Surveying the E-Services Technical Landscape

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E-Services,
speak-easy,
Jini,
Chai

Hewlett Packard has presented an E-Service vision for electronic commerce in which a rich array of nimble modular electronic services (e-Services) are accessible by virtually anyone and any device. This document surveys current efforts to meet the technical challenges presented by E-Services. We discuss what differentiates E-Services from today's applications, and what new requirements are presented by these differences. We summarize the efforts of major vendors who seem to be reaching for the E-Service vision, and then compare and contrast the functionality, characteristics, and limitations of those vendors' products.

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1 Introduction

HP's E-Services initiative envisions a new paradigm for electronic commerce in which a rich array of nimble modular electronic services (e-Services) are accessible by virtually anyone and any device. Today's e-commerce world is primarily business-to-consumer (B2C); business-to-business (B2B) connections must be laboriously created point-to-point and with human direction at every stage. Some human being (possibly with some programmatic tools) must discover the potential match between two businesses, negotiate a contract between them, compose the necessary business-to-business data exchange mechanisms, and program the appropriate flow. HP's E-Services vision proposes a platform where applications can be wrapped and presented as E-Services; where E-Services can be effortlessly composed to create new E-Services; where very small businesses can employ the E-Services paradigm to out-source complex functionality so as to become virtual corporations.

HP's new E-Services vision transforms current paradigms of e-commerce by replacing the assumptions of B2C and point-to-point B2B connections with a many-to-many B2B model. It transforms the paradigm of the isolated storefront by enabling the storefront to buy from and sell to other E-Services as peers. It transforms the application hosting paradigm by allowing an E-Service to dynamically discover and connect to E-Services hosted by other providers. It transforms out-sourcing paradigms by automating the process for connecting heterogeneous E-Services, enabling the entire process to occur electronically, potentially without human intervention. E-commerce services will be connected to the numerous E-Services that manage the other business-related activities (e.g. business returns or supply chain management). Transactions and workflow will span across all of these services, and an event in one service will be able to trigger actions in another.

The E-Services vision presents a unique set of technical challenges. In addition to the technical requirements imposed by existent point-to-point application server technology (such as the need for secure transactions, highly available servers, etc.), the E-Services vision is associated with its own, new, needs. For example, in order for one E-Service to identify which other E-Services provide required functionality, the platform must support uniform discovery mechanisms (this is also required for support of internet appliances). In order to compose two (or more) E-Services dynamically, they must have some means of exchanging business data - even if they don't initially share a common vocabulary – and coordinating heterogeneous business processes. And finally, in order to enable E-Services to arrive at and execute contracts in an automated fashion, the platform must provide models of business interaction between E-Services and identify "official" entities that can aid in the various aspects of contract maintenance.

Figure 1 shows the software stack underlying the E-Services framework. There are many companies that either already offer or else are in the process of developing products to meet any given requirement. For example, Microsoft, IBM, BEA, and SAP (among others) all provide transaction management packages. In this document, we focus on the top layer of the stack, exploring which of our competitors are striving for this vision, and which of our competitors seem likely to reach it.

