

THE SCIENCE THAT CHANGED THE WORLD

*Volume Two — The Connected World: Sixteen Inventions
That Wired Us Together, Now in the Public Domain*

By

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INDEPENDENT PUBLISHER

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Publisher: Independent Publisher

ISBN Placeholder

TABLE OF CONTENTS

Introduction — The Fence That Comes Down	4
Part One — The Web Becomes a Place	8
The Page Built Just for You	9
Surviving the Crowd	13
The Internet's Gatekeeper	17
Part Two — Working Together at a Distance	21
Sharing a Screen Across the World	22
The Meeting Inside the Browser	25
Data That Follows You	28
Part Three — The News That Finds You	31
The News That Came to You	32
Channels of Metadata	35
The Watchers on the Page	38
Part Four — Owning the Bits	41
Locking the Digital Lock	42
What's On	46
The Advert Meant Only for You	49
Part Five — The Connected Home and Beyond	52
Making the Gadgets Talk	53
Music in Every Room	56
Streams Without End	59
Information That Knows Where You Are	62
A Note on the Method	66

INTRODUCTION — THE FENCE THAT COMES DOWN

Behind every ordinary miracle of the connected age there is a document almost nobody reads.

It is dry, defensive, and written in a language built to survive lawyers rather than to be understood. It talks about "a first server means" and "a plurality of client nodes" where you or I would say the website loaded. It numbers its sentences. It repeats itself on purpose. It is a patent — and it is the closest thing we have to the birth certificate of an invention.

A patent is a bargain struck with time. In exchange for telling the world exactly how your invention works — publishing it, in full, for anyone to read — the state grants you twenty years to be the only one allowed to make it. Twenty years to earn back the risk, the failures, the burned venture capital, the nights spent proving the

thing worked at all. And then, on a specific and unremarkable morning, the clock runs out and the second half of the bargain quietly completes itself: the monopoly ends, the fence comes down, and the invention becomes the property of everyone, forever.

This book is about that morning — and about the strange, fast, world-remaking decade in which most of these inventions were made.

The first volume of this series told the story of medicine. This one tells the story of connection: how, in the space of a few years around the turn of the millennium, a planet of separate computers, televisions, telephones, and stereos was wired together into a single humming nervous system. Each of the sixteen chapters tells the story of one invention that helped do it — the web page built fresh for every visitor, the meeting held inside a browser, the news that came looking for you, the digital lock that decided who could play a song, the music that followed you from room to room. In every case the twenty years are up. The secret has been given away. What one company guarded and licensed and fought over in the courts is now common ground.

I did not choose these sixteen by taste. They were chosen by the data.

Every patent records which later inventions cite it, and that citation count is a rough but honest measure of how heavily the world leaned

on an idea. I took a database of expired patents in communications and networking, ranked them by that number, stripped out the near-duplicates so that each chapter is a distinct breakthrough, and kept the ones with both a high impact and a story worth telling. The citation counts at the head of each chapter are real. So are the patent numbers, the companies, and the expiry dates. Many of the companies in these pages no longer exist — swallowed, bankrupted, or forgotten — which is itself part of the story. In the gold rush of the early internet, the pioneer very rarely kept the gold.

A word on what this book is and is not. It is not a technical manual, and nothing in it is professional advice. The explanations are written for a curious general reader, and where I have had to choose between precision and clarity I have usually chosen clarity. For any serious purpose, the patents themselves — all freely readable now — are the primary source.

We spend our lives on the near side of these inventions, using them without a thought — the page that loads in an instant, the video call that just works, the playlist that fills the house. This is a chance to walk around to the far side: to see how each was made, and by whom, and how often the maker lost everything to whoever came next. And to notice the quiet moment when an invention that wired the world together was handed, at last, to us.

Nobody rings a bell on the day a patent expires. The fence just

comes down, and almost no one looks up.

Let us look up.

PART ONE — THE WEB BECOMES A PLACE

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CHAPTER 1

THE PAGE BUILT JUST FOR YOU

Anchor patent: US 6,826,565 — "Method and apparatus for serving files to browsing clients." Ablaise Limited, filed 2002, granted 2004. Cited by 2,116 later inventions. Entered the public domain in 2022.

The earliest web pages were, quite literally, files. A person wrote a page of text marked up with a few formatting instructions, saved it as a file on a computer somewhere, and when you visited that address the computer handed you back that exact file — the same one, character for character, that it handed to everyone else. The web was a library of fixed documents. To change what a page said, someone had to sit down and rewrite the file.

That model could not survive contact with what people wanted the web to become. A shop cannot pre-write a separate fixed page for every product, every price change, every customer's basket. A news

site cannot hand-edit a file every time a story updates. A bank cannot store a pre-made page showing your balance. The moment the web stopped being a library and started being a place where things happened, the fixed file became a straitjacket.

BUILDING THE PAGE ON THE FLY

The idea that broke the straitjacket is so ordinary now that it is invisible: build the page fresh, on demand, at the moment it is requested. Do not store finished pages at all. Instead, store the ingredients — the current data in a database, and a template describing how to lay it out — and when a visitor arrives, combine the two on the spot to generate a page made just for that request, that person, that instant. The page for your shopping basket has never existed before you asked for it and will never exist again after you leave.

US 6,826,565, titled with deliberate blandness "Method and apparatus for serving files to browsing clients," describes exactly this: dynamically generating the content sent to a browser by combining stored data with formatting templates, rather than serving pre-made files. It is the mechanism beneath every website that is not a static brochure — every shop, every social feed, every search result, every dashboard. Which is to say, very nearly the entire modern web.

THE PATENT THAT PUT THE WEB ON NOTICE

There is a sharper edge to this particular story, and it is part of why it matters. The company that held this patent, Abtase, became well known not for building websites but for asserting the patent against those who did — sending letters to companies whose sites generated pages dynamically, which by then was almost all of them. Whatever one thinks of that, it is a vivid illustration of the power of a foundational patent: when a single document can plausibly be read to cover the basic way modern web pages are made, its owner sits astride an enormous toll road. More than two thousand later inventions cite it, a measure of how central the underlying idea became.

AND THEN THE FENCE CAME DOWN

The patent expired in 2022. The basic method of generating web pages on the fly from a database and a template — the thing that turned the web from a library into a living place — is now common property, free from any toll.

In truth the technique had long since become so universal that no one could imagine the web without it; a great many people used it every day without knowing anyone had ever claimed to own it. That is often how these stories end. The idea becomes the air everyone breathes, the ownership becomes an awkward historical footnote,

and then the clock quietly runs out and even the footnote closes. The page built just for you now belongs to everyone who builds pages.

CHAPTER 2

SURVIVING THE CROWD

Anchor patent: US 5,774,660 — "World-wide-web server with delayed resource-binding for resource-based load balancing on a distributed resource multi-node network." Resonate Inc., filed 1996, granted 1998. Cited by 1,683 later inventions. Entered the public domain in 2016.

Every popular website faces the same impossible-sounding problem: how does one address serve millions of people at once? When you type in the name of a giant site, there is no single computer at the other end straining to answer you and everyone else simultaneously — no machine on earth could do it. Behind that one name sits a whole farm of computers, and something has to decide, for each of the millions of incoming requests, which machine should handle it. Get that decision wrong and the site slows to treacle or collapses entirely under the weight of its own popularity. Get it right,

invisibly, millions of times a second, and the site simply works, and no one thinks about it at all.

That deciding is called load balancing, and it is one of the quiet miracles that holds the internet up.

WAITING TO LEARN WHAT YOU WANT

The naive way to share the load is to hand each incoming request to the next machine in turn, round and round, like dealing cards. It works, up to a point, but it is dumb: it assumes every machine can answer every request equally well, and that every request costs the same. Resonate's insight was subtler. Its system delayed the decision — it waited, just a moment, to learn what resource the visitor was actually asking for before choosing which server should handle it. Because it knew what was wanted, it could send the request to a machine that specialised in exactly that, or that had it ready, rather than blindly to the next in line. Servers no longer had to each hold a complete copy of everything; they could divide the work, and the balancer would route each request to the right place based on what it was for.

US 5,774,660 — the "delayed resource-binding" load balancer — protects this idea of routing by content, of holding off the decision until you know enough to make it well. It is a small change in timing with a large change in consequence: it let websites scale not by

making every machine do everything, but by letting machines specialise and sending each visitor to the right one.

THE INVISIBLE FOUNDATION

You have never seen this working, and that is the point. Every time a vast site absorbs a sudden surge — a breaking news story, a ticket release, a viral moment — without falling over, something descended from this idea is at work behind the name, quietly steering the flood to where it can be handled. More than 1,600 later inventions cite it, tracing the lineage of intelligent traffic-steering that keeps the large-scale internet standing.

AND THEN THE FENCE CAME DOWN

The load-balancing patent expired in 2016. The technique of routing web requests intelligently by what they ask for is now in the public domain.

Like much of the internet's plumbing, this is invisible infrastructure — nobody markets it, nobody outside the trade can name it, and yet the connected world would sink without it. That such foundational plumbing is now free matters most to the people building the next generation of it: the students, the start-ups, the engineers in places far from Silicon Valley, all of whom inherit a proven way to hold a website up under a crowd, at no charge and with no permission

required.

CHAPTER 3

THE INTERNET'S GATEKEEPER

Anchor patent: US 5,793,763 — "Security system for network address translation systems." Cisco Technology, Inc., filed 1995, granted 1998. Cited by 664 later inventions. Entered the public domain in 2015.

There is a small deception running quietly inside almost every home and office on the planet, and without it the internet as we know it could not exist. The internet identifies every device by a number — an address — and in its original design there were not nearly enough of those numbers to go around. There are billions of phones, laptops, televisions, thermostats, and doorbells wanting to be online, and the old addressing scheme simply did not have billions of addresses to give them.

The trick that saved the day is called network address translation,

and it works by letting a whole household or company hide behind a single public address, like an entire office sharing one street address while a receptionist sorts the post. Inside, each device has its own private number; at the boundary, a device translates between the crowd of private numbers within and the single public number the outside world sees. It is elegant, and it is why your home full of gadgets can share one connection.

THE DANGER AT THE BOUNDARY

But that boundary — the place where the private inside meets the public internet — is also precisely where danger enters. If the translating device simply passes traffic both ways, then the whole wild internet can reach into the private network behind it, probing and attacking the devices that were supposed to be hidden and safe. The very mechanism that let everyone share an address created a doorway that had to be guarded.

Cisco's patent, US 5,793,763, is about guarding that doorway: a security system for address translation that lets the private network reach out to the internet freely, while blocking unwanted traffic from reaching back in uninvited. It combined the addressing trick with a set of adaptive rules about what may and may not cross the boundary — permitting the ordinary machinery of the internet to function while shutting out the unsolicited and the hostile. In doing so it drew, in effect, the shape of the modern home and office firewall: the

friendly gatekeeper that sits between your devices and the open internet, letting your traffic out and turning strangers away.

THE COMPANY THAT WIRED THE WORLD

Cisco is not a name most people think about, but for decades it built a staggering share of the machinery through which the internet's traffic actually flows — the routers and switches that pass your data, hop by hop, from wherever you are to wherever you are going. That a company so central to the internet's plumbing also helped define how that plumbing keeps the household safe is fitting. The patent has been cited hundreds of times by those who built the security that everyone now takes for granted.

AND THEN THE FENCE CAME DOWN

The patent expired in 2015. The approach it protected — securing the boundary where a private network meets the public internet — is now common property.

Network security is a field that never stands still, and the specific mechanisms have long since grown far more sophisticated than anything in a patent from the 1990s. But the foundational idea, of a smart, adaptive gatekeeper at the edge of the private network, sits now in the public domain, part of the shared groundwork of everyone who builds the defences that keep the connected world

safe.

PART TWO — WORKING TOGETHER AT A DISTANCE

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CHAPTER 4

SHARING A SCREEN ACROSS THE WORLD

Anchor patent: US 5,761,419 — "Remote collaboration system."
NCR Corporation, filed 1996, granted 1998. Cited by 2,215 later
inventions. Entered the public domain in 2016.

For as long as people have worked together, they have needed to look at the same thing at the same time — to gather around one drawing, one document, one plan, and point at it and argue over it. The office was, among other things, a machine for putting people in front of the same surface. When work began to spread across cities and countries and time zones, that simple act — look at this, here, with me — became suddenly, absurdly difficult. You could describe a screen down the telephone. You could post a printout. But you could not both be looking at the same living document, watching the same cursor move, seeing the same change appear.

The invention in this chapter is the one that let a screen be shared across the world.

ONE PROGRAM, MANY WATCHERS

The idea sounds simple and was not. Take a single program running on one computer — a drawing, a spreadsheet, a slideshow — and let people at other computers, anywhere, see its screen and take part, marking it up with annotations that everyone can see, jointly controlling the one underlying application. The program runs in one place; the view and the interaction are shared everywhere. What each person sees is the same live surface, and what one person does upon it, the others watch happen in real time.

US 5,761,419, NCR's "remote collaboration system," describes exactly this arrangement: software that lets remote users jointly view and annotate a shared display, with one part of the system running on every participant's computer to translate their inputs into shared marks, while the actual application runs on a single host. It is the ancestor of an entire category of tools we now use without a second thought — screen sharing, the shared whiteboard, the remote presentation where everyone sees the slide advance at once. More than 2,200 later inventions cite it, a measure of how fundamental "let me show you my screen" turned out to be.

THE OFFICE WITHOUT WALLS

It is hard, now, to feel how strange this once was. The idea that a group of people scattered across a continent could gather around a single document as easily as around a table — that a colleague could say "watch this" and simply show you, live, whatever was on their screen — quietly dissolved one of the oldest constraints on how people work. The shared screen did not just make remote work possible; it made it feel almost like being in the same room, which is a far higher bar and the one that actually matters.

AND THEN THE FENCE CAME DOWN

The patent expired in 2016. The basic method of sharing and jointly annotating a screen across a network is now public property.

By the time it expired, the world had been thoroughly remade by the thing it described. A generation had grown used to working together without being together — and then, when circumstances forced almost everyone to do so at once, the technology was simply there, mature and universal, its origins forgotten. The screen shared across the world belongs now to everyone who shares one.

CHAPTER 5

THE MEETING INSIDE THE BROWSER

Anchor patent: US 6,654,032 — "Instant sharing of documents on a remote server." WebEx Communications, Inc., filed 1999, granted 2003. Cited by 2,308 later inventions. Entered the public domain in 2019.

The previous chapter let people share a screen. This one asks a harder question: what if you did not have to install anything at all? What if a meeting — with its shared documents, its many participants, its live back-and-forth — could simply happen inside the web browser everyone already had, hosted on a distant server, with nothing to set up and nothing to send around beforehand?

That question defined an era of work, and WebEx was the company that answered it most influentially.

THE DOCUMENT THAT LIVES ON THE SERVER

The core move was to put the shared thing not on any one participant's computer, but on a server in the middle that everyone connects to. You want to show a document to a dozen people in six cities? Do not email it around and hope everyone opens the same version; place it on the remote server, and let all twelve view and interact with it there, together, in real time, through their browsers. The meeting has a place, and that place is not anyone's desk — it is a machine in the middle that all of them reach at once.

US 6,654,032, "Instant sharing of documents on a remote server," protects this arrangement: real-time collaborative viewing and interaction with shared documents, hosted centrally, so that geographically scattered people can work on the same material during a live session without passing files back and forth. It is the beating heart of web conferencing — the shared document, the shared session, the meeting that exists in the cloud rather than in any room.

THE CLOUD, BEFORE WE CALLED IT THAT

There is a larger idea hiding in this one, and it turned out to be the defining idea of an age: that the important thing should live on a server somewhere and be reached through a browser, rather than living on your own machine. We would later call this "the cloud" and

build much of the modern software economy on it. But you can already see its shape here, in a patent about sharing a document during a meeting: don't send the thing to everyone; put the thing in the middle and let everyone come to it. More than 2,300 later inventions cite this patent, tracing the rise of web conferencing and, more broadly, of software that lives on the far side of a browser.

AND THEN THE FENCE CAME DOWN

The patent expired in 2019. The method of hosting a shared document on a remote server for a live, multi-person session is now in the public domain.

The world would shortly discover just how much it depended on this idea, when circumstances made the meeting-in-the-browser not a convenience but a necessity for hundreds of millions of people at once. By then the founding patent had already lapsed, its technique long since woven into the fabric of ordinary working life. The meeting that lives in the cloud belongs now to everyone who calls one.

CHAPTER 6

DATA THAT FOLLOWS YOU

Anchor patent: US 6,233,617 — "Determining the visibility to a remote database client." Siebel Systems, Inc., filed 1999, granted 2001. Cited by 2,327 later inventions. Entered the public domain in 2019.

Here is a problem that sounds dull and turns out to be everywhere. A great central database holds everything a company knows — every customer, every order, every account. Out in the world are hundreds of people who need pieces of that information: the salesperson on a train, the engineer at a customer's site, the manager on a laptop in a hotel. They cannot each carry the whole database; it is far too large, and much of it is none of their business. And they are often disconnected — on that train, in that basement, on that flight — unable to reach the central store at all. So each carries a partial copy, a slice of the whole, and works on it offline.

And now the hard question: when they reconnect, whose changes go where, and who is allowed to see what? How does the central database decide which slice of itself each remote worker should have, and keep all these partial, wandering copies honest and in step?

DECIDING WHO SEES WHAT

Siebel Systems built its business on customer relationship management — the software that tracks a company's dealings with the people it sells to — and that business lived and died on exactly this problem. Its salespeople worked on the road, often offline, each needing their own relevant portion of a vast shared database and needing their changes to flow back correctly when they returned to the network. US 6,233,617, "Determining the visibility to a remote database client," addresses the heart of it: a system of rules that decides which updates from the central database should be propagated out to each partially-replicated remote copy, and thus what each remote client can see and hold.

Put plainly, it is the machinery that lets your data follow you — that gives each mobile, sometimes-disconnected worker their own correct, permitted slice of a shared whole, and reconciles everyone's changes when they come back into contact. It is unglamorous and it is fundamental; more than 2,300 later inventions cite it.

THE SHAPE OF MOBILE LIFE

This is one of those inventions whose descendants you touch constantly without noticing. Every time an app on your phone holds its own copy of your data, works while you are offline, and then quietly syncs back up when you have signal — your notes, your email, your files, your messages — you are living inside the problem this patent set out to solve. The reconciliation of scattered, partial, sometimes-disconnected copies of a shared truth is the invisible condition of mobile life, and the rules for deciding who sees what are its beating heart.

AND THEN THE FENCE CAME DOWN

The patent expired in 2019. The method of deciding what slice of a central database each remote client may see and hold, and of keeping the scattered copies in step, is now public property.

The world of disconnected-then-reconciled data that this patent helped define has become simply the water we swim in — every synced app, every offline-capable service, every device that holds its own copy and catches up later. That the foundational logic of it now sits in the public domain is a quiet gift to everyone building the next generation of software that must, above all, follow its user wherever they go.

PART THREE — THE NEWS THAT FINDS YOU

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CHAPTER 7

THE NEWS THAT CAME TO YOU

Anchor patent: US 5,740,549 — "Information and advertising distribution system and method." PointCast, Inc., filed 1995, granted 1998. Cited by 2,045 later inventions. Entered the public domain in 2015.

In the early web, information sat still and waited. If you wanted the news, the weather, a stock price, you went and fetched it — you opened a browser, typed an address, and pulled the page toward you. The web was a place you visited. Nothing on it ever came looking for you.

PointCast inverted that. Its idea, dazzling and slightly maddening in its time, was that the information should come to you — that your computer, while you were not using it, should quietly reach out across the network, gather the news and headlines and stock quotes

you cared about, and display them to you unasked, scrolling across your idle screen like a personal news ticker. You did not go to the news. The news arrived.

PUSH, AND THE SCREEN THAT TALKED TO YOU

This was the birth of what everyone soon called "push" — content pushed out to you rather than pulled in by you — and PointCast was its briefly dazzling star. US 5,740,549, an "information and advertising distribution system," describes the machinery: a system that automatically delivers selected news and advertisements to a subscriber's computer, filtered by what the user has said they care about, and displayed on the idle machine, with the content sorted into categories so that advertising could be matched to interest. Read that description again and you will notice it contains, in embryo, two of the most powerful and fateful ideas of the connected age: content that comes to you unbidden, and advertising targeted to your declared interests.

More than 2,000 later inventions cite this patent. Its fingerprints are on every notification that lights up your phone, every feed that refreshes itself, every headline that appears without your asking — the whole vast apparatus of a world that no longer waits for you to come and look, but comes, insistently, to find you.

THE PIONEER WHO FLEW TOO CLOSE

PointCast is also one of the great cautionary tales of the early internet, and this book would be dishonest without it. For a moment it was the hottest thing on the web, reportedly courted for acquisition at a spectacular price it chose to refuse. And then it fell, and fell hard — its push of content proved a heavy burden on the slow networks of the day, users tired of the clutter, and the company that had invented the future was gone almost as quickly as it had arrived, its name a byword for the bubble. It invented push and could not survive it. The idea, however, was exactly right; it simply arrived a decade before the phones and the networks that would make it irresistible.

AND THEN THE FENCE CAME DOWN

The patent expired in 2015. The method of pushing selected, interest-filtered information and advertising to a user unbidden is now common property.

By then the world PointCast glimpsed had arrived in full — a planet of glowing screens forever lighting up with news that came looking for its readers. The company that first built it was two decades gone, but its founding idea had conquered everything, and now it is free. The news that comes to you belongs to everyone now.

CHAPTER 8

CHANNELS OF METADATA

Anchor patent: US 5,862,325 — "Computer-based communication system and method using metadata defining a control structure." InterMind Corporation, filed 1996, granted 1999. Cited by 1,716 later inventions. Entered the public domain in 2016.

The previous chapter was about content coming to you. This one is about the quiet, clever layer beneath that: not the content itself, but the description of it — the data about the data, or metadata — that lets computers arrange to send and receive information automatically, without a person managing each exchange.

It is an abstract idea, and InterMind's expression of it was ahead of its time to the point of being hard to explain even now. But its shadow falls across a great deal of how the connected world actually works.

DATA ABOUT THE DATA

Imagine you want your computer to automatically receive updates from somewhere — a source of news, a friend's page, a company's announcements — and to keep receiving them, correctly, as they change, without you managing each transfer by hand. For that to work, the two computers need to agree on a structure: what is being sent, how often, in what form, and what the receiver should do with it. That agreement — the control structure, expressed as metadata that travels alongside or ahead of the content — is what lets the whole exchange run itself.

US 5,862,325 protects exactly this: a communication system in which metadata defines a control structure that coordinates automated information transfer between a provider and a consumer across a network. In plainer words, it is a way of packaging up "here is what I will send you, and how, and what to do with it" so that machines can subscribe to sources of information and keep themselves updated automatically. If that sounds like the idea beneath web feeds, subscriptions, and the endless automated syncing of the modern internet, that is because it is a close cousin of them. More than 1,700 later inventions cite it.

THE PLUMBING OF SUBSCRIPTION

Almost everything you subscribe to now runs on some descendant of

this idea. When your podcast app fetches new episodes on its own, when a site's updates flow into a reader, when one service automatically keeps itself in step with another, there is a layer of metadata underneath doing the coordinating — describing the structure of the exchange so that no human has to stand over it. It is invisible by design; the whole point is that it runs itself. Intermind saw, early and clearly, that the connected world would need this layer, and staked out a foundational claim on it.

AND THEN THE FENCE CAME DOWN

The patent expired in 2016. The idea of using metadata to define and automate the structure of information exchange between computers is now in the public domain.

Intermind, like so many of the companies in this volume, did not survive to see its vision become universal. But the layer it described — the quiet metadata plumbing that lets machines subscribe, update, and coordinate without us — became one of the load-bearing walls of the connected age. And now it is common property, free for everyone building the automated, self-updating systems that increasingly run the world on our behalf.

CHAPTER 9

THE WATCHERS ON THE PAGE

Anchor patent: US 5,796,952 — "Method and apparatus for tracking client interaction with a network resource and creating client profiles and resource database." Dot Com Development, Inc., filed 1997, granted 1998. Cited by 1,675 later inventions. Entered the public domain in 2017.

Of all the inventions in this book, this is the one whose consequences are most double-edged, and it deserves to be told plainly.

When you read a page in a book, the book does not read you back. It does not note how long you lingered, which paragraphs you reread, what you skipped. For all of history, the things we read and looked at were silent about us. The web changed that, quietly and completely, and this patent is one of the places where the change was written down.

THE PAGE THAT READS YOU BACK

The idea is simple to state and enormous in effect: as a person interacts with a web page, watch them. Record what they do — what they click, how long they stay, where they go, what draws them and what they ignore — and store it. Do this across many pages and many visits, and you can build up a profile: a growing portrait of a person assembled from the trail of their behaviour, held in a database and refined with every visit.

US 5,796,952 describes exactly this: a method for tracking a user's interaction with a network resource, and using that record to build client profiles and a database of behaviour. Embed a piece of tracking code in a page, and it quietly reports back how the visitor behaves, and that behaviour becomes data, and the data becomes a profile. It is, in a single early patent, the seed of web analytics, of behavioural advertising, of the entire economy that would come to be built on watching what people do online and selling the resulting knowledge. More than 1,600 later inventions cite it.

THE BARGAIN WE DID NOT QUITE MAKE

It is worth being honest about what this invention set in motion. On one side, it made the web measurable, and therefore improvable: sites could learn what worked, fix what confused people, and offer things a visitor might actually want. On the other, it built the

foundation of surveillance advertising — the pervasive, mostly invisible tracking of billions of people across the web, the assembling of profiles most of us never asked to have made, the quiet conversion of our attention and behaviour into someone else's data and someone else's money. Both of those worlds grew from the same root: the page that reads you back. This book's job is not to judge it, but it would be a poor history that pretended the trail of behavioural data was an unmixed blessing. It was, and remains, a genuine bargain with genuine costs, and most of us were never really asked.

AND THEN THE FENCE CAME DOWN

The patent expired in 2017. The basic method of tracking user behaviour on a network resource and building profiles from it is now common property.

Long before it expired, this idea had become the default condition of the web — so universal that the surprise, when people learn of it, is not that it exists but that anyone ever thought to own it. The watchers on the page are everywhere now, and the founding technique of watching is free. What we choose to do about that — how much watching we permit, and on what terms — is one of the defining questions of the connected age, and it is a question the expiry of a patent does not answer. It only reminds us that the tool is now everyone's.

PART FOUR — OWNING THE BITS

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CHAPTER 10

LOCKING THE DIGITAL LOCK

Anchor patent: US 5,892,900 — "Systems and methods for secure transaction management and electronic rights protection." Intertrust Technologies Corporation, filed 1996, granted 1999. Cited by 3,508 later inventions. Entered the public domain in 2016.

A physical book has a wonderful property its makers never had to design: it is hard to copy. To pirate a book you must reprint it, at real cost, one copy at a time. That friction, invented by no one, quietly protected authors and publishers for five centuries. Then everything became digital, and the friction vanished. A song, a film, a book as a file can be copied perfectly, infinitely, instantly, for nothing. The moment culture became bits, the old protection of physical scarcity evaporated — and an industry panicked.

The question that panic raised was stark: in a world where any file

can be copied perfectly and freely, how can anyone control, or be paid for, digital content at all? This chapter's invention is one of the most influential attempts to answer it, and it carries the single highest citation count in this entire volume.

RULES THAT TRAVEL WITH THE CONTENT

Intertrust's answer was to wrap the content in rules — to make the digital file carry, and enforce, its own terms of use. Instead of an unprotected song that anyone could copy and play, imagine a song bundled inside a secure package that says, in effect: this may be played on these devices, this many times, by this person who has paid; and the package enforces those rules wherever it goes. The control does not live in the shop that sold the file; it travels with the file itself, everywhere it is copied. This is digital rights management — DRM — and Intertrust built one of its foundational architectures.

US 5,892,900, "Systems and methods for secure transaction management and electronic rights protection," describes a comprehensive system for exactly this: securely governing how electronic content is distributed, used, and paid for across networks, with the rules and the enforcement bound to the content as it travels. It is a deep and sprawling patent, and its 3,508 citations — the most of any patent in this book — reflect how enormously it shaped the effort to control digital content. The technology beneath paid music, streaming video, e-books, and much of the paid digital world owes a

debt to this lineage.

THE COMPANY THAT BECAME A PATENT

Intertrust's later history is telling. It never became the household name its technology's reach might suggest; instead it became, in large part, a holder and licensor of foundational patents — its inventions woven into other companies' products through licensing and litigation, including landmark disputes with some of the largest technology companies on earth. It is a pure example of a pattern this series keeps meeting: a pioneer whose lasting power lay not in a product people bought but in a patent estate the whole industry had to reckon with.

AND THEN THE FENCE CAME DOWN

The patent expired in 2016. The foundational architecture of binding usage rules to digital content, and enforcing them as the content travels, is now in the public domain.

DRM remains one of the most contested ideas in the connected world — beloved by those who sell digital content, resented by those who feel they no longer truly own what they have bought. The expiry of a founding patent settles none of that argument. What it does is remove one company's private claim over the basic machinery, and hand that machinery to everyone. The digital lock is

now unlocked, in the one narrow sense that its founding blueprint belongs to us all.

CHAPTER 11

WHAT'S ON

Anchor patent: US 6,177,931 — "Systems and methods for displaying and recording control interface with television programs, video, advertising information and program scheduling information." Index Systems, filed 1998, granted 2001. Cited by 2,553 later inventions. Entered the public domain in 2018.

For half a century, finding out what was on television meant reaching for a paper magazine. The listings guide — that fat little booklet of grids and times — sat on millions of coffee tables, and it was, in its humble way, one of the most-used documents in the home. Then television became digital and interactive, and the paper guide moved onto the screen itself: the electronic program guide, the grid you scroll through with a remote to see what is on now, what is on next, and what to record.

That on-screen guide, so ordinary that it is invisible, was fiercely valuable and fiercely fought over — because whoever controls the guide controls the first thing every viewer sees, and the doorway through which they choose everything else.

THE GRID THAT RUNS THE TELEVISION

US 6,177,931 describes the modern electronic program guide in considerable detail: a system that displays television schedules in a grid alongside advertising and a live video window, and lets the viewer watch, record, and manage programmes through the on-screen interface with a remote control. Read as a list of features it sounds mundane. But assembled, it is the control surface of the television age that followed — the guide that greets you when you turn on a set-top box, the grid you navigate to find and record a show, the layer between the viewer and the vast sea of channels and content beyond.

Its more than 2,500 citations reflect how central the guide became. The company lineage behind these patents built an enormous business on exactly this: the interactive guide, and the recording of programmes for later viewing, became a toll-gate on the flow of television into the home, and the patents around it were among the most valuable in the whole convergence of television and computing.

THE DOORWAY IS THE PRIZE

There is a lesson in this chapter that echoes far beyond television. In any system with a great deal of content, the thing that organises and presents that content — the guide, the menu, the feed, the home screen — is not a mere convenience. It is the prize. Whoever owns the first screen a person sees owns their attention and steers their every subsequent choice. The electronic program guide was the television version of a truth the whole connected world would come to run on: the interface is the power. Control what is on, and you control what gets watched.

AND THEN THE FENCE CAME DOWN

The patent expired in 2018. The design of the interactive on-screen guide — the grid of schedules, the live window, the record-and-manage controls — is now common property.

Television has since fragmented into a thousand streaming services, each with its own grid and its own guide, but the shape of them all descends from this. That the founding design now sits in the public domain matters to everyone building the next interface onto the next sea of content — because the doorway, as this chapter's whole argument insists, is the thing that matters most.

CHAPTER 12

THE ADVERT MEANT ONLY FOR YOU

Anchor patent: US 6,698,020 — "Techniques for intelligent video ad insertion." WebTV Networks, Inc., filed 1998, granted 2004. Cited by 1,728 later inventions. Entered the public domain in 2018.

For the whole history of broadcasting, an advertisement was a blunt instrument. The same commercial went out to everyone watching a programme — the pensioner and the teenager, the city banker and the farmer, all shown the identical thirty seconds. Advertisers knew, in the famous complaint, that half their money was wasted; they simply could not tell which half, because they were buying a whole audience at once and could aim at none of it.

This chapter's invention set out to end that — to make television advertising personal, so that two households watching the very same programme, at the very same moment, might see two entirely

different adverts, each chosen for them.

THE COMMERCIAL THAT KNOWS WHO IS WATCHING

WebTV, an early effort to fuse the television and the internet that was absorbed into a much larger company, held a patent on exactly this idea. US 6,698,020, "techniques for intelligent video ad insertion," describes a system that selects and displays advertisements to individual households based on their demographics, interests, and viewing habits — replacing the one-size-fits-all broadcast advert with targeted content chosen for the particular home receiving it. The programme is the same for everyone; the advertising is not. Each household, in effect, watches its own commercial break.

This is addressable advertising, and it is one of the most consequential and lucrative ideas in modern media. It takes the targeting logic that the web was busy inventing — remember the watchers on the page, three chapters ago — and brings it to the television, the most powerful advertising medium ever built. More than 1,700 later inventions cite it, tracing the long march toward a media world in which every advert is aimed.

THE LOGIC THAT ATE MEDIA

Follow this idea to its conclusion and you arrive at the present. The defining economic engine of the connected age is targeted

advertising — content and services offered cheaply or free, paid for by adverts aimed with ever-greater precision at each individual, using ever-more data about who they are and what they do. This patent is one of the places where that logic reached for the television screen, and the reaching never stopped. Today the streaming services that replaced broadcast television are, increasingly, addressable-advertising machines, showing each viewer their own commercials. The advert meant only for you is no longer a novelty; it is the business model of modern media.

AND THEN THE FENCE CAME DOWN

The patent expired in 2018. The technique of inserting advertisements targeted to the individual household is now common property.

Whether the targeted advert is a marvel of relevance or an instrument of surveillance is, like the DRM of Chapter 10 and the tracking of Chapter 9, a genuine argument this book will not pretend to settle. What is certain is that the idea has conquered media, and that its founding technique for television is now free for anyone to use. The advert meant only for you belongs, now, to everyone who would send one.

PART FIVE — THE CONNECTED HOME AND BEYOND

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CHAPTER 13

MAKING THE GADGETS TALK

Anchor patent: US 6,032,202 — "Home audio/video network with two level device control." Sony Electronics Inc., filed 1998, granted 2000. Cited by 1,784 later inventions. Entered the public domain in 2018.

By the late 1990s the living room had quietly filled up with machines: the television, the video recorder, the disc player, the amplifier, the set-top box, each from a different maker, each with its own remote control, each an island. They sat side by side and knew nothing of one another. To watch a film you performed a small ritual of switching inputs and juggling handsets, because the gadgets, though wired together by cables, could not actually talk. They shared signals but not understanding.

The dream — one that has been dreamed and re-dreamed ever since

— was of a home in which the devices cooperated: where pressing "play" told the television to switch to the right input, dimmed nothing you did not want dimmed, and simply worked, as a system rather than a heap of parts. For that, the machines had to be able to discover one another and coordinate, across the boundaries of brand and type.

TWO LEVELS OF CONTROL

Sony's patent tackled a real obstacle in the way of that dream: how do devices from different manufacturers, with different capabilities, control one another without every maker having to agree in advance on every detail? US 6,032,202, "home audio/video network with two level device control," describes a clever answer. It separates control into two levels: a common, basic layer that any device can understand, and a mechanism by which a device can also offer up a software module describing its own particular, advanced capabilities, so that a controller can adapt to it on the fly. A new gadget joins the network and, in effect, hands over a little description of what it can do and how to drive it; the rest of the system reads that and knows how to work with it, even though it had never met that device before.

It is an elegant solution to the deep problem of interoperability — of getting independently made things to cooperate without a central authority dictating everything in advance. More than 1,700 later inventions cite it, tracing the long, still-unfinished effort to make the

devices in our homes behave as one system.

THE UNFINISHED DREAM

Interoperability in the home remains, decades later, a partly-kept promise — anyone who has wrestled with mismatched smart-home gadgets knows the islands never fully joined into one continent. But the direction was set here: devices that describe themselves, discover one another, and coordinate across the boundaries of brand. Every effort since to make the connected home actually cooperate walks the path this patent helped clear.

AND THEN THE FENCE CAME DOWN

The patent expired in 2018. The method of letting mixed devices coordinate through layered, self-describing control is now common property.

As our homes fill with ever more connected things — speakers, lights, locks, cameras, thermostats, each still too often an island — the foundational ideas for making them cooperate matter more, not less. That this one now sits in the public domain is a small gift to everyone still trying, after all these years, to make the gadgets finally talk.

CHAPTER 14

MUSIC IN EVERY ROOM

Anchor patent: US 7,571,014 — "Method and apparatus for controlling multimedia players in a multi-zone system." Sonos, Inc., filed 2004, granted 2009. Cited by 1,954 later inventions. Entered the public domain in 2024.

Here is a small, specific dream, and a surprisingly hard one: to have music play throughout a house — the same song in every room, perfectly in step, or different songs in different rooms — all controlled from one place, effortlessly. Anyone who has tried to rig it up from ordinary parts knows the frustrations: speakers that drift out of sync so that the kitchen echoes half a beat behind the hall, a tangle of wires and remotes, no single simple way to say "play this, here, and that, there."

Sonos built a business, and something close to a cult, on solving this

cleanly — on making whole-home audio that simply worked, controlled as one system, with rooms you could group and ungroup at a touch.

GROUPING THE ROOMS

The heart of it is the idea of zones. Each speaker, or group of speakers, is a zone — the kitchen, the bedroom, the garden — and the system lets you control them together or apart from a single controller: group the kitchen and the living room to play the same thing in perfect sync for a party, then split them again so each plays its own. US 7,571,014, "method and apparatus for controlling multimedia players in a multi-zone system," protects exactly this: remotely grouping multiple players across different rooms and controlling them, synchronously or independently, from one controller.

The genuinely hard part, hidden beneath the simple experience, is the synchronisation — keeping players in different rooms locked so tightly in time that music in the hall and music in the kitchen sound as one, with no echo, no drift, no shimmer of delay. Getting that right, invisibly and reliably, over a home network, is a real feat of engineering, and it is what separated a product people adored from the janky improvisations that came before. Nearly 2,000 later inventions cite this patent.

THE EXPERIENCE IS THE INVENTION

There is a lesson here worth naming, because it recurs across the connected world. Nothing in the multi-zone idea is, in isolation, unprecedented — speakers, networks, and remote controls all existed. The invention is in the experience: in making the whole thing so seamless, so synchronised, so simple to control, that it crossed the line from a project you assemble into a thing you simply use. Much of the value in the connected age lies exactly there, in the ferociously hard engineering that makes something finally feel effortless.

AND THEN THE FENCE CAME DOWN

This is the most recently expired patent in the book — 2024, filed back in 2004, its twenty years newly up. The method of grouping and synchronising audio players across the rooms of a home is now in the public domain.

That timing is a neat illustration of the whole series' theme playing out almost in real time: an invention that still feels modern, still sits inside products on sale today, and yet whose founding patent has, just now, quietly reached the end of its term. The music that fills every room in step belongs, as of this year, to everyone who would build it.

CHAPTER 15

STREAMS WITHOUT END

Anchor patent: US 6,374,336 — "Computer system and process for transferring multiple high bandwidth streams of data between multiple storage units and multiple applications in a scalable and reliable manner." Avid Technology, Inc., filed 1998, granted 2002. Cited by 1,932 later inventions. Entered the public domain in 2018.

Text is small and forgiving. Video is neither. A stream of high-quality video is a torrent of data that must arrive steadily, without pause, without stutter, for as long as it plays — and when you want to serve not one such stream but thousands at once, to thousands of people all watching different things, you face a problem of a wholly different order from serving web pages. The connected world's appetite for video would become bottomless, and something had to feed it.

Avid Technology knew this problem intimately, because it built the systems on which film and television were edited — an industry that lives or dies on moving vast streams of video reliably, in real time, without a single dropped frame ruining a take. This chapter's invention comes from that unforgiving world.

SPREADING THE TORRENT ACROSS MANY DISKS

The core idea is to refuse to let any single storage unit become a bottleneck or a single point of failure. US 6,374,336 describes a system that takes the data and divides it into segments spread across many independent storage units — scattered deliberately, with redundancy built in so that if one unit fails the stream survives — and then transfers those multiple high-bandwidth streams between many storage units and many applications at once, in a way that scales up smoothly and stays reliable under load. No one disk holds any whole thing; the torrent is spread across many, and pulled back together on demand, so that the system can serve stream after stream without choking and without falling over when a part fails.

This is the deep engineering beneath large-scale media delivery: the art of moving enormous, continuous streams of data, reliably, at scale, from banks of storage to many simultaneous viewers. More than 1,900 later inventions cite it, tracing the machinery that would eventually make it ordinary to stream high-quality video to millions of people at once.

THE INFRASTRUCTURE OF THE BINGE

Every service that now streams film and television to the world rests on solving, at colossal scale, the problem this patent addressed: how to store vast libraries of heavy media and pour them out as thousands of simultaneous, unbroken streams without stutter or collapse. The seamless, on-demand, endless video that defines modern entertainment is, underneath, a triumph of exactly this kind of scalable, reliable, distributed data plumbing. We experience it as "press play." It is, in truth, one of the hardest logistics problems the connected world ever solved.

AND THEN THE FENCE CAME DOWN

The patent expired in 2018. The method of spreading media across many storage units to serve multiple high-bandwidth streams reliably and at scale is now common property.

The streaming world that this kind of engineering made possible has become one of the central facts of modern life, and its foundations are now, one by one, passing into the commons. That the plumbing beneath the endless stream is increasingly free matters most to those building the next generation of it — the ones who will pour the next torrents of media across the network to whoever is waiting to watch.

CHAPTER 16

INFORMATION THAT KNOWS WHERE YOU ARE

Anchor patent: US 6,014,090 — "Method and apparatus for delivering local information to travelers." AT&T Corp., filed 1997, granted 2000. Cited by 940 later inventions. Entered the public domain in 2017.

The internet, in its first decade, knew everything except where you were. It could deliver the same information to a person in Tokyo and a person in a small English town, and had no notion that the question "where is the nearest one?" even had a meaning. Information floated free of place. And yet so much of what a person actually wants to know is stubbornly local: where is the nearest station, the nearest pharmacy, the nearest cash machine, and is it open now? To answer that, the network would have to learn something it had never known — where its user actually was.

This closing chapter is about the invention of information that knows where you are, and it is a fitting place to end, because it points at the world we now inhabit completely.

THE NETWORK LEARNS YOUR LOCATION

AT&T — the company that had wired the world for voice long before anyone dialled into the internet — held a patent on exactly this idea. US 6,014,090, "method and apparatus for delivering local information to travelers," describes a system that uses a mobile device's geographic location to find and deliver relevant, real-time information about nearby services and facilities: a location is determined, a server maps that location to the resources near it, and the traveller receives information tailored not to who they are but to where they are. The network, for the first time, answers "the nearest one" and "what is around me."

This is the seed of location-based services — the whole now-vast world of maps that show you where you are, of "restaurants near me," of the phone that knows which town it is in and shapes what it shows you accordingly. It is a modest-looking patent with a modest citation count by the standards of this book, but it names one of the most consequential shifts in the connected age: the moment information stopped floating free of place and became anchored to where its reader stood. More than 900 later inventions cite it.

THE WORLD THAT KNOWS WHERE YOU ARE

Follow this idea to the present and you arrive at a planet where almost everything you do online is quietly shaped by your location — the results you see, the services you are offered, the adverts you are shown, the friends and places suggested to you. Location became one of the most powerful pieces of context a system can have, and one of the most sensitive: the same knowledge that tells you where the nearest pharmacy is also tells someone else, potentially, everywhere you have been. Like so much in this volume, it is a gift and a hazard wound together, and we are still learning to hold it.

AND THEN THE FENCE CAME DOWN

The patent expired in 2017. The method of using a device's location to deliver information about what is nearby is now common property.

We now live entirely inside the world this patent glimpsed — a world where the network knows where we are and answers accordingly, for better and for worse. The founding technique is free now, common ground beneath every map and every "near me" search.

And that is the thread running through all sixteen chapters of this book. Each of these inventions — the page built fresh for every

visitor, the meeting in the browser, the news that came looking for you, the digital lock, the music in every room, the information that knows where you stand — was, in its time, a guarded secret and a private fortune, fenced off for twenty years. Most of the companies that held them are gone, outrun by whoever came next; the internet was merciless to its pioneers. But the inventions outlived the companies, and each, on its own quiet morning, has had its fence taken down. The world they built together — the connected world, the one we now live inside without a second thought — was assembled from these once-private pieces. And piece by piece, they have become ours.

A NOTE ON THE METHOD

The sixteen patents in this book were not chosen by opinion. They were drawn from a large database of expired patents in the field of communications and networking, and ranked by the number of times later inventions have cited them — a rough but honest measure of how heavily the world came to build on each idea. From the top of that ranking I removed the near-duplicates and the misclassified strays, so that each chapter tells the story of a distinct breakthrough, and among what remained I chose the inventions with both a high impact and a story worth telling to a general reader. Because this domain mixes radio, networking, and internet software, I have leaned deliberately toward the internet and networked-media inventions that defined the connected age, rather than the radio-hardware patents that a narrower reading of "wireless" might suggest.

Every patent number, assignee, grant year, citation count, and expiry

date in these pages is real and drawn from the public patent record, and every one can be read in full, for free, by anyone. The historical and technical explanations are written for the curious non-specialist and reflect the author's best understanding; for any serious purpose the patents themselves, and the primary sources, are the authorities, not this book. Where a company's history is described, it is drawn from the public record as the author understands it.

The deeper claim of the book is the same one that runs through the whole series, and it is worth stating plainly. The patent system is not a wall but a gate with a timer set upon it. Everything held behind it is on its way, by design, to becoming ours. This volume has been one attempt to notice that passage as it happens — to stand, for a while, on the far side of the inventions that wired us together, and to watch each fence, in its turn, come quietly down.