THE ARCHITECTURE OF INTERNET 2.0
By Kevin Werbach

We're approaching a critical point in the evolution of the Internet. So far we've been lucky. Back in the early 1990s, the major players in the computing and communications industries were busy chasing video on demand, closed proprietary online services and the information superhighway. They didn't much care about a bunch of academics, researchers and engineers setting up a commercial inter-network based on the Internet protocol. Many of those companies now get it... which may be cause for concern.

Architecture matters. For the most part, today's Net is open, decentralized and competitive. It fosters innovation because it is a standards-based general-purpose platform. Anyone can use it, and anyone can communicate with anyone else. Any browser (ideally) can download and display anyone's content — and with Java or plug-ins, run their code. Companies like Mirabilis, eBay and Real Networks can develop and distribute innovative applications that spur usage, without owning any network infrastructure. Service providers must continually offer better pricing, services and support to win users' business.

The people building the next generation of high-speed access pipelines are trying to change this model. They want to tie those pipelines to the content and services they are selling, and control interconnection to the world at large. Their intractability may damage the network's openness and slow down its development. Today's Internet has grown rapidly because it is open; the next-generation Internet will not grow quickly unless it too is open and competitive. The tragedy of the cyber-commons is that competitive access benefits all providers collectively but few individually. The answer is not intrusive regulation but a set of business agreements, although government prodding may be the only way to get the parties to the table.

Anyone interested in the future of the Net should understand this debate.

Today's Net is release 1.0. Like all first commercial releases, it has bugs and missing features... but works well enough for most people. Yet in the grand scheme of things, version 1.0 is less important than what comes before and after. You can get away with

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more bugs and experimentation in the beta, but at some point you have to ship. On the other end, it takes several revs to fill out the reliability and feature set. Windows 1.0 wasn't terribly important except as a way station to version 3.1 and beyond....

The transition from Internet 0.9 to Internet 1.0 took place in the early 1990s, when the US National Science Foundation privatized the NSFNet backbone. Until that time the core of the Internet was a research and education network, and there were only a handful of commercial ISPs. Commercial ISPs and backbones were a necessary precursor for other developments on the Net, such as advertising-sponsored content sites, Web-driven enterprise re-engineering and electronic commerce. These innovations have driven the explosion in interest and investment in Net-related activities. However, the architecture of the network has remained largely the same in the 1990s. (For an overview, see appendix in Release 1.0, 6-98.)

The architecture of the Net will change with the move from narrowband to broadband. Right now we're witnessing version 1.5 improvements on the narrowband Net, using technologies such as load balancing, quality-of-service management and caching (see Release 1.0, 6-98). Internet 2.0 will be an always-on multi-megabit network, capable of supporting voice and video streams in addition to data all the way to the end-user.1

The next-generation Net does not simply offer more bandwidth; it delivers that bandwidth to the home. Bandwidth is being added constantly at the core of the network, and projects such as Internet2 are building high-speed IP networks for research and academic uses. For most users, however, the Internet experience remains the same today as five years ago. There may be more places to go and things to do, but you get there the same way. With higher bandwidth will also come always-on connectivity, enabling a whole new range of services. These developments will tie into emerging home networks (see Release 1.0, 12-98).

We take it for granted that IP networks are open, but that's not preordained. Today's Net was built on the telephone network. The endpoints of that network are open in many countries thanks to government liberalization requirements. In the US, the Federal Communications Commission (FCC) stipulates that users rather than phone companies control customer premises equipment. As a result, residential users can plug modems into their phone jacks and can use any ISP they choose. This all works because the analog phone network, without modification, supports data communications up to about 50 kilobits per second (kbps).

Anything faster requires new network infrastructure. Several kinds of companies are beginning to make the necessary investments. In particular, cable and wireline local telephone companies are rolling out commercial high-speed services. In what follows, we talk specifically about the US situation, but many of the issues are relevant in other countries under

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1 We use the term high-speed rather than broadband to describe one to ten megabit services such as current cable modems and digital subscriber line connections. The true broadband Internet will be version 3.0, when we start seeing fiber and gigabits to the home... which is farther off but closer than most people think.
Broadband is coming! Broadband is coming!

"...@Home is promising to deliver Internet broadband to a million homes by the first quarter of 1997." — Wired, January 1996

Actual US cable modem subscribers as of January 1999:
- @Home 330,000
- RoadRunner 180,000

We know what you’re thinking: Broadband has been just around the corner for years. Cable and telephone companies have repeatedly made grandiose promises that haven’t panned out. Deployment of residential high-speed access will indeed take several years, but we can’t wait to address the issue of access.

This is a critical time because the constraints that have limited the growth of high-speed services are finally disappearing. Some of the issues are technical: getting systems to the necessary price points and reliability levels for mass deployment. Although hardware was available in 1995, solutions today are much more affordable and standards-based.

The most significant drivers are competitive. The companies best able financially to make the necessary investments are incumbent cable and local telephone companies, because running new wires into homes costs so much. Even these providers must make significant investments to support high-speed Internet access, and they have no incentive to take on the cost and risk until they perceive a competitive threat. The Telecommunication Act of 1996, rather than opening up the market to competition, largely fixed in place the standoff between telcos and cable operators in most of the country. Both have avoided major forays into the other’s territory, allowing them to preserve their lucrative existing markets.

The stalemate is finally ending. Three years of legal wrangling over the meaning of the 1996 Telecom Act is finally subsiding, with the Supreme Court affirming the FCC’s authority to set national policies for competitive access to local phone networks. AT&T’s acquisition of TCI (and its recent partnership with Time-Warner) give it the ability to offer local telephone service over the cable plant. While the highly leveraged cable companies balked at the cost of cable telephony, AT&T has the resources to make it happen. Fortunately, the same network upgrades and end-user devices (set-top boxes or standalone cable modems) will enable both high-speed Internet access and voice telephony over cable.

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2 Canada is the one country that has mandated unbundled access to high-speed cable Internet pipes. See page 8.
The emerging high-speed duopoly

Local phone companies such as Bell Atlantic, US West and SBC now sell residential digital subscriber line (DSL) service in some areas. These services offer anywhere from 384 kbps to 6 megabits per second (mbps) downstream capacity, but much lower upstream speeds. Several competitive local-exchange carriers (CLECs) such as Covad, NorthPoint, and Rhythms NetConnections are marketing DSL over resold local phone lines, but almost exclusively to businesses at prices between $80 and $200 per month.

For the most part, cable operators are deploying high-speed services through two affiliated service providers: @Home and ServiceCo. @Home is jointly owned by several cable operators; TCI (recently acquired by AT&T) has a controlling stake. ServiceCo (a temporary name) is a partnership of Time-Warner's RoadRunner service and MediaOne (formerly part of US West). These providers have exclusive contracts with local cable operators, meaning that customers in those areas who want high-speed cable Internet access cannot use independent ISPs such as EarthLink or Prodigy.

Cable Internet architecture

Cable Internet access platforms, especially @Home, differ in important ways from dial-up Internet service providers (ISPs). In effect, @Home is a closed network that runs on the IP protocol and interfaces with the public Internet (see Figure 1). Groups of houses are connected to shared networks; we could call them neighborhood-area networks. At a cable headend, those networks terminate in a cable modem termination system (CMTS). The CMTS connects to the regional and national @Home backbones, which tie into the rest of the Internet at network exchange points.

Subscribers pay a monthly fee (typically $35 to $50), and as part of that fee they also get access to content from @Home and its partners. Those partners now include Excite, which announced a merger with @Home last
month, but so far it's not clear whether Excite will receive preferential treatment over its competitors. Customers can connect to any Website and can view content from other providers such as AOL, but they must pay AOL's subscription fee on top of the full @Home fee. In addition, because @Home caches content locally, its own content will have better apparent bandwidth than that of third-party content providers. Because @Home makes money through advertising and commerce partnerships, the company has little incentive to provide higher-speed connectivity to outside content.

@Home controls the cable modem in the user's home and functions as the service provider. Users cannot pay a reduced fee for the high-speed pipe alone; they must purchase the @Home ISP and content offerings. Even if a user pays for another ISP's services on top of the @Home subscription fee, the primary customer relationship is still with @Home. Independent ISPs such as MindSpring and EarthLink have no control over the user's connection setup and thus cannot compete on customer service or reliability. ServiceCo also refuses to allow customers to use independent ISPs. @Home has been the focus of the most attention because of the AT&T/TCI merger, its extensive use of local caching and its larger user base.

@Home, cable operators and AT&T claim that they need the vertically integrated access model to recoup their infrastructure investment. They say the subscription fees don't cover the full cost of the system, and they must receive advertising and transaction revenue to make the service profitable. They fiercely oppose any government order to unbundle the high-speed cable pipe from the @Home ISP and content service, arguing that government intervention would distort the free market and would chill innovation and investment.

Beyond POAS (plain old access services)

AT&T and the cable industry are fighting so hard partly because they see an opportunity to build an integrated application suite on top of the coaxial cable pipe. High-speed Internet access is merely the first and potentially the least significant offering. The local voice telephony market in the US generates roughly ten times the annual revenues of the ISP industry, and the video programming market also represents tens of billions of dollars per year. Cable operators believe they will have an easier time attacking these markets if they can build tightly coupled, application-centered networks tied to digital set-top boxes in customer homes. They are also concerned that a truly open high-speed Internet system will threaten their core video-programming revenues; @Home is required under its contracts with cable operators to limit streaming video clips over its system to 10 minutes in length.

The trouble with this vision is that it's not the Internet... and as a result it may not be as successful as the Internet. The vertically integrated model provides cable operators with better incentives to deploy fa-

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3 FCC rules will eventually require devices such as cable modems to be available through retail channels, but currently they are bundled with cable Internet service offerings.

4 Independent ISPs could still offer remote services such as Web hosting, but would have no control over the user's connection to the Net.
cilities, but it leaves little room or incentive for third parties to develop innovative applications and services on that platform. The dynamism of the Net—the Web browser, Amazon.com, Yahoo! and so on—came about because the infrastructure was an open platform not tuned for any one kind of application. An always-on, high-speed Internet could enable many more unplanned innovations, but that will be less likely in the integrated world the cable operators are planning.

It's important to be clear here. Cable operators aren't filtering URLs to prevent customers from reaching unaffiliated content sites. The problem is that they could... and users would have no alternative. The cable operators wouldn't even have to be so blunt, because their caching architecture allows some sites to receive better treatment than others. Also, customers may not be able to use new services, such as home servers, without @Home's blessing. Any ISP faces pressures to keep customers in its own orbit, but users can normally vote with their feet.

Where things stand in Washington

Local phone companies in the US are legally required to allow competitors to share their networks, but the same rules don't apply to cable operators. The cable equal-access issue could still come before the FCC in several contexts. The FCC must approve AT&T's acquisition of TCI and the controlling interest in @Home that comes with it. Several parties, including AOL, MindSpring and the Media Access Project, filed formal comments on this issue in the merger proceeding. They urged the FCC to condition the merger on a guarantee to independent ISPs of equal access to the @Home broadband pipe.

The FCC had not issued a decision at press time, but it has hinted strongly that it won't impose any such conditions. AT&T CEO Michael Armstrong has stated that restrictions on @Home would imperil the entire TCI acquisition. The FCC desperately wants competition in local residential telephony, and AT&T has promised to spend billions to offer telephone service over TCI’s cable plant. That AT&T would back out of a $48-billion deal because of restrictions on its part-ownership of a 330,000-subscriber Internet service suggests that something important is going on here.

The cable issue also came up in the FCC's section 706 advanced networks proceeding. On February 2 the FCC released a report to Congress on the deployment of advanced communications services, as required under section 706 of the Telecommunications Act of 1996. The original staff draft of the report included a notice of inquiry seeking comment on open access to cable Internet services. This would have provided an opportunity for comment outside the AT&T/TCI merger proceeding, although the FCC probably wouldn't have proposed any specific rule changes. However, the notice of inquiry was removed at the last minute. FCC Commissioners were concerned

5 Part of the problem is that in 1996 Congress changed the Communications Act to suggest that Internet access should be classified as a cable service when offered over cable networks, but as an information or telecommunications service over telephone networks. This change was made at the behest of elements of the cable industry, who were concerned that interactive services such as Internet access would be regulated as both cable and telecommunications services.
that any move toward imposing conditions on cable Internet services would scare away investors, and would constitute unnecessary government intrusion in the development of the Net. They did not want to forestall the likely investments by AT&T in high-speed Internet and voice services over TCI's network.

The FCC is right to be concerned about over-regulation of the Internet, but when it comes to monopoly last-mile infrastructure the issue is not whether government will regulate but how. The FCC and local authorities control what providers charge for services over both telephone and cable networks. They don't regulate ISP pricing because the market does a better job. Regulated companies always offer a Faustian bargain: Allow us to exclude competitors as an "incentive," and we'll provide services customers want. It's a vicious circle that only leads to more regulation when the promised services fail to materialize. The point here is not that AT&T, @Home and the cable operators are evil; the local phone companies — and AOL — have also built closed systems when they thought they could get away with it. The only way to ensure investment, innovation and deregulation is to have competition in every segment of the market.

The FCC did leave open the door for future action. Supporters of unbundling are taking their case to Congress and to the local franchising authorities in every city that must approve the AT&T/TCI merger. They also formed the Open Net Coalition to coordinate their activities.

Cable unbundling 101

So far the debate has been conducted on policy rather than technical grounds. Just how difficult would it be to allow cable customers to use independent ISPs?

Because the cable modem termination system is the primary interface node for the local cable Internet infrastructure, and uses standard interfaces such as Ethernet, it is the most likely point to interconnect independent ISPs (see Figure 1). AOL vp of broadband development Mario Vecchi argues that ISPs could connect at several points, including private peering relationships between backbones one router hop beyond the CMTS. Vecchi claims that engineers could resolve any management and technical issues, just as they do today when interconnecting ISP backbone networks. As Vecchi points out, hardware vendors such as Cisco and Lucent would compete to offer multiple-access equipment if they saw the demand, but now they are building equipment tuned for a single provider. Other companies may have software that simplifies the interconnection process, but in the current environment there is no market for such a solution.

@Home cto Milo Medin, in his FCC comments, acknowledged that independent ISPs could connect at the CMTS. He argued that this approach was not feasible, however, for several reasons. First, one ISP could accidentally impair the service of other ISPs connected to the same CMTS, because all share the same Ethernet bandwidth. Second, the CMTS would have to be configured to associate the correct ISP address space with each ISP, and that addressing information would have to be incorporated into dynamic host configuration protocol (DHCP) servers, but it would be impractical for each ISP to have its own DHCP server. Third, one ill-behaved modem or user can affect all others in that neighborhood.
True enough: A system with multiple providers is more complicated than a vertically integrated approach. But all the problems listed by Medin have solutions; the question is just who will pay the costs. To avoid congestion at the CMTS or the neighborhood-area network, cable operators and independent ISPs would have to coordinate their procedures. The cable operator's DHCP servers and order provisioning systems would need to interact with ISP customer databases. This would require new procedures and automated systems, which would take time and money to develop.

There is some evidence that cable Internet access platforms can be shared with independent ISPs. MindSpring has successfully tested interconnection with Knology, which is building cable networks for high-speed Internet access in several southeastern US cities. In July 1998, the Canadian Radio-television and Telecommunications Commission (CRTC) ordered cable operators and ISPs to develop a mechanism for Canadian cable customers to select among competing ISPs. The Canadian Cable Television Association has filed a series of implementation reports since then, and has a timetable for technical trials during 1999 (see Resources section). Many business issues remain to be resolved, but the progress so far in Canada suggests that these are not impossible problems.

Is it worth the effort? If ISPs just provided transport, cable operators might have a point. @Home offers connectivity all the way from the customer premises to the public Internet with an architecture optimized for speed. But as companies such as MindSpring have shown, ISPs that own no transport facilities can compete on the basis of superior service and support. We don't doubt that @Home intends to offer an excellent customer experience. As the AT&T breakup demonstrated, however, competition produces lower prices and better service.

What's up, DOCSIS?

The cable industry, through its CableLabs standards organization, has developed the data over cable service interface specification (DOCSIS) for interoperable cable modems. DOCSIS 1.0 is now available and DOCSIS 1.1 is moving through the standards process, with volume shipments of DOCSIS, compatible modems expected this year. DOCSIS has been designed to allow interoperability of cable modems from multiple manufacturers. However, it wasn't designed with multiple ISPs in mind.

To facilitate unbundled cable Internet services, DOCSIS could be extended to support source routing and greater remote configuration features. The broader problem is that the standards process has so far been focused on the needs of the cable industry rather than the larger community of potential high-speed Internet providers. AOL's Vecchi and other proponents of open access say cable networks can be opened to independent ISPs without any changes to DOCSIS, but acknowledge that standards changes could help. Down the road technical standards are bound to play an important role, as they have for the Internet in general.

Competitive alternatives

Open access to high-speed cable Internet systems matters only if there are not likely to be alternative open pipes into the home. If most residential customers had a choice between a vertically integrated high-speed ca-
ble Internet service and a comparable phoneline high-speed Internet service that was open to independent ISPs, there wouldn't be much of a fight about the architecture of the cable service. In fact, its very closedness would become a competitive disadvantage, like a cable service that offered a limited range of channels. Everyone agrees that the goal is competitive, unregulated markets.

@Home and its supporters argue that DSL provides a competitive alternative to cable Internet services. So far, however, DSL services have been targeted primarily at small businesses, and less than 100,000 customers have DSL service compared to more than 500,000 with cable modems. DSL is also sensitive to conditions of individual phone lines, and doesn't work as well over the longer-distance loops in suburban and rural areas. It is easier to provide access to independent ISPs on DSL systems because these networks feed into central switching points at phone-company end offices, which are already designed to hand off traffic to long-distance carriers, competitive local-exchange carriers and ISPs. Local telephone companies are also subject to more stringent equal-access regulatory requirements.

Dramatis personae

The cable unbundling issue affects virtually every player in the industry. AT&T alone reportedly has 53 lobbyists working on it. The battle lines are being drawn, and some interesting alliances are forming:

Supporting unbundled access to cable Internet pipes:

Independent ISPs (AOL, MindSpring, Prodigy, EarthLink, Verio)
Consumer groups (Media Access Project, Consumer Federation of America, Computer Professionals for Social Responsibility)
Long-distance carriers (MCI Worldcom, Qwest)
Local phone companies (US West)
Independent content providers (Disney, Bertelsmann)

Supporting integrated cable Internet services:

AT&T
Cable operators and @Home
Excite (owned by @Home)
Vendors to cable Internet services (Intel, Microsoft, Cisco)
Kleiner Perkins (investor in @Home and Excite)

Nonetheless, most residential DSL deployments offer no ISP choices other than the phone company's affiliated provider. US West, while lobbying for unbundled cable Internet services, has been accused of discriminating against ISPs seeking access to its DSL networks. AOL recently struck a deal with Bell Atlantic to allow customers to purchase DSL service with AOL as the ISP and content provider for about $40 per month. Such deals may proliferate, but the slow pace of local telephone competition shows how reluctant incumbent carriers can be to allow competitors in.

Several companies are working on wireless local-loop solutions that offer speeds significantly greater than current dial-up connections. Existing
wireless services such as Metricom's Ricochet offer mobility but limited speed. The alternative is fixed wireless, where users connect in a single location but can enjoy faster service. Unlicensed and licensed wireless systems continue to improve in price/performance over time. (See, for example, the 2.4-ghz unlicensed wireless home-networking solutions we described in Release 1.0, 12-98.) Digital television spectrum may provide huge untapped new two-way bandwidth, although the current allocation rules aren't designed to exploit it.

If cable modem and DSL services are successful, there will be pressure for alternatives to serve independent ISPs. We wouldn't rule out a breakthrough, but it's unlikely any technology will threaten cable and DSL in the next five years.

Where do we go from here?

As we stated at the outset, the issue is broader than @Home, cable operators or the FCC. The question is whether an open high-speed Internet, modeled on the wildly successful Internet of today, makes economic and technical sense. We believe it does, and that efforts to supersede it with closed systems won't generate the same level of investment and innovation. In other words, a closed Internet won't grow the way the open one has. Even Microsoft was unsuccessful in building a proprietary online service with MSN.

As networking moves deeper into everyday life (see Release 1.0, 12-98), last-mile infrastructure will grow in importance. Under any likely scenario, you'll still be able to send e-mail anywhere and reach any URL, but those functions will represent a shrinking fraction of the Net's functionality. If service providers continue to insist that Internet 2.0 operate on a closed model, the most significant consequence will be to delay deployment of such a network. @Home's exclusive contracts with cable operators expire in less than five years; at the current rate the vast majority of households may still be using dial-up modems at that point in time.

The market, not the government, should be able to take care of this issue. If an ISP is willing to pay a cable operator enough, the two parties should be able to reach a mutually beneficial business agreement. Instead of arguing on principles, the parties need to explore the financial trade-offs in concrete dollar values. What are the supplemental revenues cable operators could receive by tying subscribers to an affiliated ISP? What are the costs of implementing open access systems? What would the ISPs pay for using such high-speed access to reach their customers? Both sides have taken extreme positions and used the regulatory process as a bargaining chip rather than exploring room for compromise.

If the FCC tries to supervise precise details and pricing of interconnection, cable companies and their investors will justifiably think twice about building out aggressively. On the contrary, the businesspeople should hammer out agreements and tell their engineers to find technical solutions. Several ISPs should be able to sign up more customers than the cable operator alone, and both sides will benefit. After all, @Home currently has only 331,000 subscribers despite being available to 13.2 million homes, a 2.5 percent take rate at a time when some 40 percent of US homes have Internet access. Many people have Internet access today be-
cause AOL mailed them a disk or their local ISP walked them through the set-up process; the same dynamic will occur in the high-speed market if competition exists.

However, there is a small role for the FCC: It could help matters along by issuing a non-binding policy statement in favor of open high-speed Internet systems, with a specific timetable for reviewing the pace of deployment. At the same time, it could describe specific deregulatory steps it will consider under a competitive scenario. The FCC could also request data on costs and technical concerns that would help companies to start thinking about business cases instead of "moral" positions; the absence of such information makes it difficult to evaluate competing claims. Either formally or informally, the two sides could be encouraged to sit down together and explore potential arrangements. At the least such discussions would illuminate the distance between the two camps.

We suspect none of this will happen, and most cable and telephone companies will continue to exclude independent ISPs from their systems. We also suspect that two to three years from now high-speed access penetration will still be lower than analysts are predicting. At that point the FCC probably will start some sort of proceeding, but it will be more difficult to open up networks that have already been deployed.

We hope we're wrong. Either way, the fork in the road is before us today. All participants in the industry should consider which option they prefer.
A few months back we wrote about products that use client-side agents connected through the Internet to resolve software conflicts (see Release 1.0, 10-98) and enhance customer service (see Release 1.0, 9-98). Since then, we've run into three other companies that use a similar model, although each has its own wrinkles.

The trend towards closed-loop technical and customer support systems is important... and not just because software support consumes billions of dollars every year. Ubiquitous networks are slowly changing the very nature of computing. Some of the trends are subtle, but taken together they will transform the industry. We're used to thinking of both computers and software as objects that come in boxes. Yet the boxes are merely temporary containers for fluid information. The Net breaks down the artificial boundaries between data, applications and devices. Products morph into services, information itself becomes a product (see Release 1.0, 11-98), data enriches interfaces and the computer becomes the network (see Release 1.0, 12-98).

Technical and customer support are on the leading edge of this phase transition. They are the meeting points of goods and services, products and information (see page 16, below). Aveo, Shaman and netDialog all begin with the notion that the Net fundamentally changes the support process. All three attempt to turn support from a purely reactive function into a proactive learning experience.

**VitalSigns → INSoft**

Shortly after we wrote about VitalSigns (see Release 1.0, 10-98), the company was acquired for $125 million by International Network Services (INS), a network management services company. The merged company offers enterprises a more complete array of software and services than either of the constituent entities. The VitalSigns team has become the INS software group, INSoft, responsible for both VitalSuite and the EnterprisePRO network-management product line. VitalSuite excels at diagnosing network and application problems, and INS can now offer consulting and network design services that make use of that information.

**Aveo**

Conventional wisdom holds that push technology is dead. (Like the Monty Python parrot, we suspect, it's just resting!) Companies seeking funding and analyst attention thus feel compelled to invent other names for technologies that automatically send filtered, dynamically selected information to users. Aveo, based in Santa Clara, CA, is designing products around what it calls a customer communications system using advanced dynamic agenting technology. We call it push... but for a point. The push model makes eminent sense in the right contexts, and technical support is one of them. Users need targeted information at the correct time. Push systems filter and download information in the background, so that users have it available when they need it.
Aveo originated as Cypress Research, a consumer-oriented computer telephony software vendor. Its Megaphone product sold well, but in an increasingly commoditized market. CEO Paul Hurley saw a more lucrative opportunity in the software reliability space, building on the company's expertise developing robust client software for many different PC and peripheral configurations. The company re-launched as Aveo last year. It currently has 60 employees, and investors include idealab! Capital Partners, Draper Associates and Intel.

Traditional technical support fixes problems. Aveo's AttunePrevent goes one step back, preventing some problems from happening in the first place. Technical support operations identify recurring problems and trace them back to specific causes. They then establish systems (accessible by phone, e-mail or Web) to provide the right response quickly when a customer reports a problem. Closed-loop, Internet-based systems can greatly enhance the diagnosis and correction process (see Release 1.0, 10-98). But they don't generally prevent the problem in the first place.

Aveo's insight is that many users experience the same problems at different points in time. If Al has a problem and the support organization figures out how to resolve it, why wait until Ethel gets into the same exact situation? If the support organization knows that a particular set of circumstances will cause crashes, why not tell Ethel that before she gets to that point?

With the Attune system, developers or technical-support organizations identify problems and create what Aveo calls Intelligrams. The Intelligrams are pushed down to users in the background, and the Attune system filters messages so that users receive only those that may be relevant for their system. The Intelligrams are stored on the user's hard drive and launched when specified situations occur. Attune can detect and respond to virtually any activity on a desktop machine, including running processes, open windows, text in a window and changes to the Windows registry.

In addition to suggested actions, Intelligrams can contain frequently asked questions or links to updated versions of software as appropriate. Aveo is developing knowledge packs for customers who don't want to develop Intelligrams themselves, and Hurley says customers will be able to purchase AttunePrevent as either a product or a service.

For example, let's say a new version of a voice-recognition program overwrites the sound drivers on a particular PC model, causing a problem. The software developer, PC manufacturer or technical-support organization will start getting calls and will eventually identify the conflict. The developer can post an update on its Web site, but how will all its existing customers know that's the cause of their troubles? Using AttunePrevent, any of these support organizations could create an Intelligram that encapsulated the problem, trigger and solution. When a user tries to install the voice-recognition application, a dialog box would pop up that explains the potential conflict and proposes an alternative (leaving the existing sound drivers in place).

Attune runs on top of third-party transport products; the first release supports BackWeb and Marimba support is in the works. The push vendors
handle the transport and synchronization, and Aveo provides the authoring, filtering, triggering and problem-resolution functionality.

Hurley says Aveo is “trying to be the first point of contact” for users experiencing reliability problems. Aveo plans future modules to handle warranty and registration management, upgrade information distribution and marketing communications. It will also allow partners to offer targeted products, such as a new hard drive for customers who experience disk space-related problems. To protect privacy Attune allows users to choose what information they provide, and the system can function even if users are unwilling to share any personal data.

**Shaman**

Shaman Corporation, based in San Francisco, was founded in 1996 by ceo Kurt Brouwer, who had previously started an investment advisory firm, and cto Chris Spain, an interactive media developer. Spain got the idea for Shaman when software crashes forced his company to waste two days of shooting on a project for the Discovery Channel... and the solution turned out to be a free patch he hadn't known about.

The company released its Enterprise Shaman product in October 1998 and now has 22 employees. Its customers include Intuit, Sterling Software, TRW and the National Institutes of Health. The company has been funded by angel investors to this point, although it is now beginning to look for venture capital.

Enterprise Shaman has three main components: a server, a knowledgebase and client-side agents called Scouts. The Scouts (available for both Windows and Macintosh) automatically collect hardware and software data from each desktop machine and upload it to the Shaman server. The server analyzes the information from the Scouts against the knowledgebase to locate conflicts or obsolete software. IS managers identify and prioritize problems they wish to address, and the system automatically generates a list of necessary updates and bug fixes. If a user needs to install patches, the system can create a personalized intranet Web page with the necessary information and hyperlinks, and can send a the user a notification by e-mail. IS managers can also use Shaman to distribute the necessary files themselves either electronically or manually.

Shaman's greatest source of value is its knowledgebase, which is stocked with information on over 50,000 titles and versions. Shaman has partnered with over 200 software and hardware vendors that provide it with information and permit it to distribute free patches and upgrades. The company also employs a team of researchers to collect and categorize information. Shaman maintains the master knowledgebase centrally, and regularly updates customer servers via the Internet with the newest information.

Spain estimates Shaman's system can prevent 20 to 35 percent of helpdesk calls, and beyond that as he points out, “sometimes it's just as important to know what can't be fixed as what can be fixed.” As more customers sign up, Shaman's database of both confirmed and unconfirmed bugs will grow, and the company will be able to provide such information to both users and developers. Spain emphasizes that because the Scouts are written in TCL,
a cross-platform scripting language (see **Release 1.0, 11-98**), they can be ported easily to different operating systems.

Enterprise Shaman costs $25,000 for a server license plus $50 per Scout. The company typically installs a limited number of Scouts at a customer site to demonstrate the return on investment before going forward with full deployment. This approach has its advantages. Shaman vp of marketing Michael Ciocia happily points out that when the system was tested at brokerage house Donaldson, Lufkin and Jenrette, it immediately solved a problem that had been causing the CIO's computer to crash. Within a week, Shaman received a contract for 2000 seats.

Comparing Shaman and Aveo is instructive. Both companies automatically identify potential conflicts on user machines, without waiting for the users themselves to report problems. Shaman is fundamentally an infomediary, managing the flow of existing information from software developers to users. In a sense, Enterprise Shaman is the converse of Full Circle's TalkBack (see **Release 1.0, 10-98**), which automates the information flow from users back to developers. As an information hub, Shaman controls its knowledgebase and matches user configurations against known problems centrally. This approach allows it to make available more data than any one company or technical support organization could provide.

Aveo takes a more distributed approach, beginning with its use of push technology. AttunePrevent depends on Intelligrams, whether from developers, PC OEMs, technical support organizations, or Aveo itself. This makes the system better for resolving specific, unanticipated conflicts between applications and hardware, but less efficient for delivering existing software updates. Shaman takes advantage of the work developers have already done in releasing patches, bug fixes and upgrades. Its system is therefore particularly effective for addressing horizontal problem-causers such as Y2K or a new release of Windows. Aveo does more filtering on the client side, which allows it to alert the user before a conflict is created and may scale better to millions of desktops. On the other hand, Shaman's server-centric approach avoids sending the user's machine any unnecessary information, and also works across more client platforms.

Shaman and Aveo both currently target large corporate intranets, but plan to move down the customer food chain. Existing consumer products such as Network Associates' Oil Change offer automatic updates, but with much less functionality. Shaman plans a Web-only subscription offering this spring for consumers and small businesses, once the company has established itself in the enterprise market. Aveo ceo Hurley expects to have 10 million clients deployed by the end of the year through several distribution channels, including signing up ISPs to distribute the software to their end users. That will be a tall order, but Aveo's flexible pricing strategy gives the company a chance to pull it off.

**netDialog**

Support should be a conversation rather than a series of discrete events, as we have pointed out (see **Release 1.0, 10-98**). Motive and Customer Support Technologies, which we covered in October, have built conversational applications for technical problems. Startup netDialog takes a similar approach for customer management in the e-commerce environment.
netDialog was founded in May 1997 and is based in San Mateo, CA. Investors include BankAmerica Ventures and Bay Partners. Founder and ceo Joe Fantuzzi was previously ceo of 3D graphics tool vendor MultiGen, and before that was an executive at Autodesk, Macromedia and Interleaf.

netDialog's Online Customer Management System (OCMS), launched in September 1998, automates the end-to-end process of customer management. Like several other Web-based customer-service solutions, OCMS provides a unified environment for managing customer inquiries via phone, e-mail and the Web (see Release 1.0, 9-98). All points of contact share the same workflow, queuing and knowledgebases. netDialog is unique, however, in capturing the entire customer-support interaction, rather than focusing purely on the question and the answer.

The system tracks users as they move through a Website looking for self-serve support information. If a customer can't find what she's looking for, she can click on a "more information" button. The system provides suggested answers based on where the customer was previously looking on the site. If none of those answers satisfies the customer, she can type in a question and request either live customer support via text chat or an answer via e-mail. As a support representative walks the customer through the solution, the system automatically stores the steps and information involved. If the user elects to receive a response via e-mail, support agents can quickly create personalized Web pages with the necessary information and send the customer a URL. When another customer comes to the site with a similar problem, he will see a hyperlink to the solution walkthrough developed for the previous user.

netDialog's approach also facilitates distributed support. Companies can give suppliers, partners and others access to the system, and the advice they provide to customers will be fed into the central information-management framework. The system integrates with customer-support applications from vendors such as Remedy and Clarify, and also interfaces with Aspect's computer telephony integration system.

OCMS consists of several Java-based applications for customer-service representatives and managers. The main system server runs on Windows NT, but the client is cross-platform and uses either Java or plain HTML for older browsers. Pricing starts at $50,000 for 10 service rep seats, 3 administrator seats and unlimited customer seats.

Three ways of moving information

We've learned how to package the information and functionality in software. Now we're learning to package the metadata: Support in the form of manuals, bug fixes, incompatibilities, upgrades, warranties and so forth. The billions of dollars spent every year on technical support are just the transaction costs of getting that information from its source (usually the vendor) to its destination (users) in usable form. Even when someone — the software developer, a support representative at your company helpdesk, the guy across the street — knows exactly how to fix the software problem you're having, you still usually need to go through the expensive process of making a phone call and identifying the problem.
As we explained in September and October, the best way to improve and streamline support is to automate the flow of information in a closed loop between users and vendors. There are three ways to move information between the two endpoints: push, pull and transactional. Aveo takes a push approach, sending information to users automatically in the background, and filtering it there so that only the relevant information comes up when needed. Shaman uses a pull model, with a centralized knowledge-base that sucks in information about desktop machines and identifies problems. netDialog looks at the process of interaction between customers and support organizations, and creates re-usable “activity” components that speed support in the future.

There’s no right answer, but the paradigm chosen does shape the solution. netDialog’s conversational system works best for repetitive problems over an extended period of time, because each interaction improves the knowledgebase and the self-service information on the customer’s Website. The push and pull models are more appropriate to contexts where the main issue is getting existing information out to users.
PORTALS, PORTHOLES AND POTHOLES

With the year of the portal coming to a close, industry buzz has shifted to two variations on the theme: vertical and corporate portals. Before the p-word loses all meaning it's worth exploring what's real and what's marketing hype. A new interface model is emerging, but companies are still assembling all the pieces. We therefore take a brief first look at this nascent space.

Let's get vertical

The vertical portal tries to have it both ways: It is broad like a portal, but deep like a destination site. At some point, though, the dividing line between a vertical portal and a plain old content site becomes difficult to discern.

As the television and cable industries discovered, there is a complex equilibrium between narrowcasting and broadcasting. Broadcasters have steadily lost viewers to more-targeted cable networks, but beyond a certain point of specificity cable networks experience diminishing returns. The viable level of generality varies from area to area; market experience is the best way to find the sweet spots. We think portals can succeed if they offer carefully targeted value to customers (see Esther Dyson's article in Release 1.0, 10-98), regardless of whether they aim for a specific vertical niche.

From desktop to desk drawer

Corporate portals, or portholes as we prefer to call them, are more interesting. If a portal is an entryway into the Net to catch the eyes of passing consumers, a porthole provides a view outward from the individual within an organization. Enterprises and service providers are finding it as difficult to organize material on their own networks as on the Internet at large. The portal concept – an organized jumping-off point – thus makes sense for internal users as well.

An effective porthole is more than an intranet home page on steroids. Rather than comparing portholes to portals, we should compare them to user interfaces. Ever since Apple introduced the Lisa and Macintosh in the early 1980s, the state-of-the-art PC interface metaphor has been the desktop. Many failures have been variations on that theme, such as General Magic's MagicCap and the browser-as-desktop efforts from Microsoft and Netscape. The porthole heralds a subtle shift: from the desktop to the desk drawer. (We know we're mixing metaphors, but bear with us!) The desktop offers objects and devices; the desk drawer offers tools and information. To put it another way, the desktop organizes containers such as applications, peripherals and documents; but the desk drawer takes you directly to the content, regardless of origin. Just as the desktop freed users from knowing where a file was located in the directory tree, so the desk drawer may free them from knowing what application generated a piece of information.

Portholes can incorporate several functions. Each has value on its own, but Web-based aggregation makes these functions available to far more users and increases employee productivity. In the past some companies have
built custom portholes using content-management systems such as 2Bridge’s 2Share (see Release 1.0, 9-98). Several vendors now offer packaged applications designed specifically for this task. Below, we briefly describe and categorize the leading players in the emerging porthole space.

The first function is search and classification, since after all portholes exist to help users find and see things. As we discussed last month (see Release 1.0, 1-99), several new technologies are significantly improving Internet search performance. Most corporate intranets are far smaller than the public Web, which makes searching easier, but users also have higher expectations on an internal system. Document and knowledge-management systems help, but both cover limited information types and expect other applications to revolve around them.

### Vertical portholes?

Vertical portals may make more sense inside companies than on the Net at large. Employees tend to see the world through functional or industry categories: At some level a consultant is a consultant, and a benefits administrator is a benefits administrator. Both could use the same porthole, but no matter how customizable the interface it probably wouldn’t meet all their unique needs.

Startup Portera Systems builds vertical portholes for mobile professionals. The company’s first product, announced earlier this month, is a hosted solution for consulting firms. ServicePort gives consultants, managers and clients easy access to engagement-related materials along with external news and information feeds. In the old days we would have called it groupware, but ServicePort doesn’t require information to be stored in its own format. The groupware vendors are all migrating their products to the Web and open standards, but vertical portholes start there.

Some application vendors such as PeopleSoft are trying to become portholes themselves. The PeopleSoft Business Network, announced in November, will offer a Web-based front-end integrating PeopleSoft applications with content from independent providers. Content will be organized around “e-business communities” in vertical areas such as benefits, payroll, procurement and recruiting. Companies that have already organized their business processes around PeopleSoft may prefer such a solution, but a single vendor has less incentive than an independent aggregator to make the porthole open and flexible.

Plumtree Software, a startup based in San Francisco, makes software that automatically organizes documents and other information into a Yahoo!-like hierarchy on an intranet. The Plumtree Server periodically polls data sources for new content, and automatically creates metadata for each document to facilitate effective searching. The software can also send employees regular e-mail updates about new information relevant to their jobs. Plumtree currently focuses on research and development, field support and competitive intelligence, all of which involve aggregation of information from many sources.
A few established search technology companies are also moving in this direction. Verity, best known for providing inexpensive search software to Website operators, has refocused on managing unstructured data across intranets using a browser front-end. The company offers a suite of products to locate, organize and disseminate information in a wide range of formats. Another contender is Autonomy, which uses intelligent pattern recognition technology to organized textual data into subject categories. Its recently released Portal in a Box product automatically classifies materials on corporate intranets, then creates hierarchical hyperlinks to simplify navigation through those categories.

The second important area is information analytics, including decision support, business intelligence and data mining. Such applications have been around for a while, but typically only a limited subset of employees has access to them. Bringing such functionality to more users and integrating it into business processes involves more than just a browser interface. Effective portholes will span several enterprise applications and incorporate sophisticated data management. No one is quite there yet, but some companies are trying. For example, Viador (formerly Infospace) offers a browser-based interface for creating and viewing reports across any database, data mart or data warehouse in an enterprise. Customers include 3Com, Charles Schwab, Citibank and FedEx.

Startup BroadQuest allows users to run sophisticated queries against enterprise resource planning, sales-force automation, groupware and customer-support systems, all through a simple browser interface. Users can also save queries as reports and ask to be notified when certain information changes. For example, a sales rep could cross-reference support calls and order-status information for a particular customer without contacting IS. Texas Instruments uses BroadQuest's MyEnterprise to give managers access to worldwide customer information, even though US and UK data are stored in separate Vantive databases.

Home is where the Web is

Finally, a porthole can give users a convenient starting point for all their activities. This has been the basis for the success of traditional portals: Yahoo! provides value even though each service it offers is available somewhere else. Moreover, corporate IS administrators may want to shape what users do and see online. A cio who invests millions of dollars in an intranet won't be happy if all the company's browsers default to My Yahoo because it provides convenient news headlines.

The company most committed to this form of porthole is Epicentric, a 15-employee startup in San Francisco founded by Ed Anuff and Oliver Muoto. The company’s Portal Server creates customized Web pages for either employees or customers (bearing a striking resemblance to personalized portals such as My Yahoo, My Excite and the Go Network). President and ceo Anuff, formerly the product manager of HotBot at Wired Digital, says “the opportunity in the corporate space is to create a desktop for Web applications.” Epicentric provides Java-based modules that link enterprise applications to its Web-based platform via the extensible markup language (XML). Administrators can then customize the information available to users; each user can further personalize the layout and content of his or her page. Epicentric has negotiated relationships with content providers
so that companies can easily offer features such as news, stock and weather feeds on their intranets or extranets.

Epicentric is beta testing its product with several customers including the US Postal Service, Baan, Philips and Hewlett-Packard. It plans a hosted service version by the end of the second quarter, targeted at small to medium businesses. Anuff says enterprises are unwilling to outsource sensitive data such as company directories, and also want total control over infrastructure and branding. As Epicentric develops its offerings and content relationships, the hosted option should gain appeal.

More than just potholes?

The companies we describe offer elements of the desk-drawer model, but none of them yet delivers all the necessary functionality. At this point potholes are primarily tools for specific markets, like consultants, or incremental improvements on home-grown home pages. Aggregating links into one jumping-off page offers some value, but it's hardly revolutionary.

Still, we think the porthole vendors are onto something. The trouble with portals on the Web at large is that they can easily turn into potholes, designed to slow users down long enough to generate advertising or transaction revenues (see Kevin Werbach’s article on portals in Release 1.0, 10-98). Portholes, on the other hand, attempt to speed up the user experience. True portholes will offer value above and beyond individual applications. They will provide simple interfaces for managers and other employees to retrieve information stored in complex back-end systems. Beyond that, they will offer unique mechanisms to analyze simultaneously information sitting in several different applications. They will be the mediation points between local and hosted applications. They will provide a new level of interface personalization, building on the personalization capabilities of other Web-based applications (see Release 1.0, 9-98).

What's the real benefit of all this? More flexible and rapid access to information throughout extended enterprises. VisiCalc did nothing you couldn't achieve with a pencil, paper and infinite time, but it opened up a whole world of value for users. If vendors can deliver, portholes could also change the way we think about information.
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Except as noted otherwise, all companies’ Websites are at the likely address, http://www.domain_name.com.

For further reading:


Release 1.0 Calendar

1999

February 23-24  *Silicon Alley 99 - New York, NY. The Silicon Alley Reporter's third annual conference. For info call Jennifer Rentz at (212) 475-8000 x103; e-mail jennifer@siliconalleyreporter.com; www.siliconalley99.com.

March 1-3  Jupiter Consumer Online Forum - New York, NY. The intersection between the consumer Internet and traditional media, entertainment and communications companies. To register, call (888) 780-5010 x103; fax, (212) 780-6075; e-mail jon@jup.com; www.jup.com/events/forums/cof/.


March 6-9  SPA/IIA Spring Symposium - Los Angeles, CA. Issues critical to the future of software and information providers. Contact Anika Valentine, (202) 452-1600 x339; fax, (202) 785-3649; valentine@spa.org.

March 8-9  Alley to the Valley - San Francisco, CA. AlleyCat News brings New York new media companies to the technology-starved Bay Area. E-mail events@alleycatnews.com; fax, (212) 966-9371; www.alleyvalley.com.

March 21-24  *#PC Forum - Scottsdale, AZ. Sponsored by EDventure Holdings. You read the newsletter; now meet the players. Call Daphne Kis, (212) 924-8800; fax, (212) 924-0240; daphne@edventure.com; www.edventure.com.

April 6-8  *Computers, Freedom, and Privacy 99 - Washington, DC. The ninth annual conference on technology and public policy. This year's theme is "The Global Internet." E-mail info@cfp99.org; www.cfp99.org for more info.


May 21-23  Foresight Group Genius Weekend - Palo Alto, CA. Annual gathering on technological change. Call (650) 917-1122; fax, (650) 917-1123; e-mail inform@foresight.org; www.foresight.org/SrAssoc/99Gathering/.

June 22-25  INET '99 - San Jose, CA. The Internet Society's annual conference. For information e-mail inet99-register@isoc.org; www.isoc.org/inet99/.

* Events Esther plans to attend.
# Events Kevin plans to attend.

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