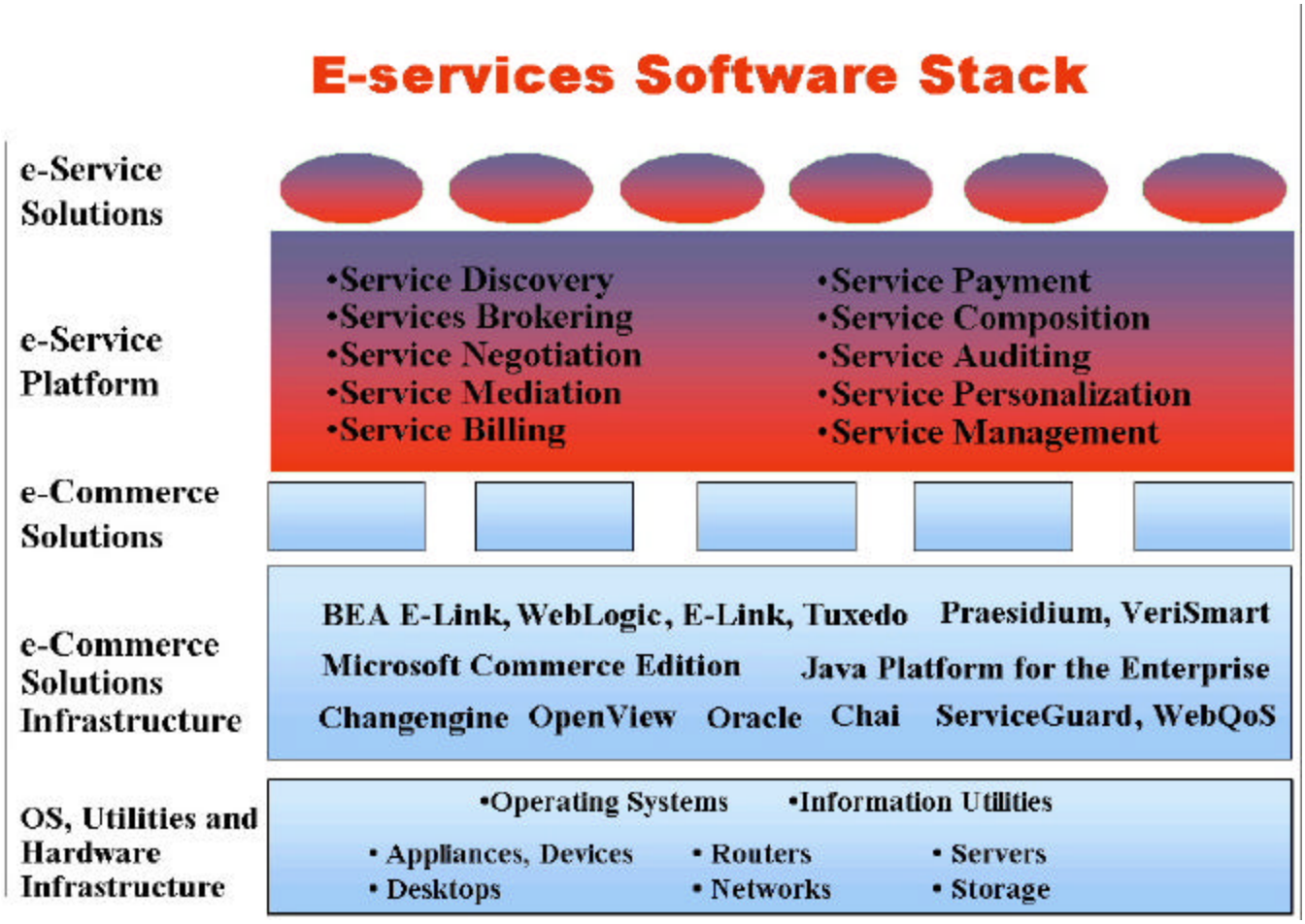

Figure 1 – E-Services Software Stack (figure from Anna Durante)

2 So what's new?

Viewed individually, the components of an E-Services framework (Figure 1) may seem cutting-edge, but are not clearly disruptive, in that technology addressing the listed requirements has been in development, and in many cases in commercial use, for years. E-Service technology seems to be a natural and expected extension of the (disruptive) presence of the web. For example, a multitude of products exists for coordinating applications using workflow. Any disruptive impact of the E-Services vision depends upon the fulfillment of the complete vision. A partial implementation resulting in yet another storefront development kit or yet another B2B connection solution will not be disruptive.

The potential impact of E-Services can be viewed as a matter of scale and gestalt. Patricia Seybold identifies five factors as differentiating tomorrow's e-services from today's Web-based applications[35]. Below, we quote Patricia Seybold's factors (in italicized text), list the technical issues implicit in each factor, and briefly summarize current efforts to address these technical challenges.

1. *An application running in any device – on or off the Net – can request an e-service. Once the request is received, the appropriate e-services will kick into action.*

   There are at least two requirements implicit in this factor. First, the application presumably has some way of discovering the e-service – that is to say, a *discovery mechanism and protocol*. Second, applications running on heterogeneous platforms and devices (including intermittently connected platforms) must have a common means of communication – it must be possible to bridge between them. An argument can be made that today's applications running on heterogeneous devices can discover and communicate using any of a number of distributed computing protocols (e.g., CORBA or DCOM). However, it is not clear that existing protocols are scalable enough or vendor-independent enough to stand up to the scope of full E-Services. Several companies are developing products that

address these issues, for example HP's JetSend, Chai, and E-Speak; Sun's Jini; Microsoft's BizTalk, and Lucent's Inferno.

2. *E-Services are self-contained, modular, mix-and-match applications. They act as resources to other applications. E-Services can be performed, initiated, scheduled, or committed (or all of the above) by software with or without human intervention.*

   This factor sketches the interoperability needs of E-Services. First, E-Services must provide API's (or their equivalent) so that they can be integrated with other applications. Second, in order for E-Services to interact (as resources to each other), they must have a standard means of exchanging business data. Third, in order for E-Services to be "performed, initiated, scheduled, and committed" without human intervention, E-Services must have some degree of autonomy with regards to their interactions, as well as some mechanisms or protocols that would allow heterogeneous E-Services in a potentially insecure environment to inter-operate with managed risk.

   One way of looking at this is to view it as the problem of how to integrate business applications. Online transaction processing (OLTP) vendors such as BEA and Oracle are addressing the problem of managing transactions that span multiple companies in a network. E-Services extends the scope of the application integration problem by casting the E-Services as re-usable resources. Another similar problem is how to coordinate reusable components. Roger Sessions coins the term "component oriented middleware", meaning business logic packaged in the form of software components, with component oriented middleware handling all details of component coordination[33]. However, E-Services raise the granularity of the coordination problem from components to heterogeneous applications.

   Currently, ERP vendors such as Baan, SAP, PeopleSoft, and Oracle are expanding their business (through partnerships and the building of new applications) to link front-office Web-based sales applications -- catalogs, purchase orders, and online approvals -- to back-end accounts receivable, shipping, and receiving applications. This is accomplished using static, pre-configured connections. In addition, many ongoing efforts (not necessarily competitive) attempt to address the problem of how to exchange business data and carry out inter-business transactions – for example, CommerceNet's eCo Framework project, Microsoft's BizTalk, IBM's EECOMS-related projects, etc.

3. *E-services are self-describing applications. Each e-service knows what functions it's capable of performing, what inputs it requires, what outputs it produces, and what its attributes are (e.g., security, location, cost, etc.)*

   This factor specifies that E-Services must "know" and be able to communicate their capabilities and requirements to other applications, presumably through some well-known mechanism or protocol. This implies that E-Service providers must agree upon (or to) some definition of minimum sets of self-descriptive information that E-Services must be able to provide to each other in various contexts.

4. *E-services are highly visible and manageable. They are instrumented so that they can be monitored by external application management and workflow systems. An e-service may be running on a system you don't own or control, running on an operating system you know nothing about, or written in a programming language you aren't familiar with. But you can detect and manage the state of the e-services application and the status of its outcome.*

   This factor touches upon the topics of visibility and risk management. Presumably, for practical purposes, an E-Service provider would want to tightly control how much of its internal state it exposes and to whom. For example, if an E-Service could be readily queried for its internal pricing tables and product specifications, then a competitor could steal its business by offering better deals. On the other hand, in order for an E-Service to be able to predict resource status and availability when using another E-Service as a resource (as specified by the previous factor), it must have at least some visibility into the "resource" E-Service.

5. *E-Services can be brokered and auctioned. Once a request is received by an e-services broker or directory service, different e-services applications may vie for the opportunity to perform the requested functions, based on their attributes and their current state (available or busy, highly secure or less secure, price per transaction and volume of transactions that can be handled within a time frame, and so on).*

   This factor touches upon at least three major requirements. First, a marketplace must exist that supports the acts of brokering and auctions and that enables the dynamic creation and fulfillment of agreements for E-Services. It is unclear from the given description to what extent this marketplace must automate the five phases of a classical capital market transaction (information, order routing, execution, clearing and settlement phases). Second, in order for E-Services to be brokered automatically (without human intervention), it must be possible to construct connections between E-Services dynamically. Third, the E-Services must have some means of being represented in an auction (or of representing itself) in "loosely coupled interactions". Currently, there are many auction sites on the

Internet, both academic and commercial. Most of these employ agent technology to enable individual humans (as opposed to applications) to sell and bid on items electronically (i.e., C2C)[24]. In addition, a number of companies, including HP, are looking at the "apps-on-tap" (rental apps) market. Other companies include BizTone, Agillion, DigiThink, etc.

Note that this factor is quite different in nature from the first four. The first four factors can be read as requirements for a distributed computing system with diverse resources in a strongly heterogeneous environment (or for an extended framework for application integration). This fifth factor is higher level, requiring an established electronic marketplace in which contracts can be automatically negotiated and E-Services can be dynamically composed.

3 Who wants to go there (and how)?

Presumably implementation of an E-Services platform will occur incrementally (as opposed to presuming a complete E-Service solution). For example, it seems likely that support for the first four factors will be available long before the fifth is realized. In addition, participation in the E-Services paradigm must be allowed to occur incrementally (as opposed to forcing a company to commit to the full E-Services vision). For example, it's possible that an existent application could be wrapped and presented as an E-Service but not be capable initially of participating in dynamic contract formation. The goal of this document is to identify who else, besides HP, is headed towards the e-service space. For each company that is headed towards the e-service space, we want to answer two questions in this section:

1. In what way is this company heading towards the e-service space? That is, what do they have that looks like e-services?
2. How big of a leap is it between what this company is offering and the full E-Services vision?

Academic efforts aside, there are a lot of companies that offer solutions that to a greater or lesser extent look like E-Services. For example, there are more than 20 "Java application servers" available [35], many electronic brokerage services (e.g., Instinet, web broker) – not to mention hundreds of online-storefront development packages. Because there are so many of these products (and because such products are not themselves E-Services), this document does not attempt to survey these products. Due to time and space constraints, we do not examine ongoing efforts to develop formats, protocols, vocabularies, data schemas, and standards for business data exchange, nor do we examine technical efforts to address political/economic issues specific to E-Services, such as who has proposed what business models for electronic contract formation, which efforts address how E-Services will establish trust, how can trading partners be managed automatically, etc.

Instead, we focus here on companies that are large enough and diverse enough that they have a chance at realizing the complete HP E-services vision. That is to say, we look at companies that are powerful enough to be able to *host* an e-services platform and function as a "market-maker." For example, most companies that offer virtual mall development kits have no intention of expanding into e-services.

Table 1 summarizes the offerings of a number of these companies. More details about each company are given below.

	Factor 1: **Discovery, Invocation, Communication of E-Services**	***Factor 2:*** **E-Services as Modular Resources**	***Factor 3:*** **E-Services as Self-Describing Applications**	***Factor 4:*** **Instrumenting E-Services for Manageability and Visibility**	***Factor 5:*** **E-Service Marketplace – brokering, auctioning, etc.**	***Other***
HP E-Speak, Broker-In-A-Box, Speak-Easy, Chai-Server, Smart Internet Usage, JetSend, OpenView, Changengine	E-Speak , Jet-Send, Chai-Server	E-Speak, Speak-Easy, Chai-Server	E-Speak, Speak-Easy, Chai-Server	E-Speak, ChaiServer, Smart Internet Usage , OpenView	Broker-In-A-Box, Speak-Easy	HP has partnered with i2 to provide a supply-chain E-Service framework.

	Factor 1: **Discovery, Invocation, Communication of E-Services**	***Factor 2:*** **E-Services as Modular Resources**	***Factor 3:*** **E-Services as Self-Describing Applications**	***Factor 4:*** **Instrumenting E-Services for Manageability and Visibility**	***Factor 5:*** **E-Service Marketplace – brokering, auctioning, etc.**	***Other***
Microsoft BizTalk, Universal Plug-and-Play, Windows DNA 2000	Universal Plug-And-Play, BizTalk Server, XML and SOAP, Babylon	Babylon	Universal Plug-And-Play, XML and SOAP	Microsoft AppCenter Server, Universal Plug-And-Play?		Babylon, XML/SOAP, AppCenterServer, Shiloh, etc. are part of Windows DNA 2000 – scheduled to be available around June 2000
Sun Jini, iPlanet Commerce Integration Suite	Jini, (Netscape Directory Server?)	Jini, iPlanet	Jini			Allied with Netscape to build iPlanet. BizTone committed to building rental-apps based on Jini technology.
IBM San Francisco, EECOMS (CommonRules), Web Intermediary (WBI) Developer Kit for Java	T-Spaces, San Francisco?	San Francisco?	Aglets		Alphaworks efforts, such as Web Intermediary Development Kit for Java, DIPLOMAT and CommonRules.	IBM T-Spaces whiteboard system may be dropped (rumor).
Lucent Inferno, InfernoSpaces	Inferno's Styx protocol	Inferno				As of 6/1999, Inferno customers were all reportedly building Inferno-based webphones.
Hitachi TradeWinds, TradeLink	TradeLink	TradeLink				TradeLink is aimed at supply chain.

Again, we recognize that *many* companies are currently developing E-Service-like products, and that they are not necessarily publicizing their efforts. Because the sources used to compile this survey are primarily publicly available, because the E-Services landscape is rapidly developing and changing every minute, and because most companies do not want to "tip their hand," readers should be aware that this document is neither comprehensive nor complete.

3.1 HP

HP has committed itself to reaching E-Services [3,4,21,25,34]. HP's strength is its size and vision – it does not have any established advantage in native software and indeed seems to rely on outside vendors' software products. Towards this

end, HP has partnered with a rapidly increasing number of companies, listed in Table 1 below. (See the web site http://hp.com/e-services for more details about these partnerships.)

- **Ariba**
- **BEA Systems, Inc.**
- **BroadVision, Inc.**
- **Comptel**
- **Helsinki Telephone Corp.**
- **HP Company Consulting**
- **HP Open Skies**
- **i2**
- **Impress**
- **Internet Travel Network**
- **Insurance Answer Center**
- **Lexacom N45W73 Inc**
- **LPG Innovations Ltd.**
- **NexGen SI**
- **Okobank Group**
- **Oracle**
- **PSINet**
- **Qwest**
- **Sapient**
- **Seagate Technology, Inc.**
- **Sonera SmartTrust**
- **The Swedish Government**
- **USinternetworking Inc.**
- **The viaLink Company**
- **Viant Fact Sheet**
- **Yahoo!**
- **Yomi Media**

Table 1 - HP's Partners in E-Services (as of 9/14/1999)

HP has a number of E-Service-enabling efforts underway:

- **E-Speak** enables higher level services interaction model on the Internet – including secure service discovery, negotiation, composition, automated brokering (i.e., **Broker-In-A-Box**), auditing, etc. HP is unique in its efforts to address the problem of the dynamic composition of services.
- **Speak-Easy** provides an architectural layer above e-speak that defines how e-services and e-clients hold *conversations* on the e-speak platform. It hides low-level e-speak abstractions such as messages, key rings, protection domain, and instead allows users to deal directly with higher-level business abstractions such as queries, proposals, negotiations, and requests. However, Speak-Easy does not abstract the usage of low-level E-Speak abstractions.
- HP **ChaiServer** is a secure web server with powerful features targeted for embedded devices but applicable to non-device environments. It integrates objects written in Java programming language with web server technology. ChaiServer provides an RCP-over-http mechanism that uses the World Wide Web's URLs (Uniform Resource Locators) to identify and directly access individual devices and their applications. This makes it possible to access resources via any browser, as well as to invoke services programmatically.
- **SIU** (Smart Internet Usage) supports simplified usage metering, unlimited scalability, flexibility for multiple usage applications, and multiplatform support (HP-UX(1), Windows NT and Solaris).
- **JetSend** is a communication technology that enables networked devices (e.g., printers, scanners, and digital cameras) to negotiate common file formats for data exchange.
- **OpenView** provides integrated management tools for applications, systems, networks, software, desktops, security, storage, and IT service level management (including all layers of an application service infrastructure, including the network). Independent intelligent agents provide secure and reliable communication mechanisms, advanced local filtering, and corrective action for proactive management.
- **Changengine** is an enterprise-class process manager designed to allow companies to automate their business processes and create new process-based solutions in order to run their businesses more effectively.

3.2 Sun

In contrast to HP, who is promoting a somewhat abstract E-Service vision (without publicly committing to any particular technology) and partnering with a multitude of companies in order to reach it, Sun [12-14,17,18,38] has focused on promoting one specific technology – **Java**, and with it, **Jini**. In addition to these, Sun has also partnered with Netscape to produce the **iPlanet Commerce Integration Suite**, which provides customers with a complete solution to build and deploy e-commerce applications that tightly integrate with internal applications and external trading communities. However, Sun has not publicized any efforts in the market-making area, including brokering, dynamic composition, etc.

3.3 Microsoft

Microsoft [1,23,27,29] offers an integrated (yet well partitioned) suite of products and projects:

- **Millennium** is a research project with the long-term goals of creating a distributed operating system that enables extreme location transparency. It is not itself a product; in general, as features of Millennium become successful, they will be moved into MS products.
- **Windows DNA 2000** is Microsoft's cornerstone for an infrastructure enabling a new "web services" vision, including application services, legacy interoperability, e-commerce, data access and storage, developer tools and exciting new software for deployment and management of servers. The components of this suite include: **Microsoft AppCenter**, **Windows 2000** (including built-in XML support), **Shiloh** (the next version of Microsoft's SQL Server database, the **"Babylon" Integration Server**, **BizTalk Server**, and **Microsoft Commerce Server 4.0** . All these services are integrated by XML. All components of Windows DNA 2000 are slated to ship by mid 2000. Many are just enhancements to current Microsoft products.
- **Universal Plug and Play** is a set of API's that extends Plug and Play capabilities to home networks and the Internet**,** enabling any Windows CE-based device to automatically connect to a home network, the Internet, or an intranet.

3.4 Hitachi

According to Hitachi Computer Products of America's Chief Scientist Jack Bissell, Hitachi is building component-ized Internet-commerce solutions focusing on "providing services built around top-of the-line infrastructure for workflow, event management, security" [19]. The issues surrounding this goal are similar to the ones faced by HP. Describing Hitachi's **TradeWinds** effort Bissell says, "electronic business is about getting a service to talk to another service. How does that service get to another service, which is probably going to call yet another service, and what's the flow of the work that you're doing among these things, and what's the rollback sequence, and how do you put this together?" [5-7,19,20,24,26,30,32,37]

However, Hitachi seems currently focused on supply chains. Their current product is **TradeLink**, a collection of Internet commerce components that can be used to automate the entire procurement process, either in business-to-business or business-to-consumer arenas. (TradeLink is part of Hitachi's **TradeWinds** effort.)

3.5 IBM

IBM's most visible e-commerce initiative is its **San Francisco Frameworks** product. The goal of the San Francisco project was to build a set of distributed object frameworks that can handle business logic for targeted application domains. However, San Francisco focