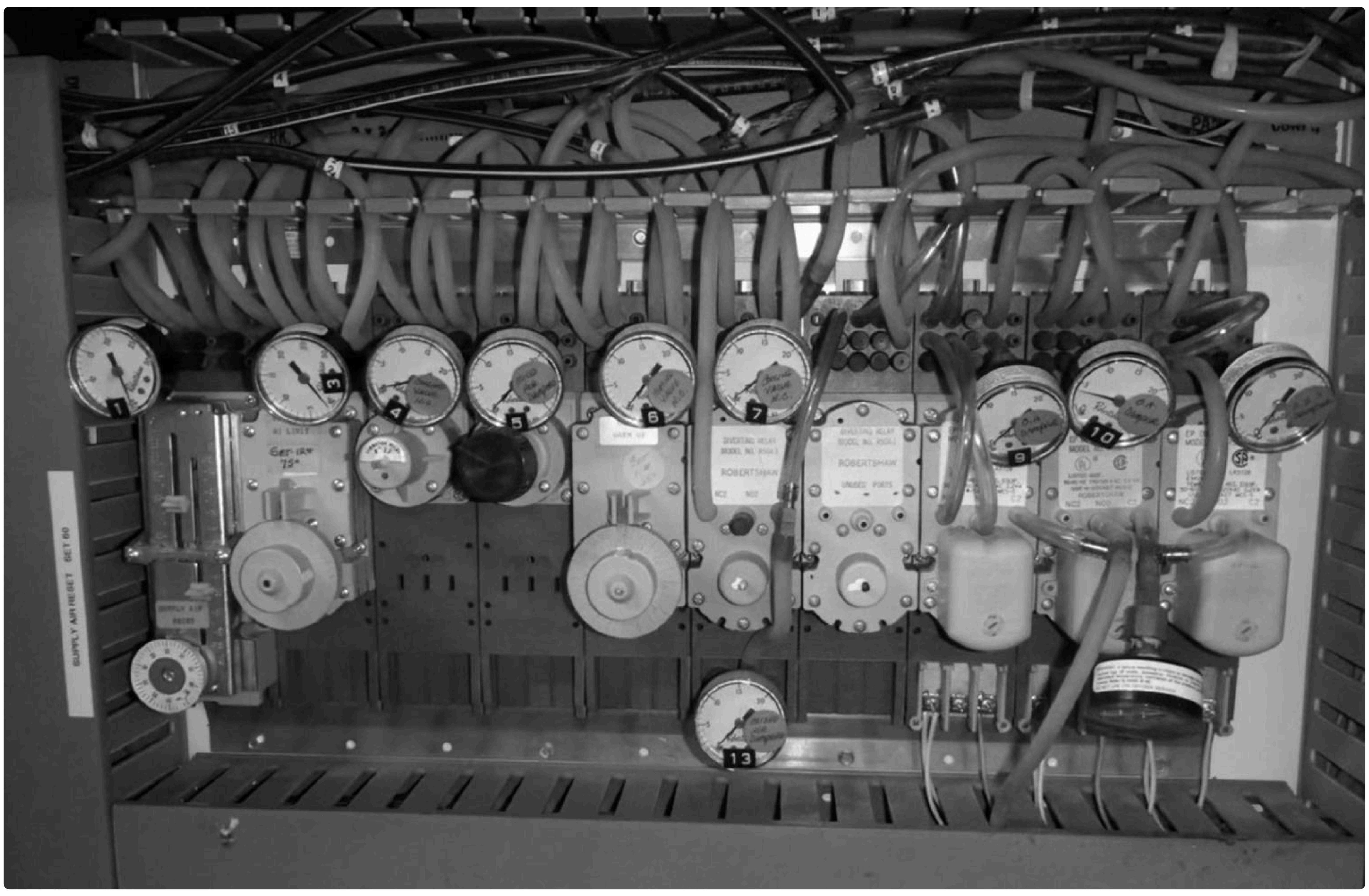
That idea belonged to Warren S. Johnson, a professor at the University of Wisconsin. He was frustrated by a janitor who interrupted his class every hour to check the classroom temperature and adjust the basement furnace, and he spent three years in his laboratory solving the problem. In 1883 he received his first U.S. patent for what he called the "electric tele-thermoscope"—a sealed bimetal element connected to a small pool of mercury, closing an electrical circuit when the room got cold and opening it when the room got warm. Two years later he and the Milwaukee hotelier William Plankinton founded Johnson Electric Service Company to manufacture it. By 1895, Johnson had a pneumatic version of the device—compressed air instead of electricity—and with it the first commercially viable multi-zone temperature control system in the world. It was installed in the U.S. Capitol, the Smithsonian, the New York Stock Exchange, West Point, and Andrew Carnegie's home. It worked well enough that when the Singer Building went up in Manhattan in 1908, the tallest building on earth at the time, it was fitted with 1,200 Johnson thermostats controlling 1,800 valves.







