

QUEUES

THE WORKFORCE PLANNING EDITION

CIQ

47

LWT

999

SVL

62

AGTS

14

THE WALLBOARD — the scoreboard everyone lived under, and the number it refused to say

SERVICE LEVEL: A THEOLOGY — 80/20, its heresies, and the denominator a professor called perverse

THE 11:59 PROBLEM — a 44-minute call walks into a 15-minute interval. CMS decides who pays.

WHERE DID THE CALLS GO? — the offshoring wave confesses · Manila · Belfast · the queues that never rang

THE ADHERENCE WARS — aux codes, AUDIX vengeance, and a password called **stupid**

Plus: the switch census 1995–2010 · the listening post · the brochureware · Erlang C, filed reverently at the back · and AUX 9, a cartoon

YOUR CALL IS IMPORTANT TO US · YOUR CALL IS IMPORTANT TO US ·

In this edition

Filed by position in the call's journey: TRUNK, where it arrives; QUEUE, where it waits; AGENT, where it is answered; WRAP, where it is counted — honestly or otherwise.

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AUX 9, a cartoon, appears wherever the schedule says its subjects should be. · **QUEUES** is a personal production in the house style of the trade press it remembers. Machines and platforms are named; employers, clients and colleagues appear only with per-item clearance or not at all. Every specification is sourced or honestly marked unverified. The 80/20 service level is discussed as theology because it is one.

MASTHEAD — Editor, war-story correspondent, switch programmer, 19-year-old QA zealot (retired): the editor. Research fleet: nine catalogue agents, a lexicon hunter, and a workbook that reproduces the answer 14. Set in phosphor green on office white. No calls were placed on hold in the making of this edition.

The queue is now forming

Every trade gets the magazine it deserves, roughly twenty-five years too late. This one is for the people who knew, to the second, how long you had been waiting — and could prove it, interval by interval, in a report nobody else could reconcile.

I should declare my interests, because this entire edition is one. I spent the formative years of my working life inside the machine this magazine catalogues — first as a nineteen-year-old QA team leader with a formal instrument called a QACAR and no idea it was pronounced "quacker", later as the person who set up the offshore centres the closing feature confesses to, and throughout as a member of the quiet priesthood that ran the Erlang C before the morning meeting and believed, genuinely believed, in the 80/20 service level the way other people believe in tide tables.

The rules of the house are the same ones the photocopier edition established. The machines get named — the Definity and the Meridian, the Galaxy that started it all, the Periphonics cabinets, the boards from Symon and Spectrum, the AUDIX that features here in an unexpectedly tactical role. The people mostly don't. Where a colleague appears by name in these pages, they appear with clearance and with warmth, and nowhere else. Where a story could only have happened at one identifiable employer, it is the editor's story to own, and he owns it. Everything else is a silhouette: a bank, a client, a Team Leader who was a bit better than everyone else.

Two confessions belong up front. The first: this magazine is printed in phosphor green, the colour of the wallboard as

the trade remembers it — and my own wallboard was red. Red LED, three fields, CIQ · LWT · SVL, left to right: arrival, suffering, judgment. I have printed the magazine in the green of the boards I coveted rather than the red of the one I had, and I am at peace with this, which is more than can be said for anything my board ever displayed.

The second confession is structural. The features in this edition lean on first-hand testimony — fourteen war stories, collected in a single extraordinary evening, every one cleared for print by their sole owner, who is me. This is either the most rigorous editorial clearance process in trade publishing or the least, and I decline to check which.

The wallboard's field was three digits wide. The queue was not.

What you hold is filed the way a call is: TRUNK, where the switches live and the census begins; QUEUE, where the waiting happened and was made visible in LEDs; AGENT, where a human in a Plantronics finally said the scripted sentence; and WRAP, where it was all counted — and where the counting itself, as the 11:59 feature demonstrates from Avaya's own documentation, was stranger than anyone on the floor suspected. The mathematics is filed at the back, reverently, where the appendix of scripture belongs.

A word on the cartoons. AUX 9 appears through the issue because every centre had an unallocated aux code and someone was always in it. The characters are inventions — archetypes, not colleagues. Any resemblance to persons living, working, or shown as AVAILABLE while clearly at lunch is a property of the trade, not the drawing.

This edition owes a debt it can finally file correctly. I learned Erlang C — and scheduling, and forecasting, and the whole quiet discipline this magazine mythologises — from **Ian Morris** of the Operations Administration Centre, out of an ICMI book, and I have never forgotten it. The mathematics only truly landed years later, in formal statistics study, long after I had left the trade; by then the debt had compounded. The Reference well at the back of this edition — the same formula, worked in full, published in three languages on the editor's own site — is the repayment schedule. Ian: this one is dedicated to you, and the interval in which the debt is recorded is, per CMS convention, the one in which it finally completed.

Thanks are also due to Nellie, who ran telephony, and who in 1997 changed my CMS password to *stupid* and set it to never expire, because I kept forgetting it. It never expired. Neither has my gratitude, nor — the adherence feature will explain — a certain Team Leader's voicemail tutorial. And to the two graveyard-shift agents of a Japanese-language queue in Melbourne, Florida, who kept a perfect service level for the only customer who ever called, and to that customer, wherever he woke up: the empty queues feature is yours.

HOUSE RULES How this edition was made

Every specification in the census pages carries a confidence tier — verified, partial, or listed-only — and at least one source actually consulted. Where the record is silent, the tables say *unverified* in italics rather than inventing a number; the trade deserves the same honesty it rarely extended to its own service-level reporting. The wallboard lexicon, the vector listings, and the interval-attribution doctrine are drawn from vendor documentation of record, cited where they appear.

STORIES CLEARED PLATFORMS HERESIES

14 14 202 1

THIS ISSUE BY THE NUMBERS. THE HERESY IS THE DENOMINATOR. SEE THE THEOLOGY FEATURE.

One more thing. If you worked this trade — if you balanced a roster at 6:40 in the morning, or hid in wrap, or watched the board go to 999 and keep going in its heart — the queue for the next edition is now forming. Your call is important to us. You know exactly how important, and in which interval it will be recorded.

— The Editor

AUX 9 · SINCE 1995

TRUNK.

The call arrives. Somewhere in a cabinet the size of a wardrobe, a switch decides what you deserve.

Before there was a queue, there was a trunk — a cop-
per promise between the network and the building,
terminated in machinery that cost more than the
building. This section is the switch census: the Definity em-
pire and its three business cards, the Meridian's rise and
Chapter 11 fall, the Galaxy that invented the category on be-
half of an airline, the purpose-built challenger that eventu-
ally bought its own ancestor's history, and the software

heresy that sat above them all and told them what to do. It
ends with a confession about where the calls went, filed by
the person who took them.

Every capacity figure in these pages is sourced or marked
unverified. The switches would have wanted it that way:
they logged everything, forgave nothing, and reported it all
to an adjunct in a locked room, fifteen minutes at a time.

TRUNKS 384 · IN SVC 384 · BLOCKED 0 · NEVER ADMIT BUSY

AVAYA

Three company names, one Bell Labs kernel, and the switch that became every mega-centre's default answer.

DEFINITY entered the world in 1989 as AT&T's attempt to stop selling two PBX architectures out of one showroom. It left the decade as Lucent's crown asset, then Avaya's entire reason for existing — rebadged twice, re-engineered once, and never once rewritten from scratch underneath.

AT&T went into the 1990s carrying two separate PBX families that happened to share a logo: **System 75**, the smaller 1983 architecture, and **System 85**, the older and larger of the two. On 5 March 1989 the company merged them into a single line called **DEFINITY** — “definitive” crossed with “infinity,” which is either the best or the worst PBX name of the decade, no consensus reached — launched as Generic 1 (up to 1,500 lines) that March and Generic 2 (up to 30,000 lines) that July. Existing System 75 sites upgraded for \$8,500; System 85 sites paid \$35,000 for the privilege of joining one family.

Generic 3 (G3) is the workhorse the rest of this spread is about: four cabinets — G3vs, G3s, G3i, G3r — sharing one feature set across a spread of Intel 80386 boxes and, at the top, a RISC-based flagship with its own Center Stage Switch fabric for multi-cabinet builds. That flagship carried the number every mega-centre planner eventually had to know by heart, and it sits in the specbox opposite.

Skills-based routing landed as a named feature, **Expert Agent Selection**, documented from AT&T publication 555-230-520 in November 1993. Before EAS an agent belonged to one queue; after it, an agent could carry up to four skills with prioritised expertise levels, and the industry quietly stopped talking about “the ACD split” as though it were singular.

Corporately, the switch changed employers twice without changing much else. AT&T's 1996 restructuring spun off **Lucent Technologies**, taking Bell Labs, Definity and the CentreVu brand with it. Lucent then announced, on 1 March 2000, that it would spin off its enterprise-networking arm as an independent company; the spin-off completed that September and **Avaya Inc.** began trading on the NYSE on 2 October 2000 — roughly 34,000 employees, 90 countries, some \$8 billion in revenue, all inherited rather than built. Avaya went private in 2007 and, in 2009, bought Nortel's enterprise business for \$900 million, which is the reason so many later Avaya estates turn out to be part Nortel underneath the badge.

■ Oryx/Pecos: the kernel that outlived three business cards

Underneath every one of those corporate identities sat the same operating system: **Oryx/Pecos**, a proprietary real-time kernel Bell Labs began building in 1978 — not Unix, not derived from Unix, just quietly running since Jimmy Carter's first term. It shipped on System 75, then on every Definity G3 switch across the AT&T/Lucent/Avaya handover, and stayed in production on the Avaya G3csi until end-of-sale on 5 February 2007. Avaya's first attempt to retire it — Definity One, rebadged IP600 then S8100, on Windows NT4 and later Windows 2000 — was a brief and slightly awkward detour. The kernel itself didn't retire so much as move house: in 2005 Oryx/Pecos was ported to run as an application on Linux, under a new name, Communication Manager, and carried on.

DEFINITY GENERIC 3 — THE VARIANTS

CABINET PROCESSOR		EAS AGENTS	BHCC
G3vs	Intel 80386, 16MHz	150	14,000 (shared, G3vs/s/i)
G3s	Intel 80386, 16MHz	150	
G3i	Intel 80386, 16MHz	500	
G3r	RISC + Center Stage Switch	5,200	70,000

Figures per Versions 1–4, one skill per agent. The 5,200/70,000 G3r ceiling is the number that shows up unchanged in both the 1996 AT&T/Lucent G3 documentation and the November 2000 Avaya-era ECS Release 9 documentation — a four-year span, two owners, one unmoved flagship spec.

The reporting religion, briefly

Sitting beside the switch, on Sun hardware, ran **CentreVu Call Management System** — the box that turned raw ACD events into the interval-by-interval reports a call centre actually lived by, real-time and historical both. By 1998 **CentreVu Advocate** layered predicted-wait-time routing on top of EAS's skills model, requiring Definity G3 Version 6 and CMS together. CMS is the reporting platform this issue treats properly elsewhere — see the CMS feature later in this issue for the database items, the Supervisor client, and the wallboard feeds it fed.

One switch, three name badges

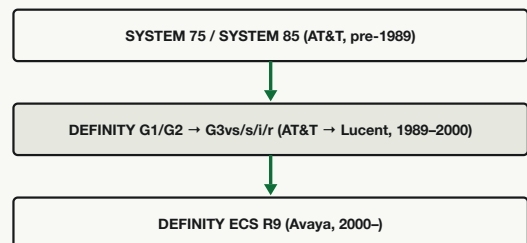
AT&T through 1995, Lucent from 1996, Avaya from 2000: each inherited, rebranded and kept selling essentially the same Definity/CentreVu architecture. The ECS Release 9 documentation, dated November 2000, is functionally an AT&T-designed switch wearing its third company's name — and still quoting the same G3r ceiling it quoted under the first two.

SOURCES: techmonitor.ai · en.wikipedia.org · comtalkinc.com · patents.google.com · virsae.com · eetimes.com · documentation.avaya.com · tek-tips.com · computerworld.com · wiki.wfmlabs.org · manualslib.com

THE VERDICT — DEFINITY G3r

CAPACITY HEADROOM	★★★★★
LONGEVITY OF DESIGN	★★★★★
REPORTING DEPTH (W/ CMS)	★★★★☆
MIGRATION COMFORT	★★★☆☆
BROCHURE QUALITY	★★★★☆

Ten times the mid-tier's agent ceiling, unchanged across three corporate owners, on a kernel Bell Labs wrote before most of its operators were born. The mega-centre's default answer for a reason.



Oryx/Pecos underneath, unbroken, 1978–2005 (then ported to Linux)

ONE KERNEL, THREE BUSINESS CARDS: THE DEFINITY LINEAGE FROM SYSTEM 75/85 THROUGH TO THE AVAYA ECS REBRAND, WITH THE SAME 5,200-AGENT G3R CEILING QUOTED AT BOTH ENDS.

NORTEL

The Meridian empire — one switch, five cabinet sizes, and a software bet that came four years too late to save it.

By 1991 Northern Telecom was, by most trade-press counts, the world's largest PBX supplier, on the strength of a single scalable architecture sold under one name from a sixty-line branch office to a sixteen-thousand-port carrier flagship. The empire was real. So, eventually, was the bankruptcy.

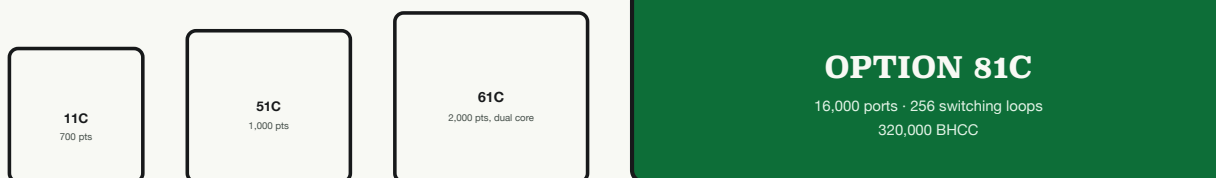
The machine that mattered arrived in 1975 as the **SL-1**, unveiled at the USITA convention that September and marketed as the first fully digital PBX aimed squarely at the mid-size business market — a stored-program, digitally-switched alternative to the crossbar systems still running most of the industry, spanning 100 to 7,600 lines out of the box. Nortel licensed the SL-1's advances aggressively and rode the wave: a third of the US digital-switch market by 1990, and the rebrand to **Meridian 1** in the late 1980s carried the name the whole family — Options 11C through 81C — would wear through the decade this issue covers.

The Meridian 1's genius was modularity, not cleverness. One call-processing architecture, the X11 software lineage, scaled from a 60-line branch office up to a 16,000-port carrier-grade install, ACD included at every size. Nortel's own "Evergreen" pitch sold this as an investment that never went obsolete: buy the small cabinet, grow it, keep the software you already know. By the time the "C" generation (Vx-Works-based, replacing the earlier Protel-language core) had fully rolled out, Nortel could credibly claim the

Meridian 1 as the most widely installed PBX platform on Earth — a figure later put at 43 million users worldwide.

ACD itself was never a bolt-on here. It rode along as switch-resident software from the SL-1 era, and its own feature-package taxonomy — opposite — defined exactly how sophisticated the queuing got, one package number at a time, all the way back to a system where *every* ACD deployment needed the base package before it could buy anything cleverer.

Where the decade changed the story was reporting. As call centres outgrew what switch firmware could report on, Nortel built **Meridian MAX** as a dedicated layer, then placed a much larger bet on **Symposium Call Center Server** — a Windows NT client-server platform with real-time displays, historical reporting and eventually skills-based routing, first shipping in 1998. Symposium was Nortel's answer to a hard truth: the call centre had become a software business sitting on top of a PBX, not the reverse. It kept shipping releases into the mid-2000s and was re-branded the Nortel Contact Center portfolio at release 6.0 in November 2005.



ONE ARCHITECTURE, FIVE CABINETS: MERIDIAN 1 OPTIONS 11C MINI THROUGH 81C, SAME X11 SOFTWARE LINEAGE THROUGHOUT, SCALING FROM A BRANCH OFFICE TO A CARRIER-GRADE MEGA-CENTRE FLOOR.

MERIDIAN 1 — THE OPTION RANGE

OPTION	PORTS	BHCC	NOTABLE
11C Mini	up to 700	<i>unv.</i>	Rack-mount branch office; smallest “C” cabinet
11C	30–700 lines	58,000	Carried CCR and IVR workloads
51C	1,000	~135,000	Single Core/Net module; mid-range step
61C	200–2,000	~135,000	Dual Core/Network module: first with core redundancy
81C	200–16,000	320,000	256 switching loops; the mega-centre’s actual machine

Figures per the rircommunications.com Meridian 1 datasheet. Start/end dates across the whole option range are unverified against a primary source.

ACD FEATURE PACKAGES (X11)

PKG	NAME	DOES
40	Base ACD	Foundation every deployment required
45	ACD-A	Agent login, call-source ID, priority trunks
41	ACD-B	Agent/supervisor comms, music-on-delay, overflow
42	ACD-C1	Management reporting (superseded by D)
43	ACD-C2	Load-management (SAGP/SATS) commands
—	ACD-D	Rolls up A+B+C2, replaces C1; enables CTI via the Auxiliary Processor Link

THE VERDICT — OPTION 81C

CAPACITY HEADROOM	★★★★★
REDUNDANCY	★★★★☆
FEATURE PACKAGING CLARITY	★★★★☆
REPORTING (PRE-SYMPOSIUM)	★★★☆☆
BROCHURE QUALITY	★★★★☆

320,000 BHCC on 16,000 ports and 256 switching loops — the spec sheet that let one Meridian 1 do the job most rivals needed a cluster for. The green-screen reporting underneath it was the weak link.

■ MAX: the ceiling depended what you bolted it to

Meridian MAX topped out at wildly different agent counts by hardware: 1,200 agents on the SNN/SNNE platform, but only 150 on the entry IPE card and 300 on IPEE. “MAX” described the reporting software, never a promise about the box underneath it. Sales ended 31 July 2000; MAX, Customer Controlled Routing and Meridian Link all shared the same withdrawal date, 31 March 2004 — the formal changing of the guard to Symposium as the reporting, routing and CTI story going forward.

The fall, briefly

Nortel’s ending was corporate, not technical. Market capitalisation peaked near C\$398 billion in September 2000 on the optical-networking boom, then collapsed to under C\$5 billion by August 2002 as the bubble burst, gutting Canadian pension funds along the way. A 2003 accounting scandal, eventually found to involve some \$3 billion in improperly booked revenue, compounded it. Contact Center 7.0 slipped from a 2007 promise through three re-announcements before shipping in 2009 — trade press treated the delay itself as the story. Nortel filed for bankruptcy protection on 14 January 2009; Avaya bought its Enterprise Solutions division, Meridian 1 and Symposium included, for \$900 million that December.

SOURCES: en.wikipedia.org · pbxbook.com · nojitter.com · rircommunications.com · cacomunications.com · tek-tips.com · pbxmechanic.com · archive.org · britishtelephones.com

ROCKWELL & ASPECT

How 1973 became Aspect's founding year — a genealogy in two acquisitions, told straight.

Two companies, two founding stories, one merged lineage: Rockwell sold the industry its own creation myth in 1973, and Aspect built the purpose-built ACD thesis that eventually out-competed it. They only met corporately in 2004–05, by which point the buyer, Concerto Software, absorbed both and kept the smaller Rockwell's history as decoration on the bigger Aspect's name.

In 1973, Rockwell's Switching Systems Division sold Continental Airlines an automatic call distributor called **The Galaxy** — a hot-swap triad of three DEC PDP-11/24 minicomputers, one distributing calls, one reporting, one sitting idle as standby. Continental had asked AT&T first; AT&T reportedly said the automation would take eight years to build. Continental turned to Rockwell instead, partly on the strength of Rockwell's 1971 purchase of Collins Radio, whose avionics work already had it in the room with the airline. The Galaxy stayed on the job at Continental for 23 years. The honest caveat, from trade historians rather than Rockwell's own marketing: ACD concepts existed in recognisable PABX form from the mid-1960s, and Rockwell's claim to have invented the category outright is, in one call-centre historian's phrase, "good marketing baloney." What isn't in dispute is that Galaxy was among the very first ACDs sold as a product, and by far the most durable and most cited.