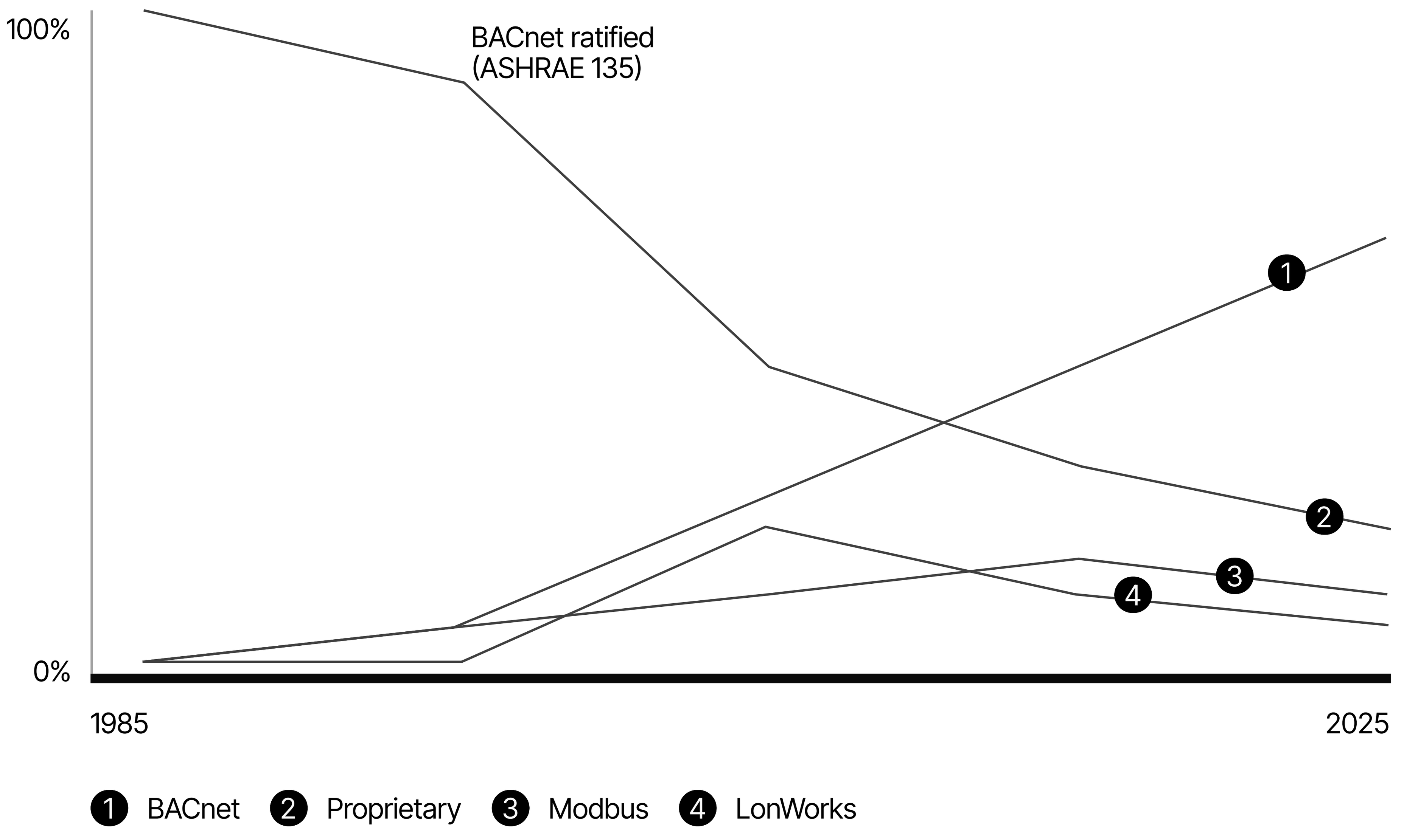
For 70 years following Warren Johnson's patent, pneumatic controls ran commercial buildings in America. Compressed air is reliable, inherently fail-safe, and easy to both understand and troubleshoot. Walk into a downtown office building in the United States today, and a surprising number still have operational pneumatic systems threading through the plenum, with 3 to 15 psi signals controlling dampers and valves exactly as Johnson intended.



The first crack in the pneumatic monopoly opened in 1968 when Honeywell introduced the Series 16, an early commercial Direct Digital Control (DDC) system. In 1972, Johnson Controls shipped the JC/80, the first minicomputer dedicated to building control. Through the late 1970s and into the 1980s, microprocessors became small enough and cheap enough that DDC could move from the experimental edge to commercial viability. By the mid-1990s, DDC was cheaper than pneumatic and the industry migrated rapidly.

The protocol wars

Pneumatics has a common signal: air pressure. With DDC however, there was no shared language. Every new DDC vendor invented its own wire format. Honeywell had one. Johnson Controls had another. Siemens, Trane, Automated Logic, Andover, Delta—each established its own language, which meant a building owner who bought from one vendor was stuck with that vendor forever. The industry papered over the incompatibility with three open standards. BACnet, developed under ASHRAE and ratified in 1995; LonWorks, developed by Echelon; and Modbus developed by Modicon. None completely dislodged the incumbents. They became, in practice, just more protocols a contractor had to learn.



Protocol Share of New BAS Installations (1985-2025)

- **1985:** Proprietary 100%, BACnet 0%, LonWorks 0%, Modbus 0%
- **1995:** Proprietary 90%, BACnet 5%, LonWorks 0%, Modbus 5% - BACnet ratified as ASHRAE 135 this year
- **2005:** Proprietary 45%, BACnet 25%, LonWorks 20%, Modbus 10%
- **2015:** Proprietary 30%, BACnet 45%, LonWorks 10%, Modbus 15%
- **2025:** Proprietary 20%, BACnet 65%, LonWorks 5%, Modbus 10%

Share of newly commissioned DDC/BAS installations, directional estimates. Sources: ASHRAE 135 ratification (1995); Building Operating Management protocol survey (2011); Optigo Networks market analysis (2025); Frost & Sullivan BAS protocol tracking. Pre-1995 share is proprietary by definition — no open standard existed. Figures exclude overlap (buildings often run more than one protocol at the same time).

Even 30 years later, proprietary formats still account for roughly one in ten new installations, and the largest "open" winner—BACnet—sits on top of a stack where the actual control logic, the alarming engine, and the data historian are still, in practice, locked inside whichever vendor installed the JACE.

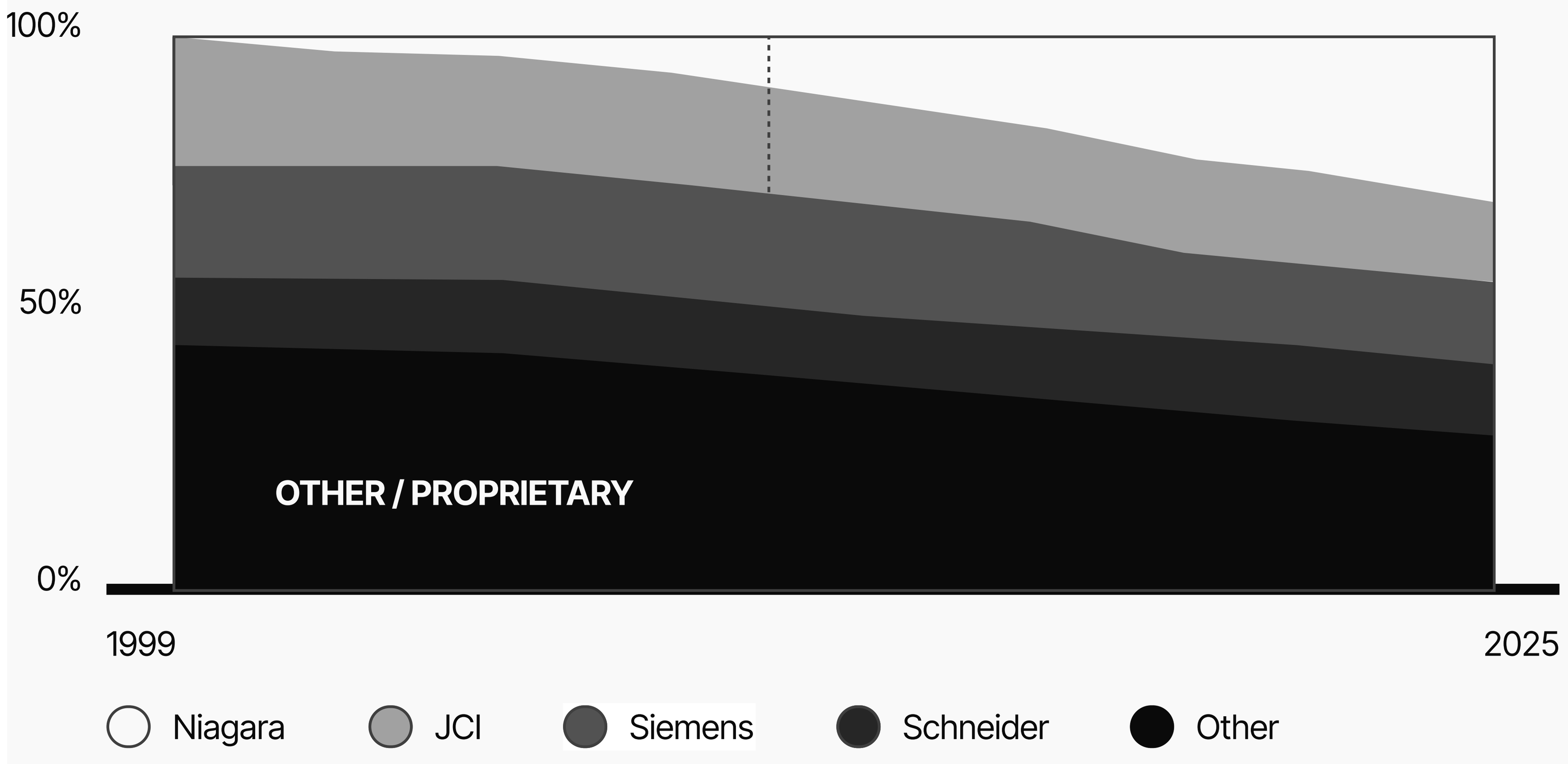
Open at the wire level. Closed everywhere that matters.

One framework to rule them all

What broke the stalemate was software. In 1999, a small company in Richmond, Virginia called Tridium shipped the Java Application Control Engine (the JACE), a hardware controller that sat in the mechanical room, spoke BACnet, Modbus, and LonWorks, as well as whatever proprietary protocol the existing panels used, and pushed the whole thing up to a web-based operator interface. By 2005, there were more than 35,000 Niagara instances in the field (Niagara is the operating system utilized by the JACE hardware platform). Honeywell acquired Tridium, the developer behind Niagara, that year. Today, Niagara is the de facto operating framework of commercial building automation worldwide, with every major vendor shipping some branded flavor of it running on some branded version of JACE.

This is the current state of the industry for buildings sophisticated enough to have a BAS at all: the illusion of transparency. The protocols are nominally open, but the alarming engine, the data historian, and the control logic remain locked inside whichever vendor installed the hardware. Thirty years after the industry agreed in principle that interoperability was a good idea, the arrangement is largely unchanged.

Share of New Installations (Niagara Growth vs. Proprietary Full-Stack BAS)



Sources: "About Tridium (corporate timeline)" - Tridium (Honeywell), 2025
https://www.tridium.com/us/en/Learn/about-us/about-tridium

A 30-year loop

Look carefully at this history and a pattern emerges. Every 30 years, the industry replaces its hardware and keeps its business model intact. Pneumatic valves became digital controllers, which became networked controllers, which gave way to web-enabled controllers, which transformed into cloud-enabled controllers. The interfaces improved, while smart thermostats and Fault Detection and Diagnostics (FDD) systems bolted themselves on as additional layers. The underlying commercial arrangement, however, persisted: a controls project is specified by a consulting engineer, bid to a pool of certified contractors, installed over weeks by journeymen pulling wire, commissioned point-by-point by a programmer, and maintained in person, for the life of the building, by the contractor who installed it. The data lives on a server in a basement. The service is billed by the hour.

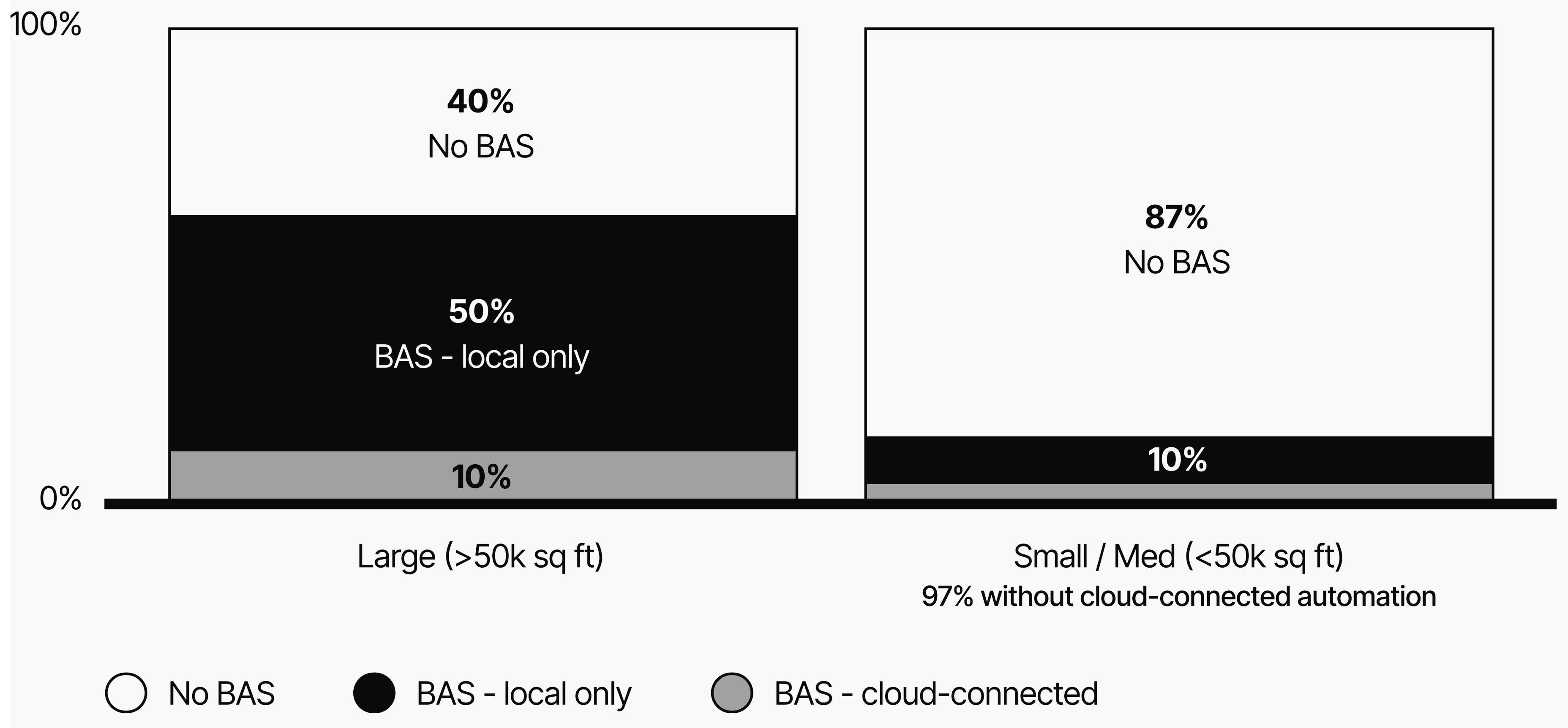
This is not a critique of the people who built that model. It reflects the economics and technology available at each stage of the industry's development. But it has produced a structural outcome that now deserves clear description: a commercial arrangement that was designed around wire, certification, and billable hours has found ways to survive each successive wave of technology that should have made it obsolete.

The cost of flying blind

Today, this paradigm has created a tale of two cities in the built environment. The buildings fortunate and sophisticated enough to justify the cost, in both finances and time, of a sophisticated building automation system have installed them and reaped the benefits. The rest of America's commercial properties must make do with a system not much more advanced than the one Johnson patented more than a century ago.

Research published by the National Renewable Energy Laboratory (NREL) and the Joint Institute for Strategic Energy Analysis (JISEA) in 2022 found that while nearly 60% of U.S. commercial buildings over 50,000 square feet have a Building Automation System (BAS), only 13% of small and medium commercial buildings, defined as those under 50,000 square feet, have adopted the technology. [3] Small and medium buildings represent the overwhelming majority of the U.S. commercial building stock. To spare you the math: more than 75% of the entire commercial building stock operates without meaningful automated intelligence.

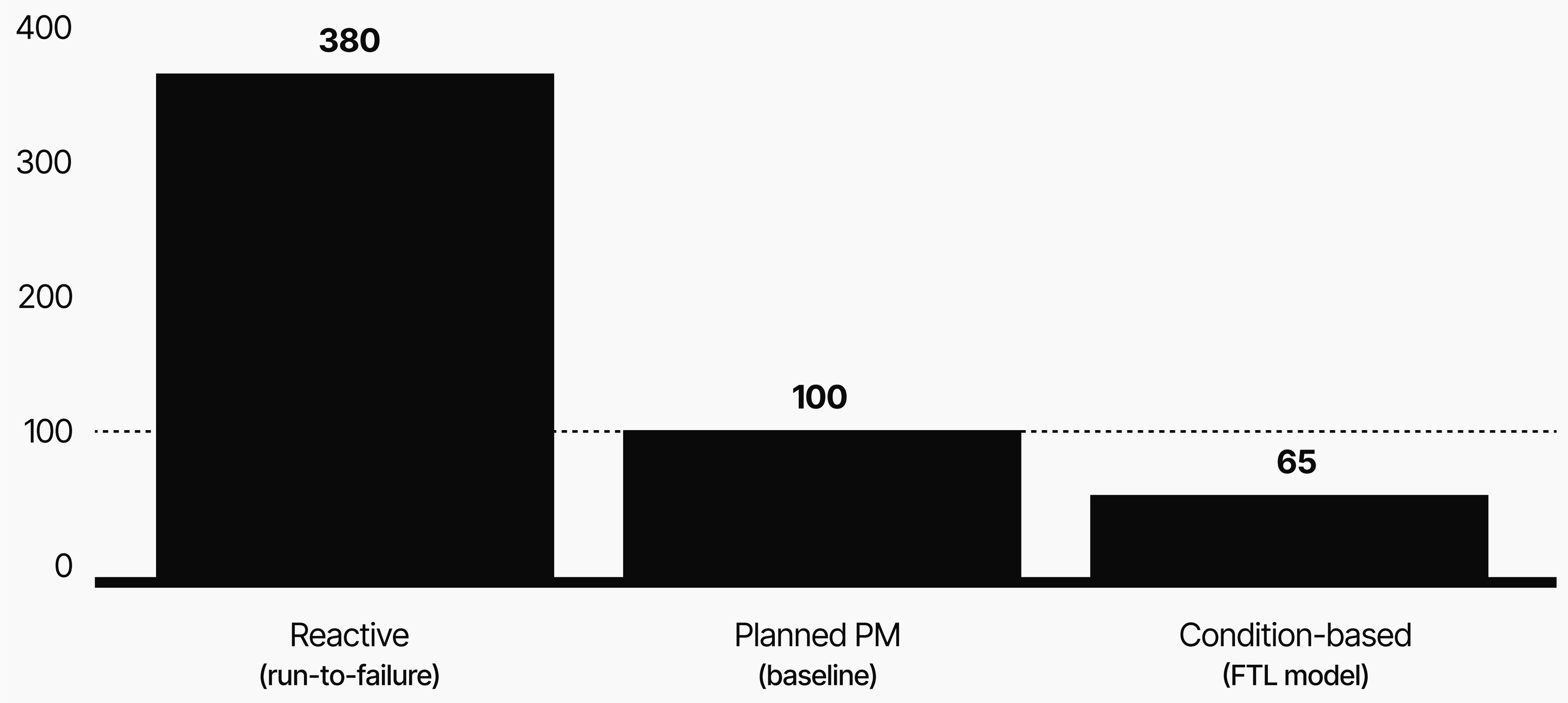
Share of U.S. commercial buildings by size class. Split by: no BAS / BAS local-only / BAS cloud-connected.



Sources: NREL/JISEA (2022); 360 Research Reports (2024); Memoori (2023).

The cost of operating in that unserved majority is not a matter of comfort or preference. The U.S. Department of Energy's Federal Energy Management Program (FEMP) calculates that reactive maintenance costs between three and five times more per event than planned preventive maintenance for equivalent equipment types. [4] The differential compounds through emergency call-out premiums, which typically run 20-50% above standard scheduled rates; the expedited procurement of unanticipated parts; the secondary damage that accumulates when primary system failures go undetected; and the operational disruption, lost revenue, tenant dissatisfaction, and food spoilage losses in refrigerated applications that accompany any unplanned outage of meaningful duration.

Relative cost per event by maintenance strategy. Planned preventive maintenance = 100 (baseline).



Sources: U.S. DOE FEMP O&M Best Practices Guide; PNNL Maintenance Approaches (2024).

For a facilities manager responsible for a multi-site commercial portfolio, the aggregate effect of operating in reactive mode is substantial. BOMA International's 2022 Office Market Study calculated that the U.S. commercial office building sector alone accounts for $137 billion in direct annual operating expenditure, [5] a figure that excludes retail, healthcare, and industrial properties. Even a conservative improvement in the ratio of planned to reactive work across the full commercial stock would represent savings running into the tens of billions annually.

Even for the buildings with the money for advanced control systems, they operate as lighthouses of data in an otherwise barren wasteland. They compose too little of the typical service provider's portfolio, and are too difficult to connect to due to their bespoke, custom design, that data never makes it past a dashboard into the hands of the professionals who actually need it. The luckiest facility manager, running a portfolio of highly sophisticated buildings instrumented with the most cutting edge controls, still needs to manually translate this data into work orders for their network of service providers.

The price of entry

Why has the unserved majority remained so? The primary answer is cost. A traditional BAS installation, depending on the building, runs between $2.50 and $7.00 per square foot, figures drawn from a 2016 Intel study that remain accurate benchmarks in 2026. [6] For a 20,000-square-foot retail store, that rule of thumb produces an installation bill between $50,000 and $140,000, before the annual service contract.

What makes this cost structure particularly notable is its stability in the face of significant component price deflation. A 32-bit microcontroller, the core computational unit of a device like a JACE, averaged around $5.00 in 2006. Industry data from IC Insights places the equivalent component at under $1.00 by 2015 and below $0.35 today. [7] The National Bureau of Economic Research found that microprocessor prices fell at an average of 43% per year between 2008 and 2013. [8] Sensors, radios, memory, and connectivity chips followed comparable trajectories.

And yet, the installed price of a building automation system has not followed a similar downward trend. The hardware got cheaper and the system got more expensive. Such an outcome is only possible when pricing has detached from the cost of the underlying components and attached instead to licenses, certifications, engineering hours, and the value of the proprietary data access that comes bundled with the installation. The NREL/JISEA study confirms this directly, finding that 50 to 75 percent of BAS system costs now come from labor rather than hardware. [3] The barrier to the unserved 75 percent of the market is not technology. It is the cost structure of an industry that lacks a compelling reason to alter its (very profitable) approach.

Three islands of data

For the buildings that do have some monitoring infrastructure, a second structural problem compounds the first. The data that a building generates about its own condition is distributed across three repositories that have, for reasons more historical than rational, remained almost entirely disconnected from one another.

01 — BUILDING DATA
Real-time sensor readings: temperatures, pressures, run times. Held on local controllers that nobody accesses until something breaks.

02 — ASSET RECORDS AND METADATA
Make, model, serial numbers, warranties, manufacturer's manuals, technical specifications, and engineering documentation. Scattered across spreadsheets, binders, filing cabinets, and manufacturer portals that require a separate login to access.

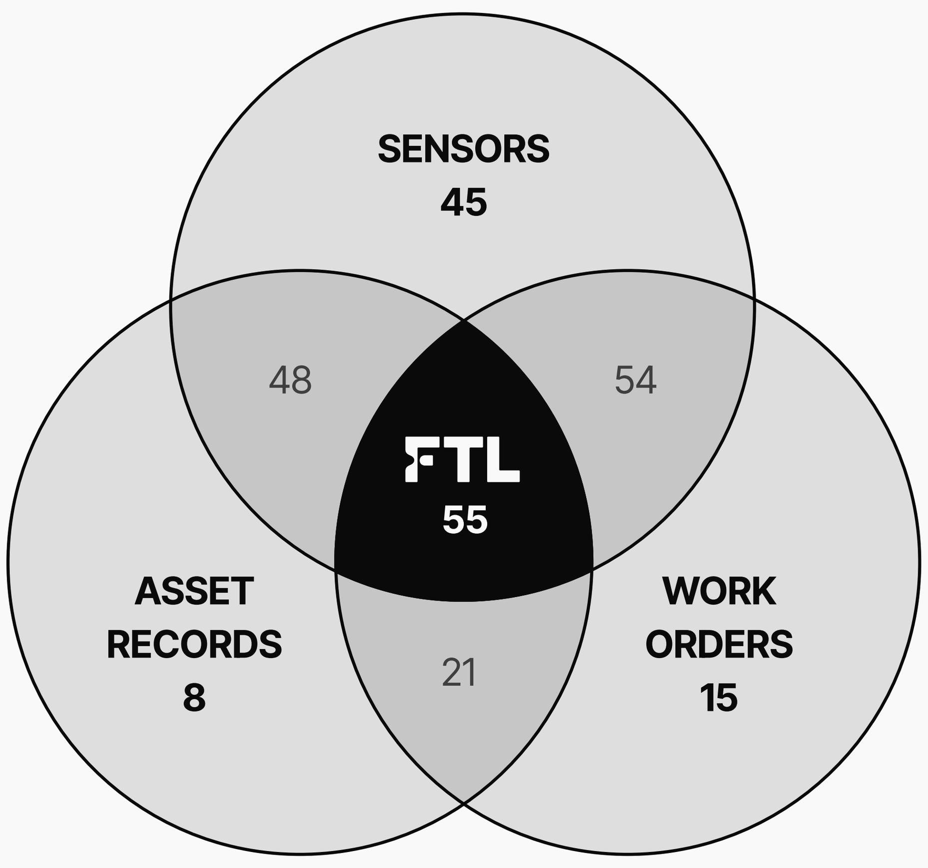
03 — WORK ORDERS
Repairs, maintenance logs, parts history, Service Level Agreement (SLA) terms, and Not To Exceed (NTE) rates. Trapped in a separate system with no visibility of real-time parts availability or pricing, and no connection to what the equipment is actually doing right now.

The first island is the building's operational sensor infrastructure. Modern heating, ventilation, and air conditioning (HVAC) equipment, commercial refrigeration systems, and electrical panels generate continuous streams of data about their own condition: supply and return air temperatures, compressor suction and discharge pressures, refrigerant charge status, run times, energy consumption, and fault codes, among many other parameters. In buildings without automation systems, this data is lost completely. In systems where there is a controls system, its bespoke construction by hyper-localized controls integrators means points need to be manually mapped to make the system functionally across a multi-site portfolio

The second island is the asset record, which extends beyond basic identifiers to encompass manufacturer's manuals, technical specifications, and engineering documentation. This information is the essential interpretive context for any reading from the first island: a compressor discharge pressure reading means something qualitatively different on a 5-ton package unit versus a 20-ton chiller, with different parts needed for repair.

The third island is the work order history: the accumulated record of every maintenance event, repair, and inspection the building's systems have experienced. Work orders carry with them the commercial framework within which that work was conducted; the SLA terms governing response times and resolution standards; and the NTE rates defining the financial ceiling of any given job. A technician dispatched without access to the applicable NTE, or without visibility of real-time parts availability and pricing, is being asked to manage a job's scope and cost exposure from memory and guesswork. The work order system is typically housed in a Field Service Management (FSM) platform or Computerized Maintenance Management System (CMMS) that has no connection to either of the first two islands.

Three data islands. Alone, each delivers limited insight. Integrated, they multiply. Operational Insight by Data Source:



Each source alone:
limited insight.

All three integrated:
operational intelligence.

Illustrative scale 0-100.
Values directional.

Source: FTL internal framework. Venn diagram - illustrative / directional values. Redundancy factor 0.9 (pairs), 0.81 (triple).

The smart thermostat industry and the FDD category each made genuine progress in addressing parts of both the cost problem and the data isolation problem, and the industry owes them credit for proving the market. Smart thermostat companies including Nest, ecobee, Pelican, and others did real work getting connected hardware onto the walls of small and medium buildings. But while a smart thermostat can tell you the space is three degrees too warm, it cannot tell you the compressor is drawing 30% more current than it did last month, or that the condenser fan bearing is beginning to degrade, or that the walk-in cooler holding half your inventory is approaching failure at eight o'clock on a Friday night.

FDD companies built genuinely good analytics on top of existing DDC infrastructure. But a dashboard is the beginning of the job, not the end. The facilities manager still has to read it, interpret it, and decide whether to act, then open a separate work order management system, retype what they found, estimate an NTE without data, and pick a vendor from a list. Every handoff in that chain leaks time and money. Fault detection without automated dispatch is a suggestion not a solution.

The industry has spent forty years adding layers. FTL was built to replace the foundation, and let everyone build upon it.

Putting building data to work

FTL is built on two core theses:

1. Wireless controls with open protocols can make solutions affordable enough to connect the majority of commercial buildings.
2. Connecting the three islands of data, then surfacing insights from this combined database to the users who need them most, will allow these connected buildings to make the industry radically more efficient.

Instrumenting the underserved majority of commercial buildings will be a team effort, and to that end we are working on an open-source wireless protocol. We hope that just as Niagara allowed an explosion of instrumentation in the top 5% of buildings 30 years ago, our solution can enable IoT and sensor manufacturers around the world to do the same, at much more affordable rates.

Solving the second problem is more difficult, and it's where we are focusing the majority of our efforts. We call our solution Facilities Triage. It aggregates data from the three islands and applies a triage logic to it. Instead of focusing on presentation of raw readings, it uses logic to identify patterns that carry operational significance, ranks them by urgency, and expresses it in language that a non-specialist can understand and act on. Moreover, it is designed to close the loop between the decision to act and action itself, by automatically converting that intelligence into a work order that routes to the appropriate person for approval. The platform has been built for deployment in buildings with no existing automation infrastructure and those with pre-existing infrastructure alike, using open-source, wireless sensor hardware that requires no proprietary wiring and no specialized commissioning.

The distinction between presenting data and acting on it is, in FTL's view, the central design question the building services technology industry has failed to answer for the past two decades. The proliferation of Internet of Things (IoT) monitoring platforms through the 2010s produced a generation of dashboards: interfaces that aggregated sensor readings without taking any position on what those readings meant or what ought to be done about them. The operational burden of turning data into decisions was transferred from the equipment to the facilities manager, who now received more information but no additional intelligence.

At FTL, we firmly believe that mere awareness isn't action. A dashboard that requires you to be the intelligence layer hasn't finished the job.

The existing model has failed every individual involved in the commercial building industry — from the tenants to the property owners. In particular, though, it has underserved the people most often tasked with solving the problem: facility managers and skilled service technicians.

Data is only effective when it is used to enable the people who do the work.

The facility manager

Most facilities managers are overseeing a constantly growing portfolio of properties with a dwindling number of resources. They're usually managing these buildings remotely, often with no technical on-site resources. If they lack a BAS entirely, they usually only discover an issue when a tenant or store manager has been uncomfortable long enough to contact them. By the time that call arrives, the fault is already a problem and the emergency service rate is already in play.

Conversely, if they are among the fortunate 25% of buildings with a BAS, they are drowning in data. Each building presents them with a multitude of alerts, and across a portfolio of properties, managing and parsing all of that data becomes nearly impossible. Distinguishing between information that requires action and data that merely needs to be logged is so challenging that they end up in the same position as the facility manager without a BAS: waiting for the phone to ring.

Facilities Triage disrupts this dichotomy by offering a third option. It reads the building continuously, identifies actionable faults, and raises the work order automatically. The brief already exists by the time the facility manager opens their laptop. This means they know an issue exists before the site does, allowing them to proactively develop a solution prior to a complaint or before the problem becomes an emergency.

The skilled service technician

While the facility manager has to manually sort through piles of data (if they have a BAS), the technician has no access to data at all. To make matters worse, they often show up at a job without knowing where the equipment is located, who their contact is, and what the nature of the issue is.

The HVAC specialist, the refrigeration engineer, the commercial electrician; these are the individuals through whom virtually all maintenance and repair of commercial building systems is ultimately mediated. Whatever a monitoring platform detects, whatever a facilities manager decides, the work of physically addressing a building fault is performed by a technician who travels to a location, accesses the equipment, diagnoses the condition, and carries out the repair. The industry's narrative about smart buildings has consistently positioned the technician as a downstream beneficiary of intelligence generated for the benefit of building operators.

FTL takes a different view: the technician is not the last step in a chain of information transmission. The technician is the whole point.

That conviction is not merely a design principle. It is a response to the most significant structural challenge the facilities industry faces. JLL's April 2026 skilled trades research found that by 2030, an estimated 2.1 million skilled trades positions in the United States could go unfilled, with the U.S. Department of Education projecting potential economic losses of up to $1 trillion annually if the shortage persists. [9] Last year alone, nearly 600,000 skilled trades positions were posted in the United States; only around 150,000 new workers entered the field through apprenticeship programs. Some 39% of U.S. facilities managers are over the age of 55, compared to 28% across the general workforce. [9]

The industry is going to have fewer people fixing buildings every year for the foreseeable future. A business model that requires a certified human to drive to a mechanical room to read a screen is structurally exposed to that reality. The only sustainable response is to make every technician in the field dramatically more effective, and that requires giving them the right information before they leave the shop rather than after they arrive on site.

The first principles of Facilities Triage

Building an ecosystem that enables wireless controls at affordable costs, provides open source software to connect the majority of commercial buildings to the cloud, then provides this data in an actionable form to facility managers and technicians isn't easy. That is why we will focus on the following as we build our solution:

The right output is action, not awareness. The end product of smart building technology should be a work order, sent to the right person, with the correct information already attached. A screen to watch is not a finished job.

Buildings need a check engine light, not a data center. When a car's engine is failing, it does not present a dashboard of 1,200 data points and expect the driver to interpret them. It turns on a single light, and a technician plugs in a tool that reads the code. Buildings should work the same way.

The technician is the whole point, not the last mile. Before they even get in in their truck, they should know the underlying data of the fault and have a probable fix in mind. That change compounds across every technician, every provider, and every building they serve, unlocking massive efficiency gains.

Operational intelligence should not require a specialist to run it. A facility manager overseeing 50 stores should have the same early warning as a hospital with a dedicated engineering team. The barrier was never the technology; it was the complexity layered on top of it.

Alerts, not Alarms. Providing alarms for every sensor that is out of spec results in too much data to process and causes alarm fatigue, preventing that data from being acted upon. FTL will consolidate multiple sensor readings into alerts, rolled up to the asset level or higher.

Protocols should be open, always. The market FTL is entering has been constrained for a generation by vendors whose model depends on keeping data inaccessible. FTL will not be one of them. The customer's equipment data belongs to the customer. The controls protocol will be published as open source.

For this solution to work, we need to increase connected buildings from seven percent to greater than 50 percent. This can only happen when assets are connected at a price that can be approved without a board meeting and can be justified within a few months of operation. That is why we are building a wireless open protocol, and it's also why we can’t do this alone.

Help us create the buildings of tomorrow

If you have read this far, you care deeply about the future of buildings and the hard-working technicians who keep our economy running. This section is for you.

Our goal is to connect as many buildings as possible, as quickly as possible, to tools that make the people who maintain them more effective. We are honest enough with ourselves to know that we cannot do that alone.

The U.S. commercial building stock is something on the order of six million buildings. Even at full scale, FTL will not instrument even a small fraction of them. We do not want to. A category is not a company; a category is an ecosystem, and an ecosystem needs more than one participant to matter. The check-engine light on a car became useful because every manufacturer agreed on what the port looked like and what the codes meant. The internet became useful because TCP/IP was free. The buildings that need to be connected outnumber any single vendor's capacity to connect them, and the industry has spent 40 years learning the hard way what happens when vendors try anyway. We do not intend to repeat that mistake.

This is why, in the next few months, we are publishing our wireless device protocol as open source. Any manufacturer will be able to build a device that speaks the FTL protocol. Any service provider will be able to install one. Any integrator will be able to pull the data into any system they choose. We will not charge a royalty, we will not gate the specification behind a membership fee, and we will not require certification to use it. We want to make it as easy for a sensor manufacturer to ship an FTL-compatible device as it is today to ship a Zigbee or BACnet one — with the crucial difference that the data, by default, is transmitted wirelessly over long ranges. If you make building automation hardware or software and you have ever wanted a cleaner way to surface real equipment health to the people who actually fix it, come build with us.

To the legacy controls manufacturers: we know how this looks. A new entrant publishing an open protocol is, historically, the thing that precedes a long painful margin compression for the companies that sell the closed one. We would rather that not be the story. The installed base you have built over decades is real, the engineering talent inside your companies is real, and the relationships your integrators have with building owners are real. None of that goes away in a world where the small and medium commercial market finally gets connected. If anything, it grows. We would like to work with you on the interoperability layer — to make your existing JACE-based installations first-class citizens in a wireless world and a Facilities Triage workflow, to give your customers a path into the 95% of their portfolios that you have never been able to economically serve, and to retire, together, the parts of the current model that no one is proud of defending.

To the smart thermostat companies and the FDD companies: you have done the hard work of teaching the market that a building can be connected and that its data is worth looking at. We would not be here without the road you paved. But the market you taught is now asking for something you were not built to provide: equipment-level health, not occupant comfort; actionable insights, not another dashboard — and we would rather meet that demand alongside you than past you. Integrate with our workorder layer. Ingest our hardware telemetry. Build Facilities Triage into the products your customers already use. The addressable market here is much bigger than the zero-sum fight we would otherwise be forced into.

To the service providers: this is your decade. The entire industry is running out of skilled hands at exactly the moment when the buildings those hands maintain are becoming more complicated and older. Every truck roll you avoid, every minute of diagnostic work you do remotely, every time your technician arrives at a site already knowing what is wrong — that is margin you keep and a career your best people are willing to stay in. We want our tools in the hands of every service company in the country that shares that goal, and we will give them to you on terms that reflect the fact that our success is mutual.

To the facility managers and building owners: we know what it is like to play a never-ending game of telephone and still end up with no information about what is wrong or a timeline to fix it. It does not have to be that way. Pilot with us. Push us. Tell us the integration we are missing. The only way we can earn the trust this industry has taught you to withhold is to do the work in public, in your buildings, against the numbers that actually matter to you.

And to the engineers, designers, operators, and installers who have looked at this industry and thought t*his is broken, and it does not have to be* — this is your invitation. Whether you work at one of the incumbents, one of the new entrants, a service company, a utility, a real-estate owner, or a start-up that is not yet born, we want to meet you. Bring us a sensor you want to make compatible, a workorder system you want to integrate, a building you want to instrument, or a problem you want to solve.

In 1883, Warren Johnson was so frustrated by a janitor climbing the stairs every hour that he built the first thermostat in the world and, with it, an entire industry. He could not have imagined that 143 years later, most of the buildings in America would still be waiting to be heard. The building has been talking ever since. It is time — all of us, together — to listen.