Nineteen years is the number Rockwell itself used for the successor: **Spectrum**, launched September 1992 explicitly as "succeeding Galaxy after 19 years" — a distributed Motorola 68030 architecture aimed, in a real change of ambition, at 25-to-50-agent shops rather than airline-scale mega-centres, priced at £1,800–2,500 per agent and built with ISDN and CTI capability Galaxy had never need-

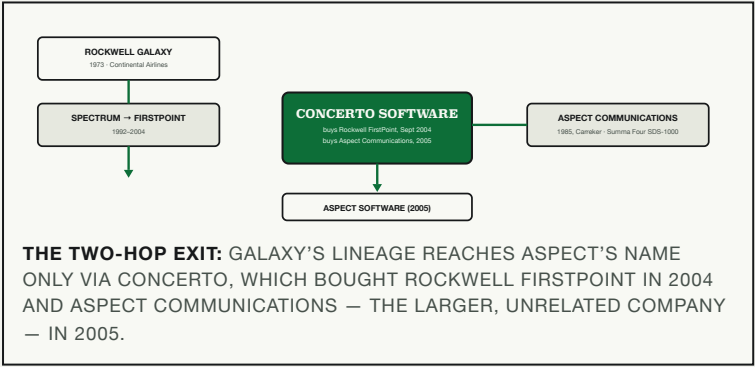
ed. Spectrum's software became Rockwell's long-term platform core — the same call-processing base that, by 2000, Rockwell's own marketing described as handling some 40 million calls a day across the field. That software resurfaced again, scaled down, as **Transcend Contact Center for Workgroups v2.0** in 2000, an NT-based mid-market ACD independently CT Labs-tested and rated "Recommended."

Aspect Telecommunications, meanwhile, was founded in San Jose in 1985 by **Jim Carreker**, a Georgia Tech/Stanford engineer who had spent his prior years at Dataquest watching the PBX industry from the analyst's side of the glass. Rather than build a switch from scratch, Carreker adapted Summa Four's SDS-1000 programmable switch and wrote ACD software on top of it — Aspect CallCenter reached market within months. The pitch was structural: a dedicated, purpose-built ACD, engineered from the ground up for call distribution on open industry-standard components (UNIX, SQL, TCP/IP, Windows GUIs), would out-route anything a PBX vendor bolted on as an afterthought. It worked: Aspect went public in 1990 and, by 1995, had eclipsed Rockwell as the long-time leader in large dedicated ACDs, installing roughly one new CallCenter system a day by 1996.

The two-hop absorption

The fade at Rockwell was corporate long before it was technical: the Switching Systems Division became Rockwell Electronic Commerce in 1997, then Rockwell FirstPoint Contact somewhere between September 2000 and February 2002, its revenue falling every year on record — \$168 million in 2000, \$150 million in 2001, \$133 million in 2002 — blamed on “continued severe declines in its telecommunications markets.” On 8 September 2004, **Concerto Software** — not Aspect — bought Rockwell FirstPoint Contact from Rockwell Automation, adding roughly \$160 million of revenue and 450 employees. Concerto’s very next release, FirstPoint Enterprise 10.0 that December, still shipped with the Spectrum ACD engine at its core. Only in **2005** did Concerto turn around and acquire its much larger rival, Aspect Communications, for roughly \$1 billion — a reverse takeover in substance, since Concerto’s own 2004 revenue of \$189 million was barely half of Aspect’s \$370 million — and the combined company kept Aspect’s name.

Which is the honest answer to the question this spread opened with. Aspect/Alvaria’s current corporate history page dates the company to 1973 and credits it with Galaxy at Continental Airlines. Independent, contemporaneous sources are consistent that Aspect Communications itself was founded in 1985 by Carreker, and that Galaxy is a documented Rockwell product. The two lineages met only in 2004–05, via Concerto’s acquisitions of first Rockwell FirstPoint, then Aspect — so “1973” reads as absorbed heritage marketing, arriving at Aspect’s door through an intermediary most tellings skip.



SOURCES: tedium.co · callcentrehelper.com · ivrtechgroup.com · techmonitor.ai · surplusmaster.com · eetimes.com · annualreports.com · destinationcrm.com · insidearm.com · prwire.com.au · fundinguniverse.com · company-histories.com · en.wikipedia.org

THE VERDICT — THE GALAXY

HISTORICAL WEIGHT	★★★★★
DURABILITY IN SERVICE	★★★★★
CATEGORY-INVENTOR CLAIM	★★☆☆☆
ARCHITECTURE (FOR 1973)	★★★★☆
BROCHURE QUALITY	★★★☆☆

Twenty-three years on one triad of PDP-11/24s is a better argument than any origin story it needed to embellish. Not the first ACD. Still the one everyone cites.

GENEALOGY — THE SHORT VERSION

YEAR	EVENT
1973	Rockwell Galaxy, Continental Airlines
1985	Aspect founded (Carreker, San Jose)
1992	Rockwell Spectrum succeeds Galaxy
1995	Aspect overtakes Rockwell in dedicated ACDs
2000	Rockwell Electronic Commerce → FirstPoint Contact
2004	Concerto buys Rockwell FirstPoint
2005	Concerto buys Aspect, keeps the Aspect name

GENESYS

The heresy: the routing brain doesn't live in the switch. It lives above every switch, and treats them all the same.

Genesys Telecommunications Laboratories was incorporated in San Francisco in October 1990 on roughly \$150,000 of family loans and second mortgages, sold the industry a single load-bearing idea, and eleven years later sat inside the “crown jewel” sentence of its own parent company’s divestment memo.

Founders Gregory Shenkman and Alec Miloslavsky — two sons of Soviet émigré families who had met over a card game as teenagers in the city’s Russian community — built the company on an insight that was, at the time, close to heretical inside the switch-vendor world: customer data lived on mainframes, calls lived on PBX hardware, and nothing spoke between them. Genesys shipped its first product, **T-Server**, in 1991. By its 1997 IPO prospectus the company was still inventing a name for the market it was chasing, because no one else had one: “Enterprise Computer Telephony Integration.”

The heresy, stated plainly in that S-1: routing intelligence did not belong welded into a Lucent Definity or a Rockwell Spectrum. It belonged in a software layer sitting above every switch, treating them identically. T-Server was the load-bearing wall of that claim — a “Media Control Services” layer of device drivers for the major ACD, PBX and central-office switches, unified behind one call-control and event model. One T-Lib API, translated locally by a T-Server per switch: the Rosetta Stone for a decade of mutually unintelligible proprietary switch links, so that a routing strategy meant the same thing whether the far end was a Lucent, an Aspect or a Nortel box. That switch-agnosticism made a second, stranger idea possible: the contact centre

that wasn’t a place, agents scattered across cities and switch vendors, routed as if they sat in one building.

The company’s own early years produced its best dry anecdote. In 1994, federal agents called on the four-year-old firm after noticing how many Russian and Eastern European names were on the payroll, reportedly wondering aloud if it was a Russian mafia front. Shenkman’s explanation was simpler than the theory: that’s where the jackpot of trained CTI engineers actually was, and the founders had built a pipeline straight to Moscow University and Phystech to tap it. Genesys went public on NASDAQ in June 1997 (ticker GCTI), used the paper to buy Forte Software and Plato Software, and then, in September 1999, agreed to sell the whole company to Alcatel for about \$1.5 billion in stock — a deal that closed the following year, with Genesys keeping its name, its San Francisco headquarters and its management inside a French telecom conglomerate. It kept acquiring under that roof through the 2000s — IBM’s CallPath business, Telera, VoiceGenie — and by 2007 was citing 100 million customer interactions a day for 4,000 companies in 80 countries. When Alcatel-Lucent later weighed selling its Enterprise division, trade press left no doubt which piece anyone actually wanted.

“Traditional telecommunications applications are often embedded within hardware such as ACDs and IVRs” — Genesys Form S-1, 3 April 1997, stating the thesis its whole platform was built to refute.

WHERE DID THE CALLS GO?

The calls didn't go somewhere. Someone took them — and he edits this magazine.

Every consolidation map needs a mapmaker, and the trade rarely asks him to sign it. This one does. For a long stretch of his working life the editor's actual job was resettlement: taking calls that used to ring on one continent and teaching them to ring on another. So this feature runs first person, on purpose. The queues didn't relocate by accident. Someone packed the boxes.

Ask anyone who lived through the decade where the calls went and the answer arrives before the question finishes: Manila. They are not wrong. Labour-cost arbitrage at industrial scale, the wave every business-school case study still teaches, the one everyone in the trade remembers because it was enormous and it was everywhere — in the editor's own words, flatly, without much romance: "I was the offshoring wave — my role for a long time was to set up the offshore call centres." Manila, mainly. That much is the expected confession.

The unexpected one is Belfast. "Bizarrely," as the editor puts it, the consolidation map also ran through Northern Ireland, where the company "got cheap rent on a new office for some reason." That reason almost certainly has a name the editor didn't know at the time, and this magazine flags rather than asserts it: the years after the Good Friday Agreement saw Belfast courted hard by inward-investment incentive schemes built to prove that peace was also good business, and a call centre — portable, labour-intensive, indifferent to a city's recent history — was exactly the kind of tenant those schemes existed to attract. Nobody signed a memo admitting the peace dividend paid the rent. The

cheap lease is the only surviving evidence, and it is circumstantial, and it is exactly the shape you'd expect if it were true.

What isn't circumstantial is how it felt in the room. "Messy. But great," the editor says of the posting. "Great craic! (not crack — to my anxious heart's relief)." That parenthesis is the whole era in miniature: an Australian abroad, discovering that a word he'd only ever seen spelled one way meant something else entirely on this side of the Atlantic, and being quietly grateful for the extra vowel. Belfast in that window was not the Belfast of a decade of nightly news. It was a city learning to be a business address again, and this consolidation map was one of the small, unglamorous proofs of it.

Neither wave was the villain the elegy version of this story usually wants. Manila built careers that hadn't existed for a generation of English-speaking graduates. Belfast rented desks in a peace that needed paying tenants to feel permanent. The map just needed someone to draw it, and the someone, on both continents, was the person writing this sentence.

■ The wave's two engines

Every offshoring story the economics textbooks tell is Manila's: wages, converted across a time zone, at scale. Belfast needed a second engine, and the honest answer — flagged here as probable, not confirmed, pending the research pass — is the peace dividend: post-Good-Friday-Agreement investment incentives that made a contact centre a cheap, visible way to prove a recovering city open for business. Two hemispheres, two entirely different currencies of persuasion. Wages bought Manila. Peace, probably, bought Belfast. The same job title booked flights to both.

The empty queues

Not every consolidation story ends with a wave landing somewhere else. Some calls, on inspection, never existed at all — and the census’s strangest exhibits are the queues built, staffed and switched on for a volume that turned out to be a rounding error, or a rumour, or nothing.

The best of them ran on “your call is important to us” — in Japanese. The editor could write it: an exchange student to Japan in 1993–94, fairly fluent by the standard of a teenager billeted with a family that didn’t speak English. Fluent enough, it turned out, to write not just the comfort message but the QA guidelines and marking criteria behind it, entirely in Japanese, for a call centre a hemisphere away from anyone who’d need either. The message ran approximately — the editor’s own caveat, offered before anyone could catch him on it: “*it wasn’t exactly this, but something like*”:

“お客様に連絡いたします。録音させていただきます、ご了承ください。”

The recording carried enough mistakes that “we had to call in a pro.” His own gloss on the effort, added without being

asked: “*I probably sounded like a high school student — that’s all the Japanese I knew.*” Which means that somewhere in the 1990s, a Fortune-scale enterprise’s official Japanese greeting was, for a while, delivered in the register of an exchange student doing his earnest best — arguably the most honest “your call is important to us” ever committed to tape. The line itself sat in **Melbourne** — Melbourne, **Florida**, the geography doing quiet comic work of its own. To staff it, the editor interviewed every Japanese speaker he could find, some fifty candidates, to select the two who would work graveyard shift — awake across Australian-plus-Japanese hours, language-certified, timezone-locked.

They never took a real call. Not one, in the queue’s entire lifetime — except a single very drunk man who had dialled the wrong number. Run the Erlang arithmetic properly and it breaks the model rather than solving it: forecast demand ≈ 0 , staffing 2, lifetime offered calls 1, that one caller intoxicated, containment 100%. It is, by any measure this magazine trusts, simultaneously the best-provisioned queue in the census and the emptiest one in it.



THE BOARD, ALL NIGHT, EVERY NIGHT: NOTHING IN QUEUE, NOTHING WAITING, A SERVICE LEVEL OF 100 BECAUSE THE DENOMINATOR NEVER TROUBLED IT. THE BEST-ATTESTED WALLBOARD READING OF THE WHOLE CENSUS, AND IT IS DESCRIBING SILENCE.

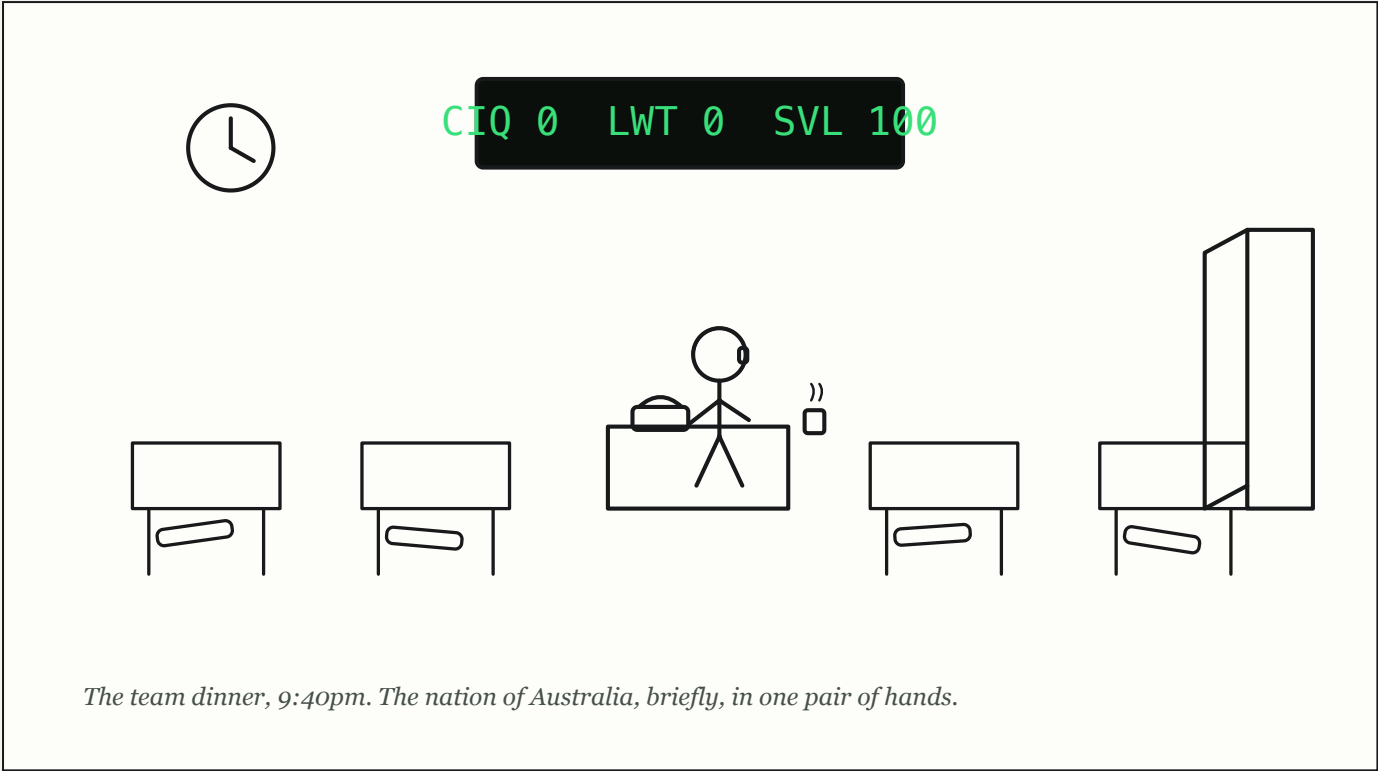
Its sibling ran shorter and stranger. One night on night shift, the whole team went out to dinner, and for an hour the editor *was* MSN Support for Australia. No one called. The staffing theology here is the purest in the whole edition: $n = 1$, offered load = 0, occupancy 0%, service level **0/0** — not zero, *undefined*, the one figure a wallboard has no LED for. The Japanese board defaulted to the appearance of perfection because a hundred is what a system shows when it has nothing to divide by; the honest answer,

mathematically, was that there was no answer at all. For sixty minutes, one person held a perfect queue — no waiting, no abandons, no calls — and Erlang C, for once, had nothing to say to him.

A third member of the family runs on the IVR page rather than here — option 6, tested exactly once, by the man who built it — and belongs to this census as surely as it belongs to that one.

Some of the calls this feature spent two pages chasing never existed. We staffed for them anyway — beautifully.

AS TOLD: the editor, 2026 · Erlang arithmetic per this edition's Reference well · Belfast investment-incentive context flagged for confirmation, not asserted



"For one hour, Trevor was MSN Support for Australia. Australia never called to check."

AUX 9 · CHARACTERS ARE ARCHETYPES · ANY RESEMBLANCE IS THE TRADE'S OWN FAULT

SERIES NOTE Why the strip is called AUX 9

Every switch shipped more auxiliary work codes than any centre had reasons. The first eight were solemnly allocated — break, lunch, meeting, training, system issues, and three variants of "ask your team leader." The ninth was never configured, never named, and never empty. This strip is set there.

QUEUE.

The wait. You are currently reader number one. Please continue to hold this page.

This is the section where nothing happens, at length, to music. The queue was the trade's actual product — manufactured by the thousand, measured to the second, displayed in LEDs above the floor so that everyone could watch it not shrinking. Here is the front door that answered before any human did; the scoreboard everyone lived under, and the vendors who built it; and the culture of

the hold itself — the music, the comfort messages, and one recording made in Japanese by a man doing his best.

The section closes, as every queue eventually does, in one of two ways. The industry's term for the second way is "abandon," and the theology feature at the back has strong views about where it belongs in the denominator.

CIQ 47 · LWT 999 · SVL 62 · YOUR CALL IS IMPORTANT

IVR

The system that answered before anyone did — Periphonics' cabinets, Edify's OS/2 wager, and the four dialects that became one language.

Before the queue, there was the menu. This is the trade that built it: engineers out of Long Island, Dallas and Santa Clara turning “press one” into a \$780m plumbing business, then, in five frantic months of 1999, turning “press one” into “say your account number.”

Periphonics got there first and stayed there longest. Four engineers out of Brookhaven Labs' government-funded “talking computer” research founded the company in Bohemia, New York, in December 1969; its first product, the 1970 Voicepac 2000, held 2,000 words on a magnetic disk and answered a Touch-Tone or acoustically-coupled handset. By the mid-1990s that lineage had become the VPS/is — Voice Processing Series/Information Server — rated at up to 480 IVR ports in a single cabinet, wired straight into a switch over T1/E1. It was the number that defined what “big” meant for a mid-decade deployment, and it made Periphonics worth \$436m in cash to Nortel in August 1999 — the single largest consolidation move in the family's history. Nortel folded the acquired Solaris-based OSCAR speech platform into what became the Nortel Speech Server; when Nortel itself went bankrupt a decade later, the whole lineage passed quietly to Avaya.

Everyone else consolidated around it. InterVoice, Dallas-based and founded 1983, insisted — almost alone in the trade — on building its own telephony cards rather than buying in, from RobotOperator (1987) through OneVoice (1989). It absorbed Brite Voice Systems in early 2000 (Brite having already swallowed Perception Technology in 1993) to become InterVoice-Brite. Syntellect, a 1984 Phoenix start-up whose 1990 IPO valued it above \$100m — one of only seven that year to clear that bar — eventually

landed inside Enghouse Systems' Interaction Management Group in December 2002. The decade's real business was never really who wrote the best menu; it was who got bought.

Edify took the contrarian bet and lived with it. Built from 1990 by a Santa Clara start-up staffed by ex-Rolm PhoneMail engineers, its Electronic Workforce platform ran on IBM's OS/2 rather than the industry's default Unix, adding voice ports through Natural MicroSystems ISA and PCI cards — the AG-4, AG-8, AG-T1/E1 family. Defensible in the early 1990s; increasingly lonely once IBM's own marketing convinced the market it didn't need OS/2-specific software at all.

Underneath almost every cabinet above sat the same third tier: Dialogic, founded 1983 in Parsippany, New Jersey by three AMD/Unisys alumni, selling the small analog boards and dense T1-class cards that IVR vendors bought rather than built — a business Intel thought worth \$780m in 1999, and that changed hands twice more once Intel gave up on it. Then, that same year, the industry's real inflection: AT&T, Lucent, Motorola and IBM each held their own incompatible dialog language, and spent five months merging them into one — VoiceXML, the standard that let “press one” give way to “say your account number” on almost any vendor's box. See overleaf.

■ Press 6

An American client once asked — insisted — that the IVR add an option: “Press 6 for our TTY service.” No one ever pressed 6. Except the editor, once, to confirm it worked.

It probably wasn't an absurd request at home: US TTY menu options traced to genuine ADA/FCC-era accessibility obligations, load-bearing there (the exact statute is a research-pass item, not yet confirmed, but the shape of the requirement is well attested). The joke, such as it is, travelled badly. Australia's deaf and hard-of-hearing callers had reached businesses through the National Relay Service since 1995 — a national front door, not a per-IVR branch — so an option 6 bolted onto an Australian menu duplicated infrastructure nobody needed to dial through. One caller, ever: the man who built it, checking the door worked, for nobody. The comedy is compliance crossing an ocean untranslated, not the door itself, and not who might have used it.

IVR — THE TRADE, 1990–2005

VENDOR / PRODUCT	YEAR	PORTS/SCALE	NOTABLE
Periphonics VPS/is	1990s–2003	480/cabinet	Flagship; T1/E1 into a Nortel switch
Periphonics VPS/sp 9500	1995–	unv.	Sun SPARCstation text-to-speech unit
InterVoice OneVoice	1989–90s	unv.	“Software Agent Platform”; own telephony cards
Edify Electronic Workforce	1990/1997–2006	unv.	OS/2-then-Windows; sold to InterVoice 2006
Syntellect Communications Portal	–2009	96 (case study)	Hosted, speech-enabled; Enghouse lineage
IBM WebSphere Voice Response	2002–	4–120 E1 trunks	Rebranded DirectTalk; AIX/Windows
Dialogic D/240 & D/480JCT-2T1	1990s	240/T1-dense	The plumbing under everyone’s cabinet
SpeechWorks DialogModules	1996–	n/a	Patented; licensed into four rivals’ toolkits
Nuance speech platform	1994–2005	n/a	SRI STAR Lab spinoff; absorbed SpeechWorks 2005

The OS/2 gamble

Edify’s Electronic Workforce is the trade’s great what-if: a genuinely capable platform tied to an operating system the market was actively being talked out of, port by port, one Natural MicroSystems card at a time. It survived on its own merits into the 2000s and sold to InterVoice in 2006 — proof the software was sound even where the platform bet wasn’t.

Four dialects, one language

The VoiceXML story is the decade’s tidiest resolution: four incompatible dialects racing each other in 1999, merged inside five months, ratified by the W3C five years later. Every speech vendor building against the standard from 2004 onward — instead of one proprietary script per platform — owes this timeline the whole of its portability.

Sources: ismoc.blogspot.com · manualslib.com · en.wikipedia.org · money.cnn.com · ftc.gov · bell-enterprise.com · m-cassociates.com · scripophily.net · redmondmag.com · tagn.wordpress.com · finextra.com · crunchbase.com · voice-boards.com · intel.com · eetimes.com · e-channelnews.com · w3.org · voicexml.org · ibm.com · cbonline.com · yumpu.com · dialogic.com · docs.nuance.com · justia.com

THE VERDICT — PERIPHONICS VPS/is

PORT DENSITY	★★★★★
DEPLOYMENT SCALE	★★★★☆
SPEECH PEDIGREE	★★★★☆
DOCUMENTATION	★★★☆☆
BROCHURE QUALITY	★★★☆☆

480 ports in a cabinet made the rest of the trade a rounding error, and it took a \$436m Nortel cheque to prove it. Ask for the manual; the brochure was never the point.

VOICEXML — THE FIVE MONTHS

1999

Mar — AT&T, Lucent, Motorola and IBM form the VoiceXML Forum, each carrying its own dialect (PML, VoxML, SpeechML) to the table.

Aug — the Forum merges them into VoiceXML 0.9, then 1.0, inside five months of drafting.

2000

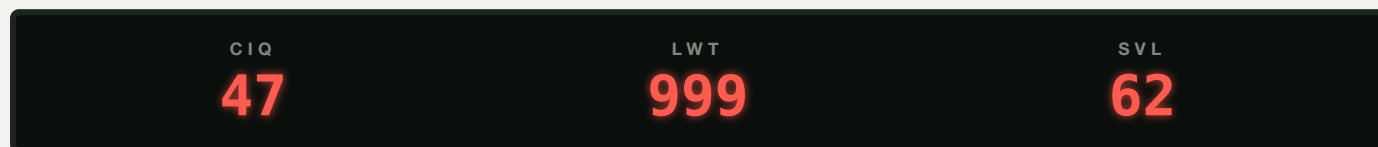
Apr — VoiceXML 1.0 submitted to the W3C.

2004

16 Mar — VoiceXML 2.0 becomes a full W3C Recommendation. “Press 1” starts losing ground to “say your account number.”

The Wallboard

The scoreboard everyone lived under, the vocabulary it spoke, and the number it refused to exceed.



THE EDITOR'S OWN BOARD, RECONSTRUCTED. RED LED, THREE FIELDS, LEFT TO RIGHT: CALLS IN QUEUE, LONGEST WAIT, SERVICE LEVEL. ARRIVAL, SUFFERING, JUDGMENT.

Every centre had one, mounted where the ceiling meets the conscience. It was the floor's only shared instrument: agents read it sideways during calls, team leaders read it openly, and workforce planners read it the way sailors read weather — knowing exactly which numbers were real, which were lagging, and which were about to get everyone shouted at. The board did not persuade or console. It displayed. Everything else — the sudden silence when CIQ jumped, the ritual standing-up of a supervisor, the specific dread of a service level with a 5 in front of it — was supplied by the room.

The editor's board is this feature's type specimen, and by a quirk of the historical record it may be the best-attested wallboard in existence: no vendor document surviving online preserves an actual deployed field layout, so testimony is what the trade has. His showed **CIQ · LWT · SVL**, left to right, and the ordering deserves notice — it is the customer's journey compressed to three abbreviations. You arrive (and are counted), you wait (and are timed), and you are answered or not (and it is judged). Whoever configured

that board wrote a three-act structure in nine LED characters and almost certainly billed it as an afternoon's work.

The number it refused to say

The board's LWT field was three digits wide. The queue was under no such constraint. The longest wait the editor ever saw displayed was **999** — seconds, he confirms, a ceiling of sixteen minutes and thirty-nine seconds — "and it didn't get bigger than that. On the board, at least." The parenthetical is the entire story. Somewhere past 16:39 the instrument stopped measuring and started pleading: an odometer rollover for suffering. Whoever specified three digits decided, in effect, that no room should ever be told what seventeen minutes looks like. The queue kept counting privately. Queues always did.

And when the data feed died, the editor's board displayed its final vocabulary item: **ERR**. Not a queue statistic — a confession. The sign had nothing to say and was saying so anyway, which puts it one honesty grade above several service-level reports covered later in this issue.

What the boards could say

The board's vocabulary was mostly borrowed. The data source of record in Definity shops was CMS, and the real-time report columns it published are the closest thing the trade has to a wallboard dictionary — the middleware (Inova's LightLink, Spectrum's UltraLink, Symon's software) simply mirrored them onto glass. The core set, verbatim from the CMS Supervisor split/skill real-time report: *Calls Waiting. Oldest Call Waiting. Avg Speed Ans. ACD Calls. Aban Calls. Agents Avail. Agents in ACW. Agents in AUX. Agents Staffed*. Underneath ran the database items themselves — ACDCALLS, ABNCALLS, QUECOUNT, EWTHIGH, INAU0-99 — the true names, spoken only by administrators.

What the record does *not* preserve, anywhere the sweep could reach, is a single actual composed message — a literal "SL 82% CW 4 OLDEST 0:38" with its trigger thresholds. That step, the one line of text the whole apparatus existed to produce, lived in site-specific configuration and died with it. The trade's most-read sentence is lost; its grammar survives.

The wire beneath the glass

The deepest surviving documentation of any board's inner life exists because a programmer got annoyed. In 2003 Robin Daugherty reverse-engineered Spectrum's sign protocol — on the stated grounds that the vendor's own manual was "poorly written, and almost completely inaccurate" — and published the frame: address bytes so one feed could drive a daisy-chain of boards, then command payloads carrying colour codes (Red, Green, Amber, Dim variants, three flavours of Rainbow), transition codes (Roll, Wipe, Scroll, Flash, a family of Twinkles), and five speeds. Amber, note,

was a first-class colour: the traffic-light convention — green fine, amber slipping, red shouting — was sitting right there in the palette, waiting for whichever integrator cared to wire judgment to hue.

The editor's board, being monochrome red, was exempt from all such nuance. It could not turn red at a slipping service level; it was born red. The only escalation available to it was blinking — and whether it did remains, formally, an open question of the historical record.

Birthdays at the top of the mountain

The boards were not all judgment. Vendor marketing promised celebration screens — birthdays, company events, league tables with agents' own pictures; one documented site ran a team competition where "the winning team was the first team to reach the top of the mountain." No specimen message survives, only the claims — but anyone who worked a floor knows the genre: HAPPY BIRTHDAY SANDRA, in the same phosphor that an hour later would render the afternoon's collapse. The board did not distinguish. Display was display.

Somewhere past 16:39 the instrument stopped measuring and started pleading.

SOURCES: documentation.avaya.com (CMS Supervisor split/skill real-time report; CMS database items dictionary) · manualslib.com (Lucent CentreVu R3V8 Database Items) · docs.geomant.com (Inova LightLink CMS data-source guide) · origin.barcodesinc.com (Spectrum ACD Wallboard installation manual #1.6) · robindaugherty.net (Spectrum sign protocol, 2003) · specorp.com · callcentrehelper.com · editor's testimony (CIQ/LWT/SVL board, 999, ERR — attested 2026).

WALLBOARDS

The vendors who built the box the whole floor watched — Symon’s browser-configurable LEDs, Inova’s device-agnostic middleware, and the slow crossing from daisy-chain to Ethernet.

What the board actually showed — the fields, the red, the theology of the number that mattered — waits for The Wallboard, elsewhere in this edition. This is the census of who built the box it lit up on.

The industry’s own vocabulary describes the object plainly enough: a wallboard provides “real-time and historical information about contact-centre queue conditions” (Genesys’ own glossary). Four names built the trade around that plain description, and one surprising absence sits beside them.

Symon Communications, founded 1980 and later headquartered in Plano, TX, built its name on LED boards for the contact centre; its NetLite II series ran eight models from a 2,048-pixel entry board to a 10,240-pixel flagship, browser-configurable — “another industry first,” by Symon’s own account — with patented standard-outlet power cabling and a wireless option. RMG Networks bought the company in 2013, by which point its boards reportedly ran in over 2,000 contact centres, network operations centres and data centres; its EMEA arm, Symon Dacon, separately claimed 8,500 installations before the 2014 rebrand to RMG.

Inova Solutions, founded 1984 and later based in Charlottesville, VA, built its whole business around one piece of middleware — LightLink — indifferent to what it fed: LED, LCD, web dashboard, or the agent’s own desktop. Its formal Avaya IQ compliance certification, tested March 2009, is the clearest dated milestone this census found for the moment the wallboard business quietly became a software business.

Spectrum Corporation, still trading out of Houston, tells its own history the same way: scrolling LED boards through the 1980s, expanding around 2000 into TV-dis-

play wallboards carrying graphics, video and weather alongside the queue stats. Its UltraLink II and V-Display split a desktop-plus-wallboard tier from a wallboard-only entry tier; its later VectraView pushed KPI gauges and, tellingly, gamification — team races, league tables, custom celebration screens — the LED board’s old competitive undertow made explicit in software.

Texas Digital Systems, founded 1972 in College Station, TX, arrived from the other direction — visual management for quick-service restaurants and cinemas — before its QuickCOM and VitalCAST lines crossed fully into contact centres, help desks and command centres.

The protocol story is harder to pin down. RS-232/RS-485 daisy-chain boards are attested in the trade’s living memory — an early-2000s Avaya CMS integrator forum describes dedicated server processes, cable runs, and a video-wall generation of scan converters and matrix switches — but exact wiring diagrams weren’t recoverable here; treat the transition as attested in outline, not in diagram detail. The confirmable milestone is Symon’s MySymon, a server bridge pushing stats to boards and TVs over IP instead of a serial run (~\$20,000 for a 300-seat build); by the mid-2000s the phosphor board itself was optional, Spectrum and Inova alike feeding LCD and web dashboards as readily as LED. One name came up empty: Daktronics, the Brookings, SD scoreboard giant since 1968, with LED scale to swamp every vendor above — no contact-centre product in its own catalogue, or anywhere else reached. The trade’s phosphor board was, on this evidence, someone else’s business.

WALLBOARD VENDORS — QUICK REFERENCE		
VENDOR	PRODUCT	NOTABLE
Symon Communications	NetLite II	8 models, 2,048–10,240 px, browser-config
Symon Communications	MySymon	IP bridge to boards/TVs, ~\$20k for 300 seats
Inova Solutions	LightLink	Device-agnostic middleware; Avaya IQ cert Mar 2009
Spectrum Corporation	UltraLink II / VectraView	Wallboard+desktop, then LCD/LED gamified templates
Texas Digital Systems	QuickCOM / VitalCAST	No-code dashboard; digital-signage companion

Sources: docs.genesys.com · contact-centres.com · mergr.com · signageinfo.com · specorp.com · txdigital.eu · crmmarketplace.com · tek-tips.com · destinationcrm.com · daktronics.com · yumpu.com · callcenterinfo.tmcnet.com

On Hold

The music, the messages, and the small recorded lies a civilisation told itself at 1200 baud of sincerity.

A customer once remarked to the editor that, after a thirty-minute wait on hold, an instrumental version of "(I Can't Get No) Satisfaction" was simultaneously hilarious and insulting. This feature is an extended footnote to that judgment.

Hold was the trade's invisible product. Nobody designed it on purpose — it precipitated out of Erlang C like sediment, the mathematically guaranteed residue of every staffing decision covered at the back of this issue. But something had to fill it, and what the industry chose to pour into its own waiting room tells you everything: music no one selected for pleasure, played through telephony bandwidth that removed whatever pleasure had survived selection, interrupted at intervals by a voice asserting a fact the queue was actively disproving.

The customer with the Rolling Stones problem had simply noticed the system state its own case. Thirty minutes is long enough for irony to complete its full call flow — arrive, queue, escalate, resolve. That the track was instrumental

only sharpens it: someone, somewhere in the supply chain of corporate audio, had removed the words while keeping the argument intact. The queue had, in the most literal sense available to licensed background music, reviewed itself. The customer held both readings at once — hilarious, insulting — which is the correct and complete critical response to the entire era, and this magazine knows it, because this magazine is that response at seventy pages.

"Your call is important to us"

The comfort message was the hold experience's load-bearing sentence, and the trade wrote it in-house. The editor did — more than once, in more than one language, as the facing column records. The genre's constraints were brutal: it had to be true enough to record, vague enough to survive any actual service level, and short enough to loop without inducing the specific madness the trade's own agents knew from hearing it through the wall eight hours a day. "Your call is important to us" won because it is unfalsifiable. Importance is not a queue statistic. There is no CMS database item for it — the closest the dictionary offers is priority tiering, and no one was going to record *your call is EWTMEDIUM to us*.

The Melbourne tapes

The editor's confession, printed with his clearance and his own caveat on the wording: he once had to record the comfort messages in Japanese. He could — exchange student, 1993–94, fairly fluent — and the message ran approximately like this:

お客様に連絡いたします。
録音させていただきます、ご了承下さい。

THE LINE, AS REMEMBERED. "IT WASN'T EXACTLY THIS, BUT SOMETHING LIKE." THE EDITOR'S RECOLLECTION, TWENTY-SOMETHING YEARS ON; THE PROFESSIONAL RE-RECORDING IS PRESUMED LOST.

He wrote the QA marking criteria in Japanese too — the full apparatus, translated. And then the honest part, in his own words: *"I probably sounded like a high school student — that's all the Japanese I knew."* The original recording carried enough mistakes that a professional was called in to redo it. Consider what briefly existed: a Fortune-scale enterprise's official Japanese greeting, delivered in the register of an exchange student doing his best. It may be the most sincere "your call is important to us" ever committed to tape — most of them are lies read by professionals; this one was the truth read by an amateur.

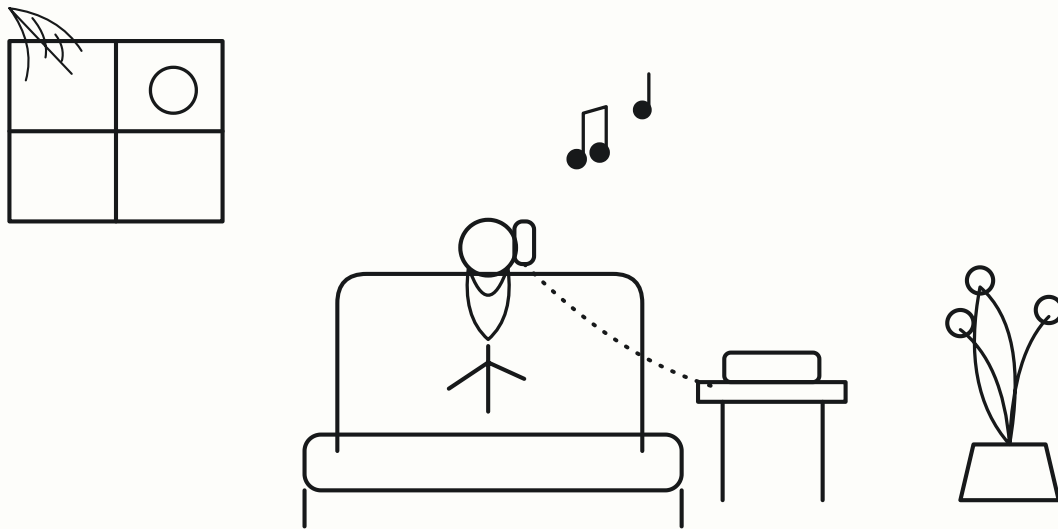
Where that queue was, who staffed it, and precisely how many customers it ever served is a story that belongs to the closing feature of the TRUNK section — it involves the number zero, the number two, and one man who had been drinking. What belongs here is the recording booth: the trade made these little tapes by hand, out of whoever it had. The industry's most-heard voices were never voice artists. They were the person in the office who could.

A field guide to hold music

The canon, as the floor knew it: the pan-pipe arrangement of a song you almost recognised; the thirty-second loop with the audible splice; the classical piece chosen by a director's spouse; licensed pop rendered instrumental for reasons of cost that read as reasons of mercy; and silence — the boldest choice, deployed only by organisations whose customers had nowhere else to go. Each looped against the comfort message on an interval someone, somewhere, had configured — and that someone never once had to listen to the combination for thirty consecutive minutes with a billing dispute unresolved.

**Most comfort messages are
lies read by professionals.
This one was the truth read
by an amateur.**

SOURCES: editor's testimony, cleared [full] (the Satisfaction incident; the Melbourne recordings — Japanese text flagged as approximate by the teller). The queue itself: see WHERE DID THE CALLS GO?, page 13.



Day three. The hold music began "Satisfaction" for the eleven-hundredth time. Gary felt the artist had a point.

"Your call is important to us. Your patience is important to us. At this point, Gary, frankly, you are important to us."

AUX 9 · THE BOARD STOPPED AT 999 · GARY DID NOT

PANEL NOTE On 999

The longest wait the editor ever saw a board admit to was 999 seconds — the display's three-digit ceiling, not the queue's. Gary here is therefore not an exaggeration. He is an extrapolation, which the planning priesthood will confirm is an entirely different sin.

AGENT.

The answer. A human being, a headset, a scripted greeting, and forty seconds of grace before the next one.

Everything in this magazine so far has been infrastructure. This section is the person it was all pointed at: the agent, seated, logged in, AVAILABLE — a state the systems tracked with more devotion than most religions track souls. Here is the equipment that touched them: the headsets whose brochures were the era's finest printed matter, the digital desksets an editor confess-

es to having loved unwisely, and the listening apparatus — cassette recorders, Service Observing, and a marking form with fifteen criteria and a skull symbol — that judged every word.

The agent's side of the story is mostly told in aux codes, and the trade's aux codes are covered where they belong: in the wars.

STAFFED 86 · AVAIL 3 · ACW 11 · AUX9 1 SINCE TUES

HEADSETS

Every dynasty, every cord, and the rival that was never a rival at all.

No agent touched the switch. No agent read the CMS interval tables. Every single one of them touched the headset, for eight hours at a stretch, and the trade's brochureware knew it — this section gives it the reverence it spent thirty years angling for.

Plantronics did not so much enter the trade as write its uniform. Founded in 1961 as Pacific Plantronics, the company was within years the sole supplier of lightweight headsets to American air-traffic controllers and Bell Telephone operators — the direct institutional ancestor of the call centre, before there was a centre to call. A division named SPENCOM built the sets NASA wore through Apollo; Neil Armstrong spoke from the Moon on 20 July 1969 through one. That mission-critical backstory sold for thirty years, right down to the SupraPlus box on a suburban call-floor desk.

The dynasty proper begins with the StarSet (1970), an over-the-ear model with a voice tube, the first headset the earliest call centres actually wore on shift. Everything after it is a wearing-style argument dressed as a product line: Supra and SupraPlus through the eighties and nineties, Encore's noise-cancelling refresh in 1996, TriStar's barely-there three-point fit, DuoSet and DuoPro convertibles, and finally the CS-series wireless sets that, by 2003, cut the cord altogether. Every one, styled differently, sold on the same word: comfort, worn all day.

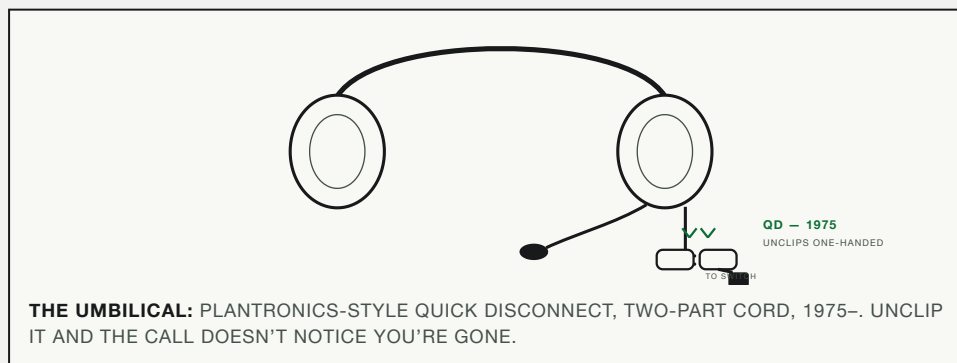
But the true spine of the era was not any named model. It was a fitting the brochures barely photographed: the **Quick Disconnect**, 1975, splitting the cord into two pieces joined by a barrel an agent could pop apart one-handed. Unclip it and you could stand, walk the call to a supervisor, or leave the desk — headset still on, the call

briefly nobody's. It is the least glamorous invention in the trade and the one every subsequent design depended on; GN Netcom built its own equivalent rather than go without one.

GN Netcom arrived at headsets from an unrelated trade: hearing aids. Spun off in 1987 from parent GN Danavox, its first product applied hearing-health acoustic engineering to office telephony. The Danish firm built its own QD-equivalent line through the nineties before buying its way into the American market, acquiring Jabra Corporation of San Diego in 2000 — the deal that put "Jabra" on the parent's global badge.

In 2003, Sennheiser did almost exactly the same thing, sixteen years later: Sennheiser Communications, a joint venture with hearing-healthcare group Demant, launched five contact-centre headsets on day one. Two of the trade's major houses entered call-centre headsets from audiology rather than telecoms, as though the ear, not the switch, were where this business actually lived.

And then there was ACS. Dealer sheets through the nineties ran it as a third house alongside Plantronics and GN Netcom. It was never a rival: ACS, alongside Liberation and UNEX, was one of GN Netcom's own house brands, sold through a different channel wearing a different name. The trade spent a decade comparing three headset makers. There were two.



WEIGHT-IN-GRAMS — THE DYNASTY, RANKED

MODEL	STYLE	WEIGHT	NOTABLE
Mirage H41/H41N	over-ear, no headband	19 g	“so light you hardly know it’s there”
TriStar H81/H81N	three-point, no headband	~12 g	help-desk / telemarketing niche
DuoPro H161N/171N/181N	convertible	38 g	2001 refresh; anti-twist boom
GN 2100 (2120/2125)	4-in-1 wear	21–25 g	Acoustic Transmission Line tubing
Encore H101N	over-the-head, binaural	78 g	1996 noise-cancelling standard
SupraPlus HW251N (mono)	over-the-head	67 g	the era’s default workhorse
SupraPlus HW261N (binaural)	over-the-head	88 g	wideband, both ears
FreeHand	in-ear	unv. (<1½ oz)	ultra-light entry, 1995

The wireless turn

By 2003 the whole trade had begun cutting the cord in earnest. Plantronics’ CS50 was among the first genuinely convertible wireless systems — 900 MHz digital, a 300-foot roam, eight hours of talk time, switchable over-head or over-ear straight out of the box. GN Netcom answered with the DECT-based GN 9120, offering three interchangeable boom-mic arms and 64-bit encryption borrowed from a military spread-spectrum protocol. Plantronics took a Bluetooth Voyager 510S to a CES award in 2005; by around 2008 Jabra’s Pro 9400 series had grown its DECT base station a touch screen tracking call history across three linked phones. The QD’s whole promise — leave the desk without losing the call — had, by the decade’s end, made the desk itself optional.

Sources: headsetplus.com · founderstelecom.com · headsetexperts.com · wirelessnetworksonline.com · eposaudio.com · en.wikipedia.org (Jabra brand)

THE VERDICT — THE QUICK DISCONNECT

ELEGANCE ★★★★★

UBIQUITY ★★★★★

DRAMA WHEN YANKED MID-CALL ★★★★★

BROCHURE BILLING ★☆☆☆☆

EVERYTHING AFTER IT OWES IT ★★★★★

Not a headset. The joint every headset in this section was built around, and the one thing on the price list nobody ever put on the cover. Ask for it by the barrel, not the badge.

Two houses, hearing aids, twice

GN Netcom out of GN Danavox, 1987. Sennheiser Communications out of Demant, 2003. Sixteen years apart, same origin story: a hearing-health-care parent decides the office is just a very loud, very long conversation, and builds a headset division to prove it. Two of the trade’s three real houses got here by way of audiology. The switch companies never noticed.

THE HANDSET

Not the switch. Not the CMS. The one part of the whole Definity empire an agent could actually touch.

Every census needs its Xerox 5046 moment — the machine the person compiling it will not pretend to be neutral about. Here it is: the Lucent/Avaya digital deskset, and the ring tone the editor refuses to apologise for.

The Definity empire, across three company names, was built from switches the size of filing cabinets, a reporting system on Sun hardware, and enough Erlang C theology to fill an appendix. None of it sat on an agent’s desk. What sat there was a handset — the 8400-series and 6400-series digital desksets, and above them the Callmaster sets built for the agent role — and it is the one part of the whole architecture the editor confesses, unreservedly, to having loved.

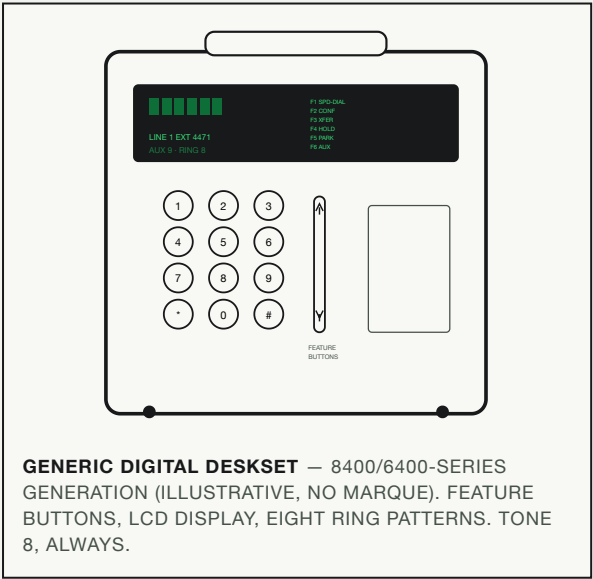
The pleasure was in the programming. Every feature button on an 8410D or a 6416D+ could be assigned — line appearances, speed-dial, call-park, the aux codes an agent lived and died by — and a set that arrived dumb from the factory came alive, one button at a time. Watching a deskset acquire a personality this way was, to a certain kind of person, close to a hobby.

Callmaster sets went further — built assuming a headset was already plugged in and a call always about to land, the

agent variant of the family, stripped and hardened for volume. Wrapped around it all was the aux-code liturgy: after-call work, break, training, codes an agent kept memorised as a PIN, each one a feature button away.

Then there was the ring. The Definity sets offered eight selectable ring patterns, a footnote to the manuals and doctrine to the editor. The choice, made once and never revisited: ring pattern 8, always. Verbatim, for print: “doooooo-da-de-doo...” No further explanation was offered, and none is really required.

The desksets outlasted every rebrand. A handset racked in 1994 under AT&T could still be humming under Avaya’s own badge a decade later, aux codes unchanged, tone 8 exactly where it had always been. Three company names, one deskset, one ring. The line art alongside is unbranded on purpose.



THE VERDICT — RING PATTERN 8

DISTINCTIVENESS	★★★★★
RESTRAINT	★☆☆☆☆
EXPLICABILITY	★☆☆☆☆
EDITOR’S COMPLIANCE RATE	★★★★★

“doooooo-da-de-doo...” — not reviewed for merit, only for permanence. Chosen once, sometime in the nineties, never revisited since.

SERVICE OBSERVE

Every call may be monitored or recorded. Somebody built the monitoring, and somebody else delivered the paperwork.

Before speech analytics, before NICE and Witness, there was a cassette recorder, a special cable, and an in-house program that crashed at the worst possible moment with the era's most honest error message.

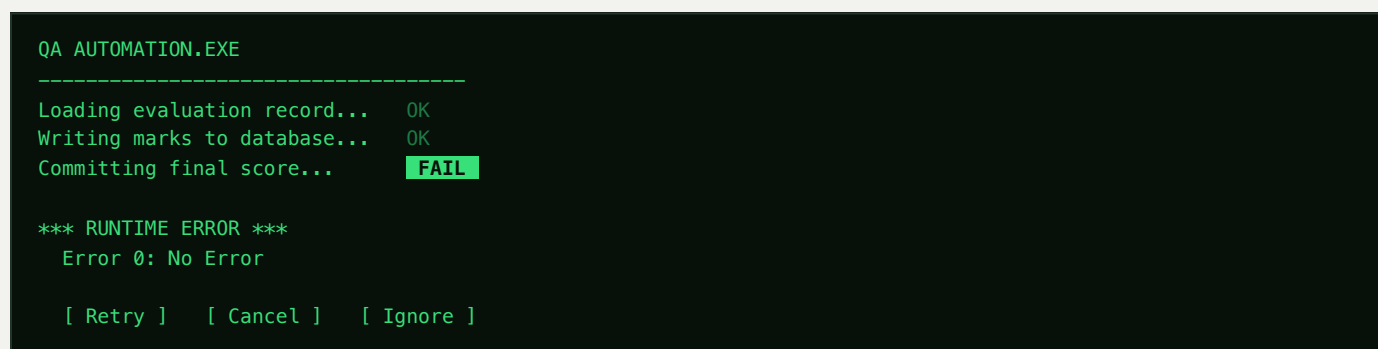
The sentence itself was Australian in origin. An Australian team — this magazine's own editor among them — pioneered one of the first recorded lines to tell a caller their call “may be monitored or recorded for quality and training purposes,” a form of words so completely absorbed into the language since that it now reads as inevitable. In the mid-nineties it was new, and somebody had to build the machine standing behind the sentence.

The machine, at first, was almost embarrassingly literal. Service Observing — a standard switch feature, built to let a supervisor bridge silently onto a live call — fed the audio

down a special cable into an ordinary cassette recorder, the kind sold for dictation. A QA marker sat with a form (see the artifact overleaf) and a tape deck, and evaluated calls the way a critic evaluated a gig: live, then again on replay, notes in hand.

Evaluation itself ran through an in-house Visual Basic application, built for the purpose and known, without irony, as **QA Automation**. It scored calls, stored results, and — with the reliability period software of this vintage is generally remembered for — crashed at the least convenient possible moment, surfacing a dialog box that has outlived every other artefact of the system.

“Error 0: No Error”



RECONSTRUCTED FOR PRINT. NOBODY WHO SAW THE DIALOG EVER WORKED OUT WHAT IT MEANT; NOBODY WHO SAW IT EVER FORGOT IT.

It is, in miniature, the whole later history of contact-centre quality: a cassette and a cable gave way to dedicated voice loggers, which gave way in turn to the speech-analytics platforms that now score sentiment before a marker ever presses play. The apparatus changed, generation after generation. The instinct behind it — someone, somewhere, should listen back — did not.

Nor did the paperwork. Every generation of listening apparatus this trade ever built came wrapped in its own quietly absurd nomenclature — forms named by people who spent

all day on the phone and, it seems, never once heard themselves. The artifact overleaf reconstructs the marking sheet a cassette-era evaluator actually worked from: fifteen criteria, a fatal mark for the ones that mattered most, and a total out of a hundred that decided, tape by tape, whether a call had gone well.

The apparatus had a human end, too — not a machine at all, but the person who received the finding. That part of the story runs overleaf.

The quacker

At nineteen, one QA Team Leader on that same Australian operation did what nineteen-year-olds with a marking sheet and a sense of purpose tend to do: he marched straight to the leader of the call centre and formally presented them with a QA Corrective Action Request — a QACAR, universally pronounced, with what can only be called institutional indifference to consequence, “the quacker.” He was full of zeal and indignation. He was, by his own later account, magnificently unaware of how the moment read from the other side of the desk.

There was a sibling instrument, deployed before the fact rather than after it: the QA Preventative Action Request, or QAPAR — pronounced, inevitably, “the crapper.” Between them, quacker and crapper made up the complete quality-

management arsenal of a genuinely pioneering QA operation: one form for what had already gone wrong, one for what might yet go wrong, both named by an organisation that spent its entire working day listening to other people’s calls and somehow never once listened to its own acronyms.

The zeal is the interesting part, not the forms. It survived. The same instinct that sent a teenager marching upward with a quacker under one arm turned up again, years later, in an editor who wrote to the discipline’s leading mathematician about a service-level formula he was certain was wrong (see *Service Level: a theology*, elsewhere in this edition), and received, by way of answer, a single scathing word. The paperwork matured. The zeal did not.

■ The instrument suite, in full

Quacker: after the fact. Crapper: before it. An organisation that listened for a living, and never once heard itself.

Which is the whole feature, really, compressed into a corridor: a switch that could bridge silently onto any call, a cassette deck that could capture it, a form that could mark it,

and an acronym factory downstream of all three that nobody thought to run past a marker with a sense of humour. The listening post heard everything except itself.

“What a knob! haha”

— the editor, on himself, nineteen years old and armed with a quacker

Told to this edition by the editor; the sentence, the tape, the app, and the acronyms are his own history.

QA-001

RECONSTRUCTION

Quality Assurance — Call Evaluation Criteria. Not the original document: a period-faithful reconstruction, built from what the marking actually rewarded and punished, for the reader who never saw the real form.

Document ref: QA-001 Rev 3 · Issued under authority of the QA Programme · Breaches may result in a QA Corrective Action Request (QACAR); systemic risks in a QA Preventative Action Request (QAPAR) · **CONFIDENTIAL — QA TEAM USE ONLY** · Calls evaluated via Service Observing with tape capture · Score /100 · Criteria marked ☹ are FATAL: automatic zero regardless of other scores · Markers must attend weekly calibration.

#	CRITERION	WHAT THE MARKER LISTENED FOR	PTS	☹
1	Correct opening	Scripted greeting, company name, agent name, offer of assistance — in order, without audible sighing	8	☹
2	Verification	Customer identity confirmed per procedure before any account detail crossed the line	8	☹
3	Active listening	Acknowledgment tokens at natural intervals; no asking for information the customer just gave	6	
4	Accuracy of answer	The answer was <i>right</i>	10	☹
5	Completeness of answer	The answer was <i>whole</i> — the question behind the question addressed; no engineered callback	8	
6	Use of hold	Permission asked AND received; reason given; thanked on return; checked back each 30–60s; under two minutes or escalate	7	
7	Hold vs mute discipline	Hold means hold. The open-mic commentary sin is a career event, not a marking event	5	☹
8	Use of tools	Correct system, correct screen, correct knowledge article — not the agent's private crib sheet	6	
9	Data capture	Notes a stranger could action; correct disposition/wrap codes, no default-code laziness	6	
10	Tone & professionalism	Courteous, confident, unhurried; no slang, no eating, no audible keyboard warfare	7	
11	Call control	The agent steered; the call went somewhere; tangents lovingly but firmly returned	6	
12	Escalation & transfer	Right queue, warm transfer, customer never re-explains from zero	7	
13	Further assistance	"Is there anything else I can help you with today?" — asked as a question, not a threat	5	
14	Correct closing	Branded sign-off, thanks, agent waits for the customer to disconnect first	6	
15	Use of ACW	Wrap begun immediately, completed within standard — ACW is for wrap, not for recovery	5	
Total			100	

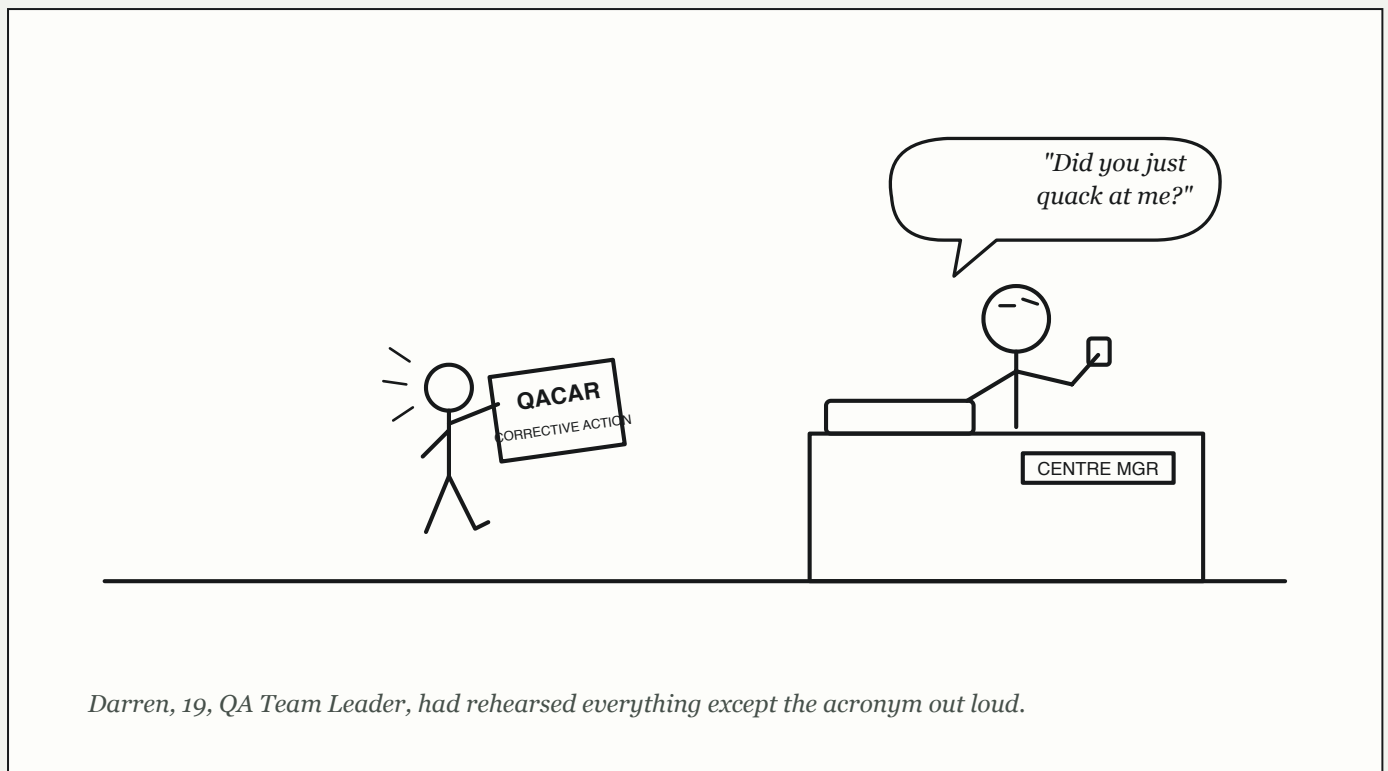
Marking notes: 90+ exemplary (played at team meetings, to the exemplar's horror); 75–89 competent; 60–74 coaching plan; <60 or any ☹ — QACAR raised, delivered per procedure. Zeal optional but traditional. The criteria also existed in Japanese — written, for one edition of this desk, for a two-person night shift staffed against a lifetime call volume of one.

■ Marker's marginalia

Criterion 1 is fatal because the opening is the brand's only guaranteed sentence; everything after it is improvisation.

Criterion 6 contains the whole trade in miniature: *permission asked AND received* — a generation of agents said "mind if I pop you on hold?" and left before the answer.

The ☹ on criterion 7 postdates an incident nobody will describe.



Darren, 19, QA Team Leader, had rehearsed everything except the acronym out loud.

Full of zeal and indignation, Darren delivered his first Corrective Action Request to the most senior person in the building. The preventative form, he explained, was pronounced differently. It did not help.

AUX 9 · THE QUALITY SUITE: QUACKERS & CRAPPERS · SEE THE LISTENING POST, PAGE 29

PANEL NOTE Historical basis

The instrument suite is real and appears in this issue's Listening Post feature: QA Corrective Action Requests and QA Preventative Action Requests, deployed by an organisation that listened to telephone calls professionally and never once heard its own paperwork. The zeal is also real. The editor has confirmed it was his.

WRAP.

After the call. The customer has hung up. Now the arguing about what just happened can begin.

The call is over; the counting is eternal. This is the section for the people who turned yesterday's calls into tomorrow's roster — the planning priesthood and their suites, the adherence wars they fought fifteen minutes at a time, and the strange scripture of interval attribution, in which a forty-four-minute call is recorded entirely in the quarter-hour it happened to end, and Avaya's

own manual explains why with perfect composure. The service-level theology opens the section because it is the section: everything else here is commentary.

At the very back, the Reference well: Erlang C worked in full, the way it was taught to the editor by a patient man with an ICMI book. Scripture, then appendix. The trade always filed things properly, even its faith.

INTERVAL CLOSED · CALLS 5 · AHT 672 · OCC 118%

Service Level: A Theology

80/20, its heresies, and the denominator that a professor of applied probability examined and pronounced perverse.

Eighty percent of calls answered within twenty seconds. No one alive can produce the council at which this was ratified, and yet for fifteen years the entire trade tithed to it. That is not a metric. That is a faith.

Every religion needs three things: scripture, a priesthood, and heretics. The scripture was Erlang C, filed reverently at the back of this issue. The priesthood was the planning function, covered two features hence. This feature is about the heretics — and about the fact that the deepest heresy of the era was not a wrong target but a wrong *fraction*, defended for two decades with a straight face by people who could have checked.

Understand first what 80/20 actually promised. Not that the average caller waited twenty seconds — averages were ASA's department, a different column with different sins. It promised that if you took every call that arrived, four in five of them reached a human inside twenty seconds. The definition's entire moral force lives in the phrase *every call that arrived*. Calls that gave up waiting arrived too. The cus-

tomers who abandoned at minute six was not a rounding error; they were the system's most emphatic data point, a person who reviewed the queue and voted with the hook switch.

The perverse denominator

Which brings us to the heresy. The editor once encountered — at an institution this magazine will describe only as *a large operation* — a service level defined as calls answered within 20 seconds, divided by **calls answered**. Read it twice; the trap is quiet. Abandoned calls do not appear in the numerator, which is defensible, and do not appear in the denominator either, which is not. They simply vanish. The customers who suffered most were removed from the ledger of suffering.

The mechanism deserves to be stated with the clarity the original documentation never achieved: under this formula, the worse the queue becomes, the more callers abandon; the more callers abandon, the fewer calls are answered late; the fewer calls answered late, the *better* the reported service level. The metric rewards failure, in proportion to the failure. A centre could improve its number by unplugging half the floor.

The emoji proof

The editor, unable to persuade the operation by algebra, eventually reached for pictographs. His communication — remembered by many, he reports, and ultimately ineffective — deserves reprinting as the clearest statement of queue accounting ever produced in an office suite:

$$\frac{\text{😊}}{\text{😊} + \text{😐} + \text{😞}} = \text{service level}$$

😊 answered within threshold · 😐 answered late · 😞 abandoned. Honest schools differ on where 😐 belongs; none delete 😞.

$$\frac{\text{😊}}{\text{😊} + \text{😐}} = \text{the heresy}$$

The 😐 is simply not in the sum. The customers who left were erased from the denominator.

Anyone can look at the second fraction and ask the only question that matters — *where did the frown go?* — which is precisely the question the algebra had failed to make anyone ask for years. It remains, to this magazine's knowledge, the only service-level dispute ever conducted in emoji, and the fact that it changed nothing is the era in one line.

The ruling

Denied by his own organisation, the editor appealed to canon law. He wrote to the lead of CCmath — which is to

say Ger Koole, professor of applied probability at VU Amsterdam, co-founder of the firm that exists to make call-centre mathematics rigorous, author of the standard text. If the discipline has a Vatican, the letter went there. The reply was scathing, and its verdict was a single load-bearing word: the formula was **"perverse."**

They still haven't changed it. Twenty years. The ruling stands; the heresy ships. Somewhere right now a dashboard is rendering that fraction in a pleasant corporate green, and somewhere beneath it a customer is abandoning their call, improving the number as they go. The trade's deepest lesson was never about staffing. It was that a metric, once institutionalised, outlives the mathematics, the mathematician, and very possibly the institution.

**The worse the queue became,
the better the number looked.
A centre could improve its
service level by unplugging
half the floor.**

As for 80/20 itself: inherited scripture, honestly examined, is still the better religion. It counted the frowns. Whatever else the era got wrong — and the next two features are an inventory — it mostly kept the abandoned in the denominator, where the mathematics, the professor, and common decency all agree they belong.

SOURCES: editor's testimony, cleared [full] (the formula, the emoji communication, the correspondence; org unnamed by editorial rule) · ccmath.com and VU Amsterdam public records (Koole, CCmath founding 2005, *Call Center Optimization*) · the private email is quoted at one word and its author may yet be asked to bless the citation.

THE ADHERENCE WARS

Service level was the scripture two pages back. Adherence was the discipline that enforced it, to the second, on people.

Every centre in this issue believed in the 80/20 target the way a congregation believes in the calendar. Adherence was the clergy sent to check you were actually in the pew during the hours the schedule said you would be — and the trade built an entire product category, numbered like firmware, just to watch the gap between the roster and the human standing at Login.

Adherence is, at bottom, a comparison of two documents: the schedule a WFM system produced weeks in advance, interval by fifteen-minute interval, and what an agent's login state actually did during that same interval. TCS Management Group thought this comparison important enough to ship as its own numbered product line — not a checkbox on a features sheet but **Real-Time Adherence**, a named SKU sitting alongside SeriesFive and AutoPilot in the company's own product roster. Blue Pumpkin took the doctrine further down the org chart: Director Professional gave supervisors intraday adherence reporting as standard, and gave agents themselves self-service access to view their own schedule and request a trade — pushing the theology from the pulpit to the pew, so the congregation could at least see the hymn sheet it was being marked against.

The aux code was where the theology met its own loopholes. Officially, an aux code was a numbered reason for being staffed but unavailable, and CMS reserved an entire family for it — INAU0 through INAU99, a hundred slots waiting for a site to decide what unavailable meant. A well-run centre populated maybe a dozen: training, coaching, systems down, break, the bathroom code nobody labelled *bathroom* because everyone already knew which number it was. That was the official list, dutifully documented in the

CMS dictionary and never once matching the folklore layer sitting on top of it.

The folklore was simpler and considerably more honest about human nature: whatever code the roll-out team forgot to configure a meaning for became, within a fortnight, the code everyone was quietly in. An unlabelled slot audits perfectly and explains nothing — the database logs the minute, not the motive — and a centre with ninety-nine reserved reason codes could still produce one unaccountable black hole that every agent on the floor could find blindfolded. This magazine's own running cartoon takes its name from exactly that phenomenon: every centre had an unallocated aux code, and someone was always in it.

Even that undersold the art of hiding, because the real virtuoso move happened one state earlier. After-call-work — ACW — was not aux at all; it was call-based, legitimate, and, per Avaya's own database logic, still *work*. An agent was permitted, even expected, to sit in ACW finishing notes on the call that had just ended, and nothing in the adherence engine could object to a call being wrapped up properly. Hold ACW open a little longer than the wrap genuinely required, and the minutes bought were invisible twice over: not aux, so no reason code to explain; not talk time, so no service-level exposure either. Two stories from the editor's own floor ran on precisely this apparatus. One is a kindness. One very much is not.

■ Aux theology, official and otherwise

The documented family: INAU0–INAU99 and its companion TI_AUXTIME items, tracking staffed-but-unavailable minutes by reason code, per Avaya's own CMS Database Items manual. The undocumented family: whichever of those hundred slots nobody assigned a name to, which is the one the floor actually lived in. Both are true. Only one appears in the training manual.

Nellie, and the password called stupid

1997. The editor kept forgetting his CMS password, which is a small, forgivable sin against a system that ran on fifteen-minute intervals and no patience. **Nellie**, who ran telephony — and telephony ran the building, whatever the org chart claimed — solved it the way the good ones always solved things: she changed his password to **stupid** and set it never to expire. It never did. Read one way it is a security lapse a modern auditor would flag in the first five minutes of a walkthrough. Read the way it was actually meant, it is a small, exact act of kindness from someone who had better things to do than watch a colleague get locked out of the reporting system every ninety days, and who fixed the actual problem instead of the policy.

The voicemail resets

The same telephony access cut both ways. For years afterward, at intervals chosen for no reason except that Nellie and the editor didn't much care for one of the Team Leaders — who was, by his own account, a bit better than everyone else — the two of them would reset her AUDIX mailbox. Not delete it. Reset it, so that the next time she dialled in she was greeted, courteously, as a stranger: new password, new name recording, new greeting, from the top, every single field. No fingerprints, no ticket, no pattern an adherence report would ever surface — just a random-interval schedule a WFM analyst would recognise as genuinely good practice, aimed, for once, at a person instead of a queue.

The mechanism is the joke's whole engineering: the reset didn't just erase the greeting, it demoted the account back to its *initial* password — which the system's own prompt insists you obtain from your system administrator. Which was telephony. Which was Nellie.

The support loop

Because here is the completed circuit, confirmed by the editor for this printing: the Team Leader, mailbox freshly amnesiac, would typically have to **call Nellie to report the problem**. The victim filed the fault with its author. Nellie, only too quick: *"I don't know what you're doing... this doesn't happen to anyone else."* Which was — note the craftsmanship — **technically true**. It didn't happen to anyone else. It happened to her. The era's most structurally honest gaslight, delivered from behind the only desk with the keys to disprove it.

And when the bit demanded escalation, it got escalation: more than once, Nellie **physically replaced the Team Leader's telephone** — a solemn hardware swap for a fault that lived three desks away, in the swapper. Diagnosis, investigation, remediation, uproarious backstage laughter: a complete incident-management loop whose single point of failure was also, in every sense, the point of failure. The trade spent the decade perfecting closed-loop process. This one simply closed a little tighter than most.

SOURCES: ql-wfm.md (TCS Real-Time Adherence, Blue Pumpkin Director Professional) · Avaya CMS R15/R16.x Database Items and Calculations (INAX/TI_AUXTIME family; ACW as call-based item) · Lucent AUDIX Voice Messaging Quick Reference, 585-305-714, Issue 1, 11/93 · Saint Joseph's College (Maine) OIT AUDIX guide · Southeastern Louisiana University AUDIX reference sheet · editor's testimony, 2026-07-29/30.

WHAT A RESET SENTENCED YOU TO

1. Dial the AUDIX system number. *"Welcome to AUDIX. For help at any time, press *H."*
2. Extension, then #. Password, then # — except it's the *initial* password again: "get your initial password from your system administrator." A walk back to telephony's desk, every time.
3. Forced password change (Activity Menu **5-4**): enter a new one, re-enter to confirm.
4. Re-record your name (**5-5**): press 1, speak at the tone, 1 to stop, # to approve. The system explains, gently, that "your name will be included in system announcements that you and other people hear."
5. Re-record and reactivate your personal greeting (Activity Menu **3**): listen, then 1 to record, 1 to stop, # to approve — then activate.

FIVE STATIONS. EVERY RESET. FOR YEARS.

THE VERDICT — ADHERENCE, THE TRADE'S TRUE RELIGION

ENFORCEMENT, ON PAPER	★★★★★
ENFORCEMENT, IN PRACTICE	★★☆☆☆
LOOPHOLES PER AGENT	★★★★☆
CAPACITY FOR KINDNESS	★★★★★

A hundred reserved codes, one always unlabelled, and a telephony desk with the keys to everyone's dignity. It enforced the schedule and, once in a while, forgot to.

THE 11:59 PROBLEM

A call answered at 11:59 and wrapped at 12:43 belongs, in its entirety, to an interval it never rang in.

Every WFM analyst who ever pulled an Avaya interval report eventually had to answer this for themselves, because the documentation answers it only if you read it exactly right: when a call spans a boundary, which fifteen minutes gets it? The manual's answer is precise, four sentences long, and violates almost everyone's instinct on first reading.

None of this begins on the reporting side. A call's entire journey is decided upstream, at the SAT, by a switch administrator typing into a text-mode form with no mouse and no GUI — the same Definity/ECS lineage the switch census covers on p.6. Dial a **VDN** — an extension with no phone behind it — and the call is handed to a **vector**: a numbered list of up to thirty-two steps that waits, announces, queues, checks a condition, or gives up. CMS, sitting beside the switch on its own Sun box, configures none of this. It only watches the vector run and writes down, afterwards, what happened. Below is a vector built exactly the way Avaya's own tutorial builds one — queue to a skill, loop on hold music, check the expected wait, escape to busy — with only the skill numbers changed to fit a sales line.

```

Page 1 of 1

CALL VECTOR

Number: 42          Name: sales-main          Multimedia? n  Lock? n
Basic? y  EAS? y    G3V4 Enhanced? y  ANI/II-Digits? n  ASAI Routing? n
Prompting? n  LAI? n  G3V4 Adv Route? n  CINFO? n  BSR? n  Holidays? y

01 wait-time 2 secs hearing ringback
02 queue-to skill 1st pri l
03 announcement 2771
04 wait-time 30 secs hearing music
05 check skill 1st pri m if expected-wait < 60
06 goto step 9 if staffed-agents in skill 1st < 1
07 goto step 4 if unconditionally
08 disconnect after announcement 3222
09 busy

```

VDN 42, "SALES-MAIN" — G3V4 SYNTAX, BUILT PER AVAYA'S OWN PROGRAMMING CALL VECTORS TUTORIAL. THE CHECK...EXPECTED-WAIT < CLAUSE IS QUOTED FROM THE COMMAND REFERENCE; THE 60-SECOND THRESHOLD AND THE SALES FRAMING ARE RECONSTRUCTION.

Whatever this vector decides, CMS logs it as one of two fundamentally different kinds of data. Its own *Database Items and Calculations* manual draws the line without hedging: **“items in the CMS database can be either *call-based* or *interval-based*. Most CMS database items are *call-based*.”** — CMS R15 Database Items and Calculations

The rule for the call-based majority is the one that trips people up: **“Call-based data is committed to the database after a call completes. Therefore, if a call starts and ends in different collection intervals, all of the data is recorded in the interval in which the call and any after call work is completed.”** — CMS R15 Database Items and Calculations

Interval-based items play by the opposite rule, and the manual is equally blunt about where each belongs: **“Inter-**

val-based items should be used only to calculate percentages such as the percentage of time staffed or in AUX work. Interval-based items should not be used, for example, to calculate average talk time; use call-based items for this type of calculation.” — CMS R15 Database Items and Calculations

ACDCALLS, ACDTIME, ACWTIME, ANSTIME — every number a supervisor actually watched — are all documented as call-based. Nothing is split at the boundary. Nothing is apportioned back to the interval the caller actually waited in. The whole of a call lands, as a single lump, in whichever interval happens to contain the moment the after-call work finally ends. Which is exactly what a call answered at 11:59 is about to demonstrate.

Everything books to 12:30–12:45

Say a call rings in at 11:59, an agent answers it as the clock turns, and the conversation plus its after-call work run all the way to 12:43. By the rule on the previous page, the entire event — every second of talk time, every second of ACW, and even ANSTIME, the time the caller waited before 11:59, before the call was answered at all — books to the **12:30–12:45** interval, because that is the interval in which the call and its wrap-up finally complete. The 11:45–12:00 interval, which the caller actually rang into and waited inside, records nothing about this call whatsoever. The 12:15–12:30 interval, which the agent and caller spent entirely talking, records nothing either. Only the interval that happens to catch the tail sees the call, and it sees the whole forty-four minutes at once.

The arithmetic makes the distortion concrete. Say the 12:30–12:45 interval otherwise took four ordinary calls averaging three minutes each — twelve minutes of talk time — plus this one 44-minute call landing whole. $ACDCALLS$ for the interval = **5**. $ACD\ TIME = 12 + 44 = \mathbf{56\ minutes}$. $AVG_ACD_TALK_TIME = 56 / 5 = \mathbf{11.2\ minutes}$ — nearly four times the interval's true typical handle time, entirely because one call's full duration, accrued across the two previous quarter-hours as well, arrived as a lump sum in the interval where it happened to finish.

Occupancy compounds it, and the manual's own worked example shows why. $STAFF\ TIME$ is genuinely interval-

based — it ticks down cleanly at the boundary, and “Average Positions Staffed” is a clean division, staffed-minutes over interval-minutes. But occupancy as a percentage divides talk-plus-ACW — call-based, arriving in unpredictable lumps — by that honestly-ticking staffed time. An interval that absorbs one long call's entire duration, divided by its own ordinary thirty agent-minutes staffed, can push occupancy over 100%: not because anyone worked more minutes than the clock allowed, but because the numerator is measuring a duration that spans several intervals while the denominator measures only the one it's divided into.

And this is precisely why BCMS and CMS — switch-resident and adjunct, watching the identical calls — never reconcile. Avaya's own support literature says so without apology: “*BCMS records a call in the interval where the call came. However, CMS records the call in the interval where the call ends.*” The two systems disagree about which end of a call matters, and Avaya's advice is not to fix this but to stop comparing: it does “*not recommend comparing CMS and BCMS reports because the way CMS does database calculation is completely different than the way BCMS does the calculation.*” A practitioner thread confirms the lived version — a maximum-delay statistic reading 81:39 in BCMS and 67:49 in CMS for the same underlying calls, two honest numbers describing two different questions.



THE 12:30–12:45 INTERVAL, HONESTLY REPORTED: FIVE CALLS, AN AVERAGE HANDLE TIME OF 672 SECONDS, OCCUPANCY THAT ARGUES THE IMPOSSIBLE. NOTHING ON THIS BOARD IS WRONG. ALL OF IT IS TRUE ONLY OF THE INTERVAL THAT HAPPENED TO CATCH THE TAIL.

■ The phantom's carve-out

One abandon in this system was never actually abandoned. Where the central office gives no disconnect supervision, any call with connect time under an administered threshold — one to ten seconds — is pegged as PHANTOMABNS rather than ACDCALLS, its “abandon time” measured from the moment it entered the vector until the agent physically released it. A call that was answered, briefly, filed forever as if it never rang at all.

SOURCES: ql-cms-vectors.md · Avaya CMS R15 Database Items and Calculations (Jan 2009) · Programming Call Vectors in Avaya Aura Call Center 6.0 (June 2010) · Avaya support KB ADMN115042 (BCMS vs CMS) · tek-tips.com practitioner thread, BCMS/CMS discrepancy.

THE PLANNING PRIESTHOOD

TCS, IEX, Blue Pumpkin, Pipkins — a scattered priesthood of scheduling shops, consolidated in three years flat, plus the \$99 heresy that outlasted all of it alone.

Every product in this census runs on the same borrowed mathematics: A.K. Erlang's 1917 formulas for a Copenhagen switchboard, repurposed half a century later as the first move of every forecast these systems produced. By 2004 the independent trade that built on it had three years left to live.

Three vendors got there first, and independently: **TCS Management Group** with what it called the world's first dedicated workforce management software, **Pipkins** with a physicist's optimization algorithms, and **IEX Corporation** with what became the industry's reference platform. By this magazine's era, "run the Erlang C" was not a metaphor — it was literally step one, whether the seat cost \$50,000 or, at the cottage-industry end, ran as eight functions bolted into Excel for ninety-nine dollars.

TCS, out of Nashville, shipped Real-Time Adherence as its own numbered product line — the adherence feature elsewhere in this issue leans on exactly that decision — but TCS itself didn't survive the decade under its own name. Aspect Communications bought it for \$37.5 million in November 1995, closing the following year, and by 2000 tcsmgmt.com's own "About Workforce Management" page had become a one-line notice: "TCS is now part of Aspect Communications." Incumbents kept calling the product TCS for years afterward regardless — a habit this magazine's own war-story sheet catches in the wild, at a centre still running "TCS (now eWFM)" well into the product's Aspect years.

IEX Corporation ran the opposite trajectory: bought young, sold rich. Tekelec paid \$165 million for it in 1999; NICE Systems paid \$200 million for it in 2006, and Tekelec's own CEO described the sale simply as converting "a non-telecom business unit into cash at an attractive val-

uation" — as clean a one-line epitaph for the whole independent-WFM era as this census is likely to find. TotalView, the platform underneath both owners' names, was the industry's reference standard the whole time.

Blue Pumpkin Software closed the loop the same way: Witness Systems bought it for a reported \$70–75 million, announced December 2004 and closed February 2005, paying roughly \$40 million cash plus 2.1 million shares. Then, in 2007, Verint Systems bought Witness Systems itself for \$950 million — folding the Blue Pumpkin lineage in behind it. Between 2004 and 2007, in three moves, the WFM trade's independent era closed: a scatter of specialist Nashville, Sunnyvale and St. Louis shops became line items inside quality-monitoring conglomerates rebranding the whole bundle "workforce optimization."

Not everyone joined the wave, and not everyone rushed to be bought. **Pipkins**, out of St. Louis, is where the record owes its detail to an accident of preservation: a Wayback Machine snapshot dated December 2000 caught the company's homepage mid-roster — Maxima Advantage, the web-enabled Advantage WAVE, SkillSense (billed, not falsely modestly, as "the only" multi-skill scheduling solution), Wireless Advantage, and a "sneak peek" at what became the long-lived Vantage Point — one archived page doing the work six product launches never got written up properly for print.

1995–
96

Aspect buys **TCS Management Group** for \$37.5m; the deal closes the following year, and tcsmgmt.com eventually just redirects.

2004

Witness Systems agrees to buy **Blue Pumpkin Software**, announced December.

2005

The Witness/Blue Pumpkin deal closes, February — roughly \$40m cash plus 2.1m shares.

2006

NICE Systems buys **IEX Corporation** from Tekelec for \$200m — arguably the era's single most consequential WFM deal.

2007

Verint buys **Witness Systems** for \$950m, folding Blue Pumpkin in behind it; InVision lists on the Frankfurt exchange the same year, heading the other way.

THE WORKFORCE VENDORS — PRODUCT CENSUS

VENDOR	FLAGSHIP	YEARS	NOTABLE
TCS Mgmt Group (Nashville)	TeleCenter Sys. → SeriesFive → Aspect eWFM	1970s/80s–2000s	Real-Time Adherence, own numbered product; absorbed into Aspect 1995/96; site redirected to Aspect
IEX Corporation	TotalView	1988–	Tekelec bought 1999 (\$165m); NICE bought 2006 (\$200m)
Blue Pumpkin Software	PrimeTime → Director Pro/Enterprise	1996/97–2004/05	Intraday adherence + agent self-service; bought by Witness 2004/05
Pipkins, Inc. (St. Louis)	Maxima Advantage → SkillSense → Vantage Point	c.1995/98–2001–	“World’s first third-generation” WFM (vendor claim); SkillSense “the only” multi-skill solution
GMT Corporation (Atlanta)	GMT Planet	1996–2011	v9 (2003) “expands skills-based scheduling”; crossed into retail bank branches; absorbed by Verint c.2011
InVision Software AG / injixo	Enterprise WFM → injixo	1995–2011–	DACH enterprise leader; Frankfurt listing 2007; cloud-native injixo spinout 2011
Westbay Engineers Ltd	Erlang for Excel	1996–	\$99 single-user Excel add-in, 8 Erlang B/C functions, lifetime free upgrades

Two who mostly sat it out

GMT Corporation built its Planet line into a genuine reference platform — version 9 still headlining “expands skills-based scheduling and multi-site support” as late as 2003, a Gartner citation for user satisfaction, and a documented crossover into retail bank branches via a First Tennessee case study — before Verint absorbed it too, on a slower fuse, around 2011. Germany’s InVision Software AG, founded 1995 in Ratingen, built real DACH-region enterprise leadership, floated on the Frankfurt exchange in 2007, and spun its cloud-native rebuild out under its own name, injixo, in 2011: independent for years past the wave that swallowed everyone else on this page.

The \$99 heresy

And at the very opposite end of the market sat Westbay Engineers, selling nothing but eight Erlang B/C functions bolted into Microsoft Excel — free online from 1996, a \$99 single-user Excel add-in from 1999, lifetime upgrades included. No ACD integration, no adherence dashboard, no acquirer waiting in the wings: just a spreadsheet, and a religion you could practise alone.

THE VERDICT — THE WFM TRADE, 1995–2010

CONSOLIDATION DRAMA ★★★★★

MULTI-SKILL CLAIMS, HONESTY ★★☆☆☆ OF

COTTAGE-INDUSTRY SURVIVAL ★★★★★

ERLANG LINEAGE, SHARED ★★★★★

BROCHURE QUALITY ★★☆☆☆

Three moves, three years, and the independent trade was gone — except at ninety-nine dollars, where it never noticed.

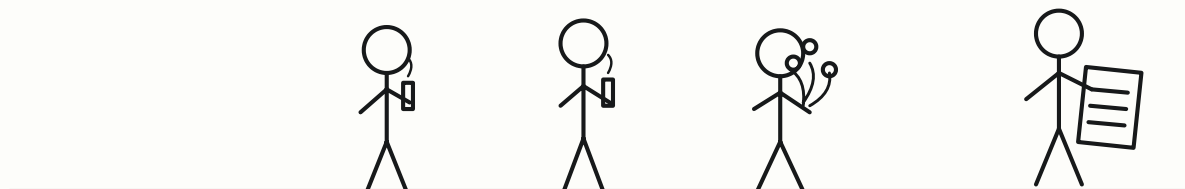
■ \$99 to \$950 million

The same trade, at both ends of its own market: Westbay’s single-user licence at one extreme, Verint’s purchase price for Witness Systems at the other. Between them sits the entire range of what workforce management ever was — a religion with cathedrals, and also a religion you could practise alone, at your desk, with a calculator built into a cell reference.

“The only scheduling solution for multi-skilled environments” — Pipkins, c.2000. GMT was still fighting the same war in its own headline three years later.

SOURCES: ql-wfm.md · wiki.wfmlabs.org (History of Workforce Management; Timeline of WFM Technology; Injixo) · erlang.com (Erlang for Excel, CC-Excel) · web.archive.org snapshots of tcsmgmt.com, pipkins.com, gmt.com, blue-pumpkin.com, invisionwfm.com · techmonitor.ai · wral.com · techpartner.news · businesswire.com.

STAFFED 86 AVAIL 3 ACW 11
AUX 1–8: 22
AUX 9: 1 (SINCE TUESDAY)



The vigil was respectful, brief, and — the planning team confirmed — adherence-neutral.

Nobody knew what AUX 9 was for. Janice had been in it since Tuesday. By Thursday the floor had accepted that some states are not worked in, but ascended to.

AUX 9 · FINAL PANEL · JANICE, IF YOU'RE READING THIS, PRESS AVAILABLE

SERIES CLOSE The strip will return

AUX 9 continues in the next edition, or on the blog, or wherever unallocated states accumulate. Reader submissions of aux-code folklore are welcomed via the address on the back cover, and will be tallied — per CMS convention — in whichever interval they finally complete.

The Multi-Skill Problem

Why the trade's one great formula refused to scale, what everyone did instead, and the answer that only a simulator could see.

Erlang C answered the single-queue question so well for eighty years that the trade assumed the multi-queue version was merely delayed. It was not delayed. It does not exist — and the reasons why are the most instructive mathematics in this magazine.

Erlang's formula performs one magnificent compression: if every agent can take every call, the entire state of a call centre collapses to a single number — how many calls are in the system. One dimension. A tidy Markov chain, a closed form, an answer by lunchtime. Every assumption in the formula exists to protect that compression, and skills-based routing walks in and breaks the load-bearing one: **interchangeable agents**.

Give agents skills and the state space refuses to stay one-dimensional. The system now needs to know not just *how many* are busy but *who* — which pool, holding which call type, with which queues at which depths. The dimensions multiply with every skill and pool; the tidy chain becomes a combinatorial object that grows beyond exact solution for any floor bigger than a toy. This is not a gap awaiting a cleverer formula. It is a structural fact about the problem.

Staffing marries routing

Worse follows. In a single queue, the staffing requirement is a property of the workload: fourteen agents is fourteen

agents. In a multi-skill centre the same headcount performs differently depending on *routing policy* — who gets the call when two pools could take it, when the generalist is held in reserve, at what expected wait the vector overflows. The question "how many agents do I need?" stops having an answer independent of "and what will the router do?" Erlang C has no concept of a router. The requirement and the routing must be solved together, and the trade's daily tooling could solve neither.

The non-separable agent

And the deepest cut: a cross-trained agent's value cannot be attributed to either queue. She helps A *and* B, by amounts that depend on every other agent's skills and the moment-to-moment state of both queues. Pooling economies are real and large — queues share their slack — but they are a property of the *system*, not of any agent, which means no per-queue decomposition can price them. Split her between two spreadsheets and both spreadsheets are wrong.

The era's coping mechanisms were three: run Erlang C per queue with an "efficiency factor" — a practice an IEX TotalView product director would later concede, on the record, was "*inherently inaccurate*"; split the cross-trained pro-rata between queues and pretend the router was that dumb; or buy the one product category that told the truth — a simulator. TCS shipped an *SBR Simulator* alongside SeriesFive for exactly this reason. The vendors that understood the mathematics did not sell a multi-skill formula. There wasn't one to sell.

The worked scenario

Two skills. A: 240 calls an hour at 180 seconds — twelve erlangs. B: 120 an hour at 240 seconds — eight. Target: the scripture, 80/20. Three pools: specialists in each skill plus a cross-trained group the router lends to whichever queue is suffering, on Definity vectoring semantics — check skill if expected-wait > — straight from the feature two spreads back.

FIVE ANSWERS TO ONE QUESTION		
METHOD	VERDICT	BIAS
Naive per-queue Erlang C	27 heads (16 + 11)	ceiling — ignores pooling entirely
Full-pooling bound (one queue, 20 E)	24 heads	floor — assumes every agent has every skill
Static split, 24 heads (12+8+4)	SL 62.7%	low — a split agent can't chase the fire
Overflow fixed point, 24 heads	SL 56.0%	low — strands overflow on a mini-pool
Simulation , 24 heads (12+8+4)	SL 72.3%	the referee

Read that table slowly, because it is the whole feature. The two spreadsheet decompositions — the only estimates a formula-based tool could offer — are not scattered around the truth. They are both *below* it, decisively. Dynamic routing beats every static story you can tell about it in columns, because the cross-trained agent goes where the trouble is, minute by minute, and no decomposition that pins her anywhere can capture what that roaming is worth.

The pooling dividend, priced

So what is the real requirement? The simulator's answer: **25 heads, mixed 11 + 7 + 7, delivers 84%** — comfortably over scripture. Naive Erlang C demanded 27 for the same promise. Two heads on a 20-erlang system — a 7.4% staffing saving — earned entirely by cross-training a third of the floor and letting the router roam, and *invisible to every per-queue formula ever written*. Centres that trusted the naive number paid for it every roster of the era.

NAIVE	TRUTH	POOLED	SVL
27	25	24	84

THE BRACKET. THE FORMULAS GIVE YOU THE FENCE POSTS. ONLY THE SIMULATOR TELLS YOU WHERE THE GATE IS.

A little flexibility, most of the miracle

Hold headcount at 24 and slide the mix from no cross-training to full pooling. The curve the simulator draws is the era's best-kept open secret:

THE FLEXIBILITY CURVE · 24 HEADS		
MIX (A + B + CROSS)	CROSS-TRAINED	SIMULATED SL
14 + 10 + 0	none	62.4%
13 + 9 + 2	2	68.3%
12 + 8 + 4	4	72.3%
11 + 7 + 6	6	75.4%
10 + 6 + 8	8	76.5%
0 + 0 + 24	everyone	79.9%

A third of the floor dual-skilled captures roughly three-quarters of full pooling's entire benefit; the remaining sixteen agents can stay specialists and almost nothing is lost. This is the celebrated result of Wallace and Whitt's skill-based-routing work — *a little flexibility goes a long way* — demonstrated here not by citation but by running the machine, with the caveat their own experiments attach and quoters routinely drop: the miracle requires the right *pairings*. Badly-chained skill sets degrade toward separate centres. With two skills there is only one way to pair; with twelve, the chaining is the craft. (Note the last row, too: full pooling at 24 heads simulates at 79.9% against Erlang C's prediction of 80.0%. Where the scripture's assumptions hold, the referee and the scripture agree to the decimal. The formula was never wrong. It was answering a different question.)

What actually works now

The modern answers, catalogued fully in the project's research note: **simulation**, which is what serious WFM has quietly run under its multi-skill screens since the era ended; **simulation-plus-optimisation** — the Cezik–L'Ecuyer school, where a linear program proposes staffing and a simulator disposes, iterating to the cheapest mix that meets grade; and a family of **approximations** descended from trunk-overflow engineering, useful for speed, honest only when their independence assumptions roughly hold. Nothing in the toolbox is a formula you'd tattoo. The single-queue miracle was a property of the single queue.

TAKE IT HOME The model, in your hands

This feature's mathematics ships as working artifacts: a workbook — *queues-multiskill-model.xlsx* — computing all four spreadsheet estimates live (the overflow fixed point unrolled over eight damped iterations; watch it converge down the rows), with the simulation referee's results on a provenance-labelled Validation sheet; and a dependency-free Python twin, *multiskill_sim.py*, holding the discrete-event simulator. Excel brackets; Python decides; the two agree with each other to three decimal places on every formula they share, and honestly disagree with reality by exactly the amount this feature is about.

Split her between two spreadsheets and both spreadsheets are wrong.

SOURCES: the project's sourced research note (Gans, Koole & Mandelbaum 2003 survey; Wallace & Whitt 2005; Cezik & L'Ecuyer 2008 — full citations there) · TCS SBR Simulator per the WFM census · vault data/multiskill_sim.py + build_multiskill_model.py (methodology + all figures; sim = 3,000 h discrete-event, seed 1) · Definity overflow semantics per THE 11:59 PROBLEM, this issue.

ERLANG C

One 1917 result for switchboards, still running quietly underneath every workforce-management suite this magazine ever priced.

A.K. Erlang, an engineer at the Copenhagen Telephone Company, published the queueing mathematics behind this entire trade in 1917 — a formula for how many operators a switchboard needs, derived for cable and plugs, and still the load-bearing wall under every ACD, dialler and WFM suite this census has catalogued.

Here is the question every contact centre quietly runs on, dressed in this edition's own numbers. Say **100 calls** arrive in **half an hour**, each takes about **three minutes** to handle, and the target is **80% answered within 20 seconds**. How many people do you need on the phones?

Guess low and the queue, and the customer's patience, blows out. Guess high and you are paying people to watch a silent phone. Erlang C answers it properly, and the answer to this edition's own worked example — first published on gethryn.com, reproduced here as the Reference well's founding exhibit — is **14 agents**. Thirteen isn't enough. Fifteen is money left on the table.

The maths behind that single bolded number is the recursive Erlang B→C formulation opposite: the same result the

published trilogy's spreadsheet version reaches with modern Excel's GAMMALN, run in log space so no factorial is ever materialised and the numbers stay sane past the point — around 170 agents — where the naive version quietly overflows. The recursion prints differently but agrees to the decimal: arithmetic old enough that a 1997 machine could have run it, computed one agent count at a time rather than in one closed-form leap.

Ninety years, several rewrites, the same nine keystrokes of algebra underneath every one of them: a 2010 C implementation leaning on a licensed gamma function old enough to need its provenance flagged, and finally the clean rewrite that became the trilogy below. The formula itself hasn't needed a single correction in the whole span. Only the tools quoting it have.

ERLANG B → ERLANG C, THE RECURSION

```

B(0) = 1
B(n) = u · B(n-1) / ( n + u · B(n-1) )

C(n) = n · B(n) / ( n - u · (1-B(n)) )

SL(n) = 1 - C(n) · e-(n-u)·t/AHT

u = offered load, in Erlangs = calls · AHT / interval

```

THE RECURSION: ERLANG B BUILT ONE AGENT AT A TIME FROM B(0)=1, CONVERTED TO ERLANG C, THEN TO SERVICE LEVEL. NO FACTORIAL TABLE, NO LOG-SPACE TRICK — JUST ARITHMETIC, RUN ENOUGH TIMES.

■ The dedication

The editor learned this, first, from **Ian Morris**, of the Operations Administration Centre — taught from an ICMI textbook, taught to schedule and forecast alongside it. “I’ve never forgotten it,” is the editor’s own account, years and one formal statistics degree later, of a debt this whole Reference well exists to repay. Scripture, in this trade, is inherited before it is understood. This section is the receipt.

Erlang C, in every language

The trilogy this Reference well is built from restates the same five functions three times over — not because the maths changes, but because the trade never agreed on a tool. **Erlang C, in Excel** spills the whole staffing table down a column with modern GAMMALN, stable past the 170-agent point where the naive factorial version falls over. **Erlang C, in Python** carries its own bundled Lanczos lgamma, standard library only, no dependencies. **Erlang C, in SQL** turns the same five functions into IMMUTABLE PL/pgSQL, joinable straight onto a forecast table — the version a WFM analyst never had to leave the database for.

Read the trilogy: [gethryn.com](#), the Erlang C series · try it without a spreadsheet: [gethryn.github.io/erlang-c](#), the live calculator · take the working itself: [github.com/gethryn/erlang-c](#), CC0, copy anything you like.

THE INTERVAL THEOLOGY		
CONVENTION	REPORTED AHT	RULED BY
Count by answer time	1,040 s	BCMS
Count by call end	1,470 s	CMS
Prorated across the boundary	≈ 240 s	unv. — neither system shipped it

SAME EIGHT CALLS, SAME INTERVAL, THREE ANSWERS: ONE CALL SPANS 11:59–12:43, AND DEPENDING ON WHICH END OF IT YOU COUNT, THE 11:45–12:45 INTERVAL’S AVERAGE HANDLE TIME IS 1,040 SECONDS, 1,470 SECONDS, OR A FLAT 240 — BY-ANSWER IS BCMS’S DOCUMENTED RULE, BY-END IS CMS’S, AND THE TWO AVAYA REPORTING SYSTEMS HAVE BEEN QUIETLY DISAGREEING ABOUT WHICH END OF A CALL MATTERS FOR AS LONG AS BOTH HAVE SHIPPED.

SOURCES: [gethryn.com/erlang-c-in-excel](#) · [gethryn.com/erlang-c-in-python](#) · [gethryn.com/erlang-c-in-sql](#) · [github.com/gethryn/erlang-c](#) · [queues-legacy](#) shift-calculator workbook, Interval Theology sheet · [ql-cms-vectors](#)

The referee neither system shipped

Prorating spreads a call’s handle time across whichever intervals it actually occupies — the honest answer, mathematically, and the one column heading absent from both BCMS and CMS. WFM analysts learned to smooth AHT across intervals rather than trust any single interval’s reported figure, which is the practical, unglamorous fix for a disagreement neither vendor ever resolved.

THE VERDICT — THE REFERENCE WELL

MATHEMATICAL RIGOUR	★★★★★
PORTABILITY (EXCEL/PY/SQL)	★★★★★
VENDOR AGREEMENT ON AHT	★★☆☆☆
SENTIMENTAL VALUE	★★★★★

One 1917 formula, three languages, a workbook that still runs it in 21,848 formulas and zero errors. The vendors never agreed on what a call even is; the maths never noticed.

202 platforms, counted properly

Every platform the research fleet could source, confidence declared: ● verified · ● partial · ○ listed-only. Null over guess, throughout.

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
AT&T / LUCENT / AVAYA — THE DEFINITY EMPIRE · 24 PLATFORMS						
DEFINITY Generic 1 (G1)	AT&T	acd	1989-	—	System 75 successor under the merged DEFINITY name; launched March 1989, rated up to ...	●
DEFINITY Generic 2 (G2)	AT&T	acd	1989-	—	System 85 successor under the merged DEFINITY name; launched July 1989, rated up to 3...	●
System 75	AT&T	acd	1983-1989	—	AT&T's smaller PBX/ACD heritage line; superseded by DEFINITY Generic 1 in 1989	○
System 85	AT&T	acd	1980s-1989	—	AT&T's larger PBX/ACD heritage line, rated to 30,000 lines; superseded by DEFINITY Ge...	○
CentreVu Call Management System (CMS) R3V5/R3V6/R3V8	AT&T / Lucent	reporting	1997-1999	—	Sun-hardware historical/real-time ACD reporting platform - "the reporting religion"; ...	○
CentreVu Supervisor	AT&T / Lucent	reporting	1990s-	—	PC client application for CMS reports; the interface layer that fed third-party plasm...	○
DEFINITY G3i (V1-V4)	AT&T / Lucent	acd	1992-1997	500	mid-tier model; duplicated control-carrier option for reliability; EAS max 500 agents...	●
DEFINITY G3r (V1-V4)	AT&T / Lucent	acd	1992-1997	5200	RISC-processor flagship with Center Stage Switch for multi-cabinet builds; EAS max 5,...	●
DEFINITY G3s (V1-V4)	AT&T / Lucent	acd	1992-1997	150	basic control cabinet; shares Intel 80386 platform with G3i/G3vs; EAS max 150 agents ...	●
DEFINITY G3vs (V1-V4)	AT&T / Lucent	acd	1992-1997	150	smallest Generic-3 model; compact single-carrier cabinet; Intel 80386 @16MHz; EAS max...	●
Basic Call Management System (BCMS)	AT&T / Lucent / Avaya	reporting	—	3000	switch-resident, low-cost reporting alternative to full CMS; no adjunct processor req...	●
Expert Agent Selection (EAS)	AT&T / Lucent / Avaya	acd	1993-	—	skills-based routing feature; documented from AT&T publication 555-230-520 (Issue 3, ...	●
Avaya Communication Manager (MultiVantage)	Avaya	acd	2003-2009 (renamed Avaya Aura Communication Manager at v5.2)	—	call-control software for the S8xxx media servers, rebranded from "MultiVantage" in 2...	●
Avaya S8300 Media Server	Avaya	acd	2002-	—	smallest of the S8xxx media-server line; local survivability for remote/branch sites;...	●
Avaya S8500 Media Server	Avaya	acd	2002-	—	replacement tier for G3si/G3csi-class deployments per practitioner mapping; standard ...	○
Avaya S8700 / S8710 / S8720 / S8730 Media Server	Avaya	acd	2002-	—	fully duplicated dual-processor line for no-downtime failover; replacement tier for t...	●
Business Advocate	Avaya	acd	—	—	later Avaya-era evolution/renaming of Advocate; patented routing algorithm combining ...	●
DEFINITY ECS Release 9 - R9csi	Avaya	acd	2000-	500	Avaya-era rebrand of Definity as "Enterprise Communications Server"; compact system-t...	●
DEFINITY ECS Release 9 - R9r	Avaya	acd	2000-	5200	flagship ECS Release 9 system; max 5,200 EAS agents with 1 skill each, max 25,000 sta...	●
DEFINITY ECS Release 9 - R9si	Avaya	acd	2000-	500	mid-tier ECS Release 9 system; max 500 EAS agents (150 if CMS-measured) with 1 skill ...	●
DEFINITY One / IP600 / S8100	Avaya	acd	2000-2002	500	early attempt to move call control off bare-metal Oryx/Pecos; Definity One/IP600 ran ...	●
CentreVu Advocate	Lucent	acd	1998-	—	predicted/expected wait-time routing layered on top of EAS skills-matching; required ...	●
DEFINITY ProLogix	Lucent	acd	1999-	—	compact modular cabinet aimed at mid-sized business locations; Release 2.0 documentat...	●
DEFINITY BCS / GuestWorks	Lucent / Avaya	acd	—	—	"category B" small-business and hospitality variant sitting alongside the ECS/ProLogi...	○
NORTEL — MERIDIAN & SYMPOSIUM · 26 PLATFORMS						
Communication Control Toolkit (CCT)	Nortel Networks	cti	mid-2000s (unverified)	—	next-generation CTI middleware for call centre and IVR environments, succeeding the S...	○
Nortel Contact Center 6.0	Nortel Networks	acd	2005-	—	launched November 2005; the release at which the Symposium portfolio was formally reb...	●
Nortel Contact Center 7.0	Nortel Networks	acd	2009-	—	announced March 2009 (GA planned mid-to-late June 2009) after slipping repeatedly fro...	●
Symposium Call Center Server (general/flagship figures)	Nortel Networks	acd	1998-2005 (rebranded to Contact Center at 6.0)	1500	commonly cited figures - up to 1,500 active agents at a single site, up to 30 network...	○

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
Symposium Call Center Server 1.0	Nortel Networks	acd	1998	—	first release of Nortel's Windows NT-based software ACD, shipped May 1998	○
Symposium Call Center Server 4.0	Nortel Networks	acd	2000	—	release shipped November 2000, confirmed via the archived Nortel documentation collec...	●
Symposium Call Center Server 5.0	Nortel Networks	acd	c. 2004-2006 (date unverified/conflicting)	—	a preliminary Windows Server 2003-compatible edition is dated March 2006 in the archi...	●
Symposium Express Call Center 1.0	Nortel Networks	acd	1999	40	entry-level Symposium for smaller sites, available May 1999, rated to 40 seats	○
Symposium Express Call Center 2.0	Nortel Networks	acd	2000	150	January 2000 release, scaled up to 150 seats, roughly US\$8,000 installed	○
Symposium Express Call Center 4.2	Nortel Networks	acd	2003	—	release dated April 2003 in the archived Nortel documentation collection index; separ...	●
Symposium TAPI Service Provider	Nortel Networks	cti	c. 2000s (unverified)	—	CTI foundation for Succession 1000/1000M switches; version 3.0 was Nortel's last stan...	○
SL-1	Northern Telecom	acd	1975-late 1980s (renamed Meridian 1)	—	first fully digital PBX marketed to the mid-size business segment; original capacity ...	●
ACD advanced features (ACD-B, package 41)	Northern Telecom / Nortel Networks	acd	X11-era (unverified years)	1200	agent/supervisor communication, music-on-delay, priority agents, time-overflow queuing	●
ACD auxiliary processor (ACD-D)	Northern Telecom / Nortel Networks	acd	X11-era (unverified years)	1200	consolidates packages A+B+C2 and replaces C1; enabled host/CTI messaging via the Aux...	●
ACD basic features (ACD-A, package 45)	Northern Telecom / Nortel Networks	acd	X11-era (unverified years)	1200	call-source identification, priority trunks, recorded announcements; system agent max...	●
ACD load management commands (ACD-C2, package 43)	Northern Telecom / Nortel Networks	acd	X11-era (unverified years)	—	load-management commands (SAGP/SATS) for shifting agents/queues under load	●
ACD management reports (ACD-C1, package 42)	Northern Telecom / Nortel Networks	reporting	X11-era (unverified years)	—	management-reports package; later superseded by package D	●
Base ACD (BACD, package 40)	Northern Telecom / Nortel Networks	acd	X11-era (unverified years)	—	foundation ACD package required underneath every other ACD feature package on the Mer...	●
Customer Controlled Routing (CCR)	Northern Telecom / Nortel Networks	acd	pre-1993-2004 (withdrawn 31 Mar 2004)	—	scripted pre-agent call treatment (announcements, music, conditional routing) via an ...	●
Meridian 1 Option 11C	Northern Telecom / Nortel Networks	acd	1990s-2000s (unverified start/end)	—	standalone/networked site switch, 30-700 lines; supported real-time-intensive applica...	●
Meridian 1 Option 11C Mini	Northern Telecom / Nortel Networks	acd	1990s-2000s (unverified start/end)	—	smallest of the VxWorks-based 'C' generation; rack-mountable branch-office chassis, e...	●
Meridian 1 Option 51C	Northern Telecom / Nortel Networks	acd	1990s-2000s (unverified start/end)	—	single Core/Network module; mid-range step between the 11C and 61C	●
Meridian 1 Option 61C	Northern Telecom / Nortel Networks	acd	1990s-2000s (unverified start/end)	—	200-2,000 lines; first option in the range with a second Core/Network module for core...	●
Meridian 1 Option 81C	Northern Telecom / Nortel Networks	acd	1990s-2000s (unverified start/end)	—	200-16,000 lines, 256 switching loops; carrier-grade flagship behind the era's mega ...	●
Meridian Link	Northern Telecom / Nortel Networks	cti	1980s-2004 (withdrawn)	—	open CTI interface exposing Meridian 1 call events to host computers; withdrawn 31 Ma...	●
Meridian MAX	Northern Telecom / Nortel Networks	reporting	1990s-2004 (withdrawn)	1200	green-screen-era ACD reporting layer for Meridian 1/DMS-100 Centrex ACD; capacity var...	●
ASPECT COMMUNICATIONS · 14 PLATFORMS						
Aspect Call Center 9.0	Aspect Communications	acd	2003-2004	—	first ACD release built on the new Uniphi architecture; could insert inbound-call dat...	●
Aspect Office	Aspect Communications	acd	1990s-2003	80	small-office ACD line capped at 80 seats; superseded by the Iphinity suite	●
Aspect headset adapter/amplifier (RNA)	Aspect Communications	headset	unverified	—	Aspect-branded headset adapter/amplifier accessory for ACD systems with the Ring-No-A...	○
CustomView	Aspect Communications	reporting	1990s-unverified	—	supervisor real-time monitoring tool feeding call-centre displays; discussed in field...	○
Iphinity Call Center	Aspect Communications	acd	2003-	200	SMB call-handling suite (sub-200 seats) replacing Aspect Office; paired with Iphinity...	●
Uniphi Connect	Aspect Communications	acd	2003-2004	—	hybrid PSTN/IP hardware-plus-desktop bridge letting a CallCenter ACD migrate to IP at...	●
TeleSet	Aspect Communications / Aspect Software	acd	1990s-2000s	—	proprietary digital agent phone/turret for CallCenter ACD; agents sign on with an ins...	●

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
WinSet	Aspect Communications / Aspect Software	acd	1990s-2000s	—	Windows agent softphone/desktop client built specifically for Aspect CallCenter ACD; ...	●
Aspect Contact Server	Aspect Software	cti	unverified-2014	—	CTI/routing middleware layer; version 6.3 seen in 2008 docs, still referenced in Cisc...	●
Aspect EnsemblePro	Aspect Software	acd	2005-2008	—	unified inbound/outbound/blended multichannel suite (voice, email, web, fax) with hos...	●
Aspect PBX	Aspect Software	acd	unverified-2008	—	underlying switch layer beneath CallCenter ACD; version 9.3 documented alongside Cont...	●
Aspect CallCenter ACD Reports (Signature Products, 4.0 CallCenter Reports Guide)	Aspect Software / Alvaria	reporting	unverified	—	reporting/analytics module bundled under Alvaria's current 'Aspect Signature Products...	○
Aspect Unified IP	Aspect Software / Alvaria	acd	2008-2020s	—	IP-native rebrand of EnsemblePro; still being sold and patched by resellers as of a 7...	●
Aspect CallCenter ACD	Aspect Telecommunications / Aspect Communications (later Aspect Software / Alvaria)	acd	1985-2010s	—	flagship purpose-built ACD, adapted from a Summa Four SDS-1000 programmable switch; A...	●
ROCKWELL — GALAXY & SPECTRUM · 4 PLATFORMS						
FirstPoint Enterprise 10.0	Concerto Software (Rockwell FirstPoint Contact business)	acd	2004-	—	first major post-acquisition release under Concerto, December 2004; still built aroun...	●
Transcend Contact Center for Workgroups v2.0	Rockwell Electronic Commerce	acd	2000-	160	Dialogic CT Media 1.2-based, NT-hosted ACD built on Spectrum's call-processing softwa...	●
Galaxy ACD	Rockwell International (Switching Systems Division)	acd	1973-1992	—	the 1973 Continental Airlines installation the industry credits (with real caveats) a...	●
Spectrum ACD	Rockwell International / Rockwell Electronic Commerce	acd	1992-2004	—	launched explicitly as Galaxy's successor 'after 19 years'; distributed Motorola 6803...	●
GENESYS — THE ROUTING BRAIN · 24 PLATFORMS						
Conseros	Conseros (acquired by Genesys 2009)	cti	unverified-2009 (acquired)	—	small 2009 Genesys acquisition; no product specifics surfaced in sources checked, inc...	○
DB Server	Genesys Telecommunications Laboratories	cti	1997- (unverified end)	—	gateway to Oracle/Sybase/Informix/DB2/SQL Server so routing and reporting could reach...	●
Genesys Call Center Manager	Genesys Telecommunications Laboratories	reporting	pre-1997-1997	—	real-time desktop monitoring of agent/call activity across a distributed network; sup...	●
Genesys Call Center Pulse	Genesys Telecommunications Laboratories	reporting	1997- (unverified end)	—	GUI redesign of Call Center Manager with object-based views of agents, groups and cal...	●
Genesys Call Concentrator	Genesys Telecommunications Laboratories	reporting	pre-1997-1997	—	historical reporting package following a call end-to-end through transfers and confer...	●
Genesys Call Router	Genesys Telecommunications Laboratories	acd	1997 (named)-2000s (unverified)	—	skills-based inbound routing on Caller ID/ANI/DNIS/account value; multi-site, multi-s...	●
Genesys Campaign Manager	Genesys Telecommunications Laboratories	acd	1997 (named)-2000s (unverified)	—	predictive/blended dialer integrated with inbound and reporting products; call-result...	●
Genesys DART (Data Analysis and Reporting Tool)	Genesys Telecommunications Laboratories	reporting	1997- (unverified end)	—	browser-based historical call-centre reporting replacing Call Concentrator; designed ...	●
Genesys InterActive-T Software Toolkit	Genesys Telecommunications Laboratories	cti	1997- (unverified end)	—	developer toolkit atop T-Server; TAPI/CORBA/DCOM/Java/ActiveX-compliant, shipped with...	●
Genesys Net Vector	Genesys Telecommunications Laboratories	cti	1996-	—	web click-to-callback; pre-release version won Call Center Magazine's 1996 Product of...	●
Genesys Video ICD	Genesys Telecommunications Laboratories	cti	1997 (under development)	—	designed to route video calls to video-capable agents as just another queued interact...	●
List Manager	Genesys Telecommunications Laboratories	acd	1997- (unverified end)	—	interface to customer contact lists feeding outbound campaign management	●
Stat Server	Genesys Telecommunications Laboratories	cti	1997- (unverified end)	—	real-time call-traffic and agent-state feed used for both routing decisions and real-...	●
T-Server	Genesys Telecommunications Laboratories	cti	1991-	—	the switch-abstraction platform itself: one T-Lib API translated locally per PBX/ACD,...	●
Genesys Enterprise Routing	Genesys Telecommunications Laboratories / Alcatel	acd	2000s (unverified)	—	on-premises bundle (Genesys CIM Platform + Inbound Voice) turning the switch-connecte...	●
Genesys Outbound Contact	Genesys Telecommunications Laboratories / Alcatel	acd	2000s (unverified)-	—	Outbound Contact Server automates dialing and call-progress detection so agents only ...	●
Universal Routing Server	Genesys Telecommunications Laboratories / Alcatel	acd	2000s (unverified)	—	formerly known as Interaction Router; successor routing engine executing graphical ro...	●

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
Genesys Suite (versioned platform bundle, e.g. "Genesys 7", "Genesys 8")	Genesys Telecommunications Laboratories / Alcatel-Lucent	cti	2000s-2010 (unverified)	—	the whole framework (T-Server, URS, GVP, Outbound Contact and the rest) sold and vers...	○
Genesys Voice Platform	Genesys Telecommunications Laboratories / Alcatel-Lucent	ivr	2000s (unverified)-	—	Genesys's IVR/voice self-service platform lineage, built from the Telera (2002) and V...	●
IBM CallPath	IBM (business acquired by Genesys 2001)	cti	unverified-2001 (business acquired by Genesys)	—	legacy CTI platform integrating voice/data in contact centres; Genesys took over supp...	●
Informiam Performance Management	Informiam (acquired by Genesys)	reporting	unverified-2007 (acquired)	—	acquired 2007; a performance-analytics layer adjacent to, but distinct from, the sepa...	○
SDE Software Development Engineering	SDE (acquired by Genesys 2009)	cti	unverified-2009 (acquired)	—	2009 Genesys acquisition; no product specifics surfaced in sources checked, included ...	○
Telera Voice Web / Genesys Voice Portal	Telera (acquired by Alcatel/Genesys 2002)	ivr	2002-	—	VoiceXML self-service platform brought in via the ~\$136m Telera acquisition (announce...	●
VoiceGenie	VoiceGenie Technologies (acquired by Genesys 2006)	ivr	unverified-2006 (acquired)	—	VoiceXML voice-portal vendor with carrier customers including Verizon and AT&T; combi...	●

WALLBOARDS — THE SCOREBOARD TRADE · 13 PLATFORMS

LightLink (incl. v2.3; Avaya IQ-compliant release)	Inova Solutions	wallboard	1990s-2000s (Avaya IQ compliance certified March 2009)	—	the middleware at the centre of Inova's business: aggregates ACD, workforce-managemen...	●
LightLink Edition (desktop presenter displays)	Inova Solutions	wallboard	unverified	—	named in period trade-press headline as a LightLink variant lighting up desktop prese...	○
NeXorce Data-Management / NX Reporting / XorceView	Spectrum Corporation	wallboard	unverified	—	product family names given on Spectrum's own company-history page alongside Web Repor...	○
UltraLink II	Spectrum Corporation	wallboard	unverified (long-running; still current on specorp.com)	—	flagship wallboard-plus-desktop software pulling from more ACD data sources than Spec...	●
V-Display	Spectrum Corporation	wallboard	unverified	—	Spectrum's basic tier: resides on the Avaya CMS server and pushes ACD stats to wallbo...	○
VectraView (Enterprise)	Spectrum Corporation	wallboard	2000s- (unverified launch year; current product)	—	post-LED, LCD/LED digital-signage wallboard: graphs/charts/gauges by CSQ (call-skill ...	●
MySymon	Symon Communications	wallboard	early-mid 2000s (unverified)	—	server-based bridge pulling Avaya CMS/BCMS stats out to IP-connected wallboards and T...	●
NetBrite / DeskView (with Symon 2000 / Publisher 5.0)	Symon Communications	wallboard	late 1990s-early 2000s (unverified)	—	NetBrite pushed statistics to agent desktops and electronic displays; DeskView ran a ...	○
NetLite II series (16x128 through 32x320)	Symon Communications	wallboard	2000s (unverified exact launch year)	—	8-model LED wallboard line, 2,048 to 10,240 pixels (16x128 up to 32x320); standard an...	●
Tray View	Symon Communications	wallboard	unverified	—	desktop-tray variant pushing the same real-time stats to an agent's own screen alongs...	○
Target Vision	Symon Communications (per forum attribution; independent branding unconfirmed)	wallboard	unverified	—	named alongside MySymon as a server-based wallboard alternative in the same 2000s-era...	○
QuickCOM (Enterprise)	Texas Digital Systems	wallboard	unverified launch year; current product line	—	no-code, multi-source real-time dashboard/wallboard platform; feeds large flat-panel ...	●
VitalCAST	Texas Digital Systems	wallboard	unverified launch year; current product line	—	digital-signage/wallboard platform for plasma, LCD and rear-projection screens; conte...	●

HEADSETS — THE BROCHUREWARE · 32 PLATFORMS

ACS Applica	ACS (GN Netcom house brand)	headset	1990s-2000s	—	multi-purpose headset amplifier sold under the ACS house brand; specs not gathered	○
ACS Orator (incl. Contour LX)	ACS (GN Netcom house brand)	headset	1990s-2000s	—	monaural or binaural corded headset sold unamplified for direct-plug compatibility wi...	●
ADDvantage / ADDvantage Plus (ADP-I / ADP-II)	GN Netcom	headset	1990s-2000s	—	monaural (ADP-I) or dual Quick-Disconnect binaural (ADP-II) call-centre headset; nois...	●
GN 2000 series	GN Netcom	headset	1990s-2000s	—	corded office/call-centre headset series preceding the 2100; specs not gathered	○
GN 2100 series (GN2120, GN2125, SoundTube, Flex)	GN Netcom	headset	2000s	—	4-in-1 wearing style (headband, behind-the-neck, ear hook, ear loop); mono headset 21...	●
GN 2200 / GN2200 Omega	GN Netcom	headset	2000s	—	series above the GN 2100; specs not gathered	○
GN 9120 wireless (Flex-Boom, Midi-Boom, SoundTube Boom)	GN Netcom	headset	2000s	51 · QUE	BEST wireless headset with 302 ft range, 12 hr talk time, choice of three boom-mic ...	10
Stetomike	GN Netcom	headset	1987-	—	GN Netcom's first product, built on parent GN Danavox's hearing-	○

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
Jabra Pro 9450 / 9460 / 9470	GN Netcom / Jabra	headset	2008(unverified)-2018	—	DECT 6.0 wireless family, up to 450 ft range, touch-sensitive 2.4in Q-VGA screen show...	●
CS50 / CS50-USB	Plantronics	headset	2003-2011	—	wireless (digital 900 MHz / DECT), convertible over-the-head or over-the-ear, up to 3...	●
CS55	Plantronics	headset	2000s	—	DECT wireless office/call-centre headset; reported as Plantronics' single best-sellin...	●
CS60 / CS70 / CS70N	Plantronics	headset	2000s-2011	—	DECT wireless family; CS70N added a noise-cancelling mic; roughly 38 units could be c...	●
DuoPro (H161N/H171N/H181N)	Plantronics	headset	2001-2000s	—	convertible headset family announced 2001; over-the-head version 38 g; noise-cancelli...	●
DuoSet H141N	Plantronics	headset	1990s-2000s	—	convertible over-the-ear or over-the-head wear, noise-cancelling mic, soft ear cushio...	●
Encore H101N	Plantronics	headset	1996-2000s	—	over-the-head, binaural, noise-cancelling boom mic; 78 g; monaural and binaural versi...	●
FreeHand	Plantronics	headset	1995-	—	ultra-lightweight in-the-ear model, under half an ounce	●
M10 amplifier	Plantronics	headset	1992-1998	—	universal desk-phone amplifier for the H-series headset line; replaced by the M12 Vista	●
M12 Vista amplifier	Plantronics	headset	1998-2006	—	universal modular amplifier for near-universal single/multi-line phone compatibility;...	●
M22 Vista amplifier	Plantronics	headset	2006-	—	replaced the M12 Vista; released alongside the P251N Polaris SupraPlus for call centres	○
Mirage H41 / H41N	Plantronics	headset	1989-	—	over-the-ear, no headband — sculpted shape hooks behind the ear; 19 g; voice-tube (H4...	●
MobilStar	Plantronics	headset	1991-	—	early mobile-phone headset; specs not found	○
Polaris SupraPlus P251N	Plantronics	headset	2006-	—	call-centre SupraPlus variant released 2006 alongside the M22 Vista amplifier; specs ...	○
StarSet	Plantronics	headset	1970-1980s	—	over-the-ear, clear plastic voice-tube mic; the model that carried Plantronics from a...	●
StarSet Supra	Plantronics	headset	1983-	—	over-the-head evolution of StarSet; direct ancestor of the long-running Supra/H51 line	○
Supra H51 / H51N	Plantronics	headset	1990s-2000s	—	over-the-head, adjustable metal headband, either-ear wear, 49 g; voice-tube mic (H51)...	●
SupraPlus (H251N/H261N; wideband HW251N/HW261N)	Plantronics	headset	1990s-2000s	—	monaural or binaural, over-the-head, voice-tube or noise-cancelling boom mic; wideban...	●
TriStar H81 / H81N	Plantronics	headset	1990s-2000s	—	three-point in-ear/behind-ear/on-top fit, no headband; under half an ounce (~12 g); v...	●
Voyager 510S	Plantronics	headset	2005-	—	Bluetooth headset, won a CES award in 2005; mobile-first but part of the desk/mobile ...	●
CC510	Sennheiser Communications	headset	2000s	—	monaural call-centre headset with noise-cancelling microphone ("ultra noise-cancellin...	○
CC530	Sennheiser Communications	headset	2000s	—	call-centre and office headset, positioned below the CC510/CC550; specs not gathered	○
CC550	Sennheiser Communications	headset	2000s	—	binaural call-centre headset with ultra-noise-cancelling boom microphone; the top of ...	○
Sennheiser Communications launch range (5 initial models)	Sennheiser Communications	headset	2003	—	Sennheiser Communications formed 2003 as a joint venture between Sennheiser and heari...	●
IVR & VOICE PROCESSING · 32 PLATFORMS						
Brite prepaid/enhanced-services IVR platform (unnamed)	Brite Voice Systems	ivr	1990s-2000	—	network-based enhanced-services platform for prepaid calling cards and intelligent-ne...	○
D/240	Dialogic	ivr	unverified	—	240 ports of basic conferencing capability (without DTMF detection, echo cancellation...	●
D/480JCT-2T1	Dialogic	ivr	unverified	—	referenced as a T1-density media board in the Dialogic JCT media-board family; exact ...	○
D/4PCI / D/4PCIU	Dialogic	ivr	unverified (PCI era, late 1990s-2000s)	—	4 ports — half-size DSP-based analog voice+fax board (PCI/PCle); small/medium-busines...	●
Electronic Workforce (EWF)	Edify Corporation	ivr	1994(approx)-2006	—	OS/2-based (later Windows) multichannel customer-interaction platform — voice, email,...	●

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
DirectTalk/2	IBM	ivr	unverified (OS/2 era)	—	IBM's OS/2-based IVR platform; branding predecessor to DirectTalk/6000 and the later ...	○
DirectTalk/6000	IBM	ivr	1995-	—	AIX-based IVR platform; a patent reference cites "IBM AIX DirectTalk/6000, Release 6,...	●
IBM 7770 Audio Response Unit	IBM	ivr	1964-1982	—	an early form of interactive voice response, announced 24 Jan 1964; Model 3 withdrawn...	●
WebSphere Voice Response (channel scaling, unspecified release)	IBM	ivr	unverified	—	vendor documentation references the line scaling "from 1400 to 2304 channels" across ...	○
WebSphere Voice Response for Windows NT/2000, V3.1	IBM	ivr	2002-	—	scalable from 4 to 120 E1 trunks (30 channels/E1); four telephony-trunk types support...	●
WebSphere Voice Response with DirectTalk Technology	IBM	ivr	1999(rebrand)-2003+	—	rebrand of the DirectTalk line for Windows and AIX under the WebSphere umbrella; prog...	●
OneVoice	InterVoice	ivr	1989-1990s	—	InterVoice's software voice-response/software-agent platform line; trademark filed 18...	○
RobotOperator	InterVoice	ivr	1987-	—	InterVoice's earliest branded automated-operator/voice-response system; trademark fil...	○
InnerView	InterVoice-Brite	reporting	2000-	—	IVR reporting/analytics package released after the Brite merger, under the combined I...	○
AG-4 / AG-8 / AG-T1/E1 / AG4000	Natural MicroSystems (NMS)	ivr	1990s	—	ISA and PCI telephony boards used by Edify's Electronic Workforce for inbound/outboun...	○
Nortel Speech Server	Nortel (ex-Periphonics OSCAR)	ivr	post-1999	—	companion speech server to Nortel's MPS 500, MPS 1000 and ICP call-centre platforms; ...	●
Nuance Voice Platform	Nuance Communications	ivr	unverified	—	carrier-grade VoiceXML platform for voice self-service applications; original release...	○
Nuance speech recognition platform (unnamed, IVR-era)	Nuance Communications	ivr	1994-2005	—	spun off in 1994 from SRI International's Speech Technology and Research (STAR) Labor...	●
Perception Technology voice-response systems (unnamed)	Perception Technology Corporation	ivr	pre-1993	—	Canton, Massachusetts IVR vendor; acquired by Brite Voice Systems under a definitive ...	○
T-Comm 80	Periphonics	ivr	1980	—	intelligent front-end processor for transaction processing; heritage precursor to the...	○
VPS/sp 9500	Periphonics	ivr	1995-	—	text-to-speech voice processing system built around a Sun Microsystems SPARCstation, ...	●
Voicepac 2000	Periphonics	ivr	1970	—	Periphonics' first voice response system; up to 2000 words stored on magnetic disk, a...	○
OSCAR (Open Signal Computing & Analysis Resources)	Periphonics / Nortel	ivr	1999-	—	Solaris-based speech processing platform underpinning large-vocabulary speech recogni...	●
VPS-7500	Periphonics / Nortel	ivr	unverified	—	companion line to the VPS-9500 in Nortel-era refurb/resale listings; port capacity an...	○
VPS/is (Voice Processing Series / Information Server)	Periphonics / Nortel	ivr	1990s-2003	—	480 IVR ports supported in a single cabinet; connects to a Nortel Succession switch v...	●
DialogModules	SpeechWorks / ScanSoft	ivr	1996-	—	patented, reusable speech-dialog building blocks, pioneered 1996; integrated into too...	●
SpeechWorks 6.5 SE	SpeechWorks International	ivr	unverified	—	telephony speech recognizer with roots in MIT research; described by SpeechWorks as a...	○
Speechify Solo	SpeechWorks International	ivr	2002-	—	text-to-speech engine with natural-sounding voices, launched 2002 for automotive and ...	●
Vista IVR	Syntellect	ivr	unverified	—	described in vendor material as Syntellect's "fourth-generation" voice-processing sof...	○
Syntellect Communications Portal (SCP)	Syntellect / Enghouse Interactive	ivr	-2009	—	96 ports (hosted, speech-enabled IVR deployment cited as a case study in a May 2009 w...	●
VoiceXML 1.0	VoiceXML Forum (AT&T, Lucent, Motorola, IBM)	ivr	1999-2000	—	the Forum (founded March 1999) unified AT&T/Lucent's incompatible Phone Markup Langua...	●
VoiceXML 2.0	W3C Voice Browser Working Group	ivr	2004-	—	W3C Recommendation dated 16 March 2004; folded in speech-recognition grammar and text...	●
WORKFORCE MANAGEMENT — THE PLANNING PRIESTHOOD · 33 PLATFORMS						
Iphinity Workforce Management	Aspect Communications	wfm	2003-	—	paired WFM companion to the sub-200-seat Iphinity Call Center SMB suite; the ACD side...	○
Aspect eWFM (TCS lineage, post-acquisition)	Aspect Communications / Aspect Software	wfm	1996-2000s	—	TCS Management Group folded into Aspect after the \$37.5m November 1995/96 acquisition...	●

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
Blue Pumpkin Director Enterprise	Blue Pumpkin Software, Inc.	wfm	c.2001-2004/05 (Witness acquisition)	—	top-tier Director SKU, versioned to at least 3.0; adds shift-bidding on top of Profes...	•
Blue Pumpkin Director Professional	Blue Pumpkin Software, Inc.	wfm	c.2001-2004/05 (Witness acquisition)	—	scheduling/forecasting plus intraday adherence and historical reporting; gave agents ...	●
Blue Pumpkin PrimeTime	Blue Pumpkin Software, Inc.	wfm	1996/97-c.2001 (superseded by Director)	—	flagship family gathering real-time ACD data for intraday forecasting and historical ...	•
Blue Pumpkin PrimeTime Skills	Blue Pumpkin Software, Inc.	wfm	unverified, pre-2.0	—	separate skills-based-scheduling add-on product, later folded into PrimeTime 2.0 as a...	○
GMT Planet - Jupiter Edition	GMT Corporation	wfm	unverified (post-2003 line extension)	—	expanded-feature tier above Mercury Edition, same Planet family	○
GMT Planet - Mercury Edition	GMT Corporation	wfm	unverified (post-2003 line extension)	—	basic/entry-tier WFM package for small call centres, aimed at operations averaging ro...	●
GMT hosted/ASP WFM	GMT Corporation	wfm	c.2000s-2011 (Verint acquisition)	—	software ran at GMT's own data centre, connecting remotely to the customer's ACD and ...	●
GMT Planet (Version 9)	GMT Corporation (Global Management Technologies Corp.)	wfm	1996 (copyright start)-2010s (Verint acquisition)	—	flagship line; version 9 (2003) "expands skills-based scheduling and multi-site suppo...	•
Genesys Workforce Management (Next Age Technologies lineage)	Genesys Telecommunications Laboratories	wfm	1999-	—	Genesys's WFM entry traces to its June 1999 acquisition of Next Age Technologies, des...	●
IEX TotalView	IEX Corporation / Tekelec / NICE Systems	wfm	1988 (company founded)-	—	the era's industry-standard enterprise WFM platform; IEX (Richardson, TX) bought by T...	•
injixo	InVision AG / Peopleware	wfm	2011-	—	InVision's ground-up multi-tenant cloud rebuild, launched 2011 — an early cloud-nativ...	●
InVision Enterprise WFM	InVision Software AG	wfm	1995 (company founded)-2011 (injixo spinoff)	—	German on-premises enterprise WFM leader in the DACH region; vendor's own site claime...	•
Monet Workforce Management	Left Bank Solutions, Inc. (renamed Monet Software, Inc.)	wfm	c.2003/04-	1000	positioned as the affordable/easy-to-use challenger; supported Mitel, Interactive Int...	•
Monet WFM OnDemand	Left Bank Solutions, Inc. / Monet Software, Inc.	wfm	2005-	—	hosted/SaaS edition unveiled July 2005, later "tailored for enterprise centers" (Jan ...	•
Pipkins Maxima Advantage	Pipkins, Inc.	wfm	c.1995/98-c.2000/01 (succeeded by Vantage Point)	—	vendor's own site (Dec 2000) called it "the world's first third-generation workforce ...	•
Pipkins Maxima Advantage WAVE	Pipkins, Inc.	wfm	c.2000	—	web-enabled Maxima Advantage variant; won "Product of the Year" from C@ll Center Solu...	●
Pipkins SkillSense	Pipkins, Inc.	wfm	c.2000	—	vendor billed it as "the only scheduling solution for multi-skilled environments" at ...	●
Pipkins Vantage Point	Pipkins, Inc.	wfm	c.2001-	700000	successor flagship ("Sneak peek - Vantage Point" trailed on the Dec 2000 site); propr...	●
Pipkins Wireless Advantage	Pipkins, Inc.	wfm	c.2000	—	web-based WFM product added to the Advantage suite; period partnership with Mustang.c...	●
TCS Agent Productivity	TCS Management Group	wfm	c.1999 (unverified)	—	named module in the product roster; specifics unconfirmed	○
TCS AutoPilot	TCS Management Group	wfm	c.1999 (unverified)	—	named product in the WFM Software product roster; likely an intraday/auto-scheduling ...	○
TCS Interactive Agent	TCS Management Group	wfm	c.1999 (unverified)	—	named module, covered by period trade press (EE Times) under this title; page content...	○
TCS Real-Time Adherence	TCS Management Group	wfm	c.1999 (unverified)	—	named adherence module in the product roster — the era's discipline, given its own pr...	○
TCS Remote Info Exchange	TCS Management Group	wfm	c.1999 (unverified)	—	named module in the product roster; likely a data-exchange/integration utility, uncon...	○
TCS SBR Simulator	TCS Management Group	wfm	c.1999 (unverified)	—	"SBR" reads as skill-based-routing simulator — a what-if planning tool for multiskill...	○
TCS SeriesFive	TCS Management Group	wfm	1999-	—	flagship late-90s release: 32-bit, multitier client/server Windows application; vendo...	•
TCS SeriesFive NetForce	TCS Management Group	wfm	c.1999 (unverified)	—	listed alongside SeriesFive in the product sitemap; specifics not fetched (page not a...	○
TeleCenter System	TCS Management Group	wfm	1970s/80s (unverified precise date)-1990s	—	claimed as the world's first dedicated call-centre workforce management software; a s...	●
CC-Excel	Westbay Engineers Limited	wfm	unverified	—	companion Excel add-in, nine functions for staffing/call-handling estimates on the Er...	○
Erlang for Excel	Westbay Engineers Limited	wfm	1999-	—	the cottage-tool end of the family: an Excel add-in bringing eight Erlang B/C functio...	•

PRODUCT	VENDOR	CAT	YEARS	AGENTS	NOTABLE FOR	CONF
Westbay online Erlang B/C calculators	Westbay Engineers Limited	wfm	1996-	—	free browser-based Erlang B (trunk-blocking) and Erlang C (agent-queuing) calculators...	•

CENSUS METHOD: nine research agents, one family each; every row carries at least one source consulted, held in the project dataset (ql-data-*.json). Capacity figures are per the release named and never blended. Dashes are honesty, not laziness. Corrections and additions: the address on the back cover.

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THE ONLY PERFECT SERVICE LEVEL IS AN EMPTY BUILDING

NO CALLS WAITING · NO CALLS WAITING · NO CALLS WAI

*Somewhere a switch is still counting. Somewhere an interval is still fifteen minutes long.
Somewhere Janice is still in AUX 9, and the board, at last, says nothing at all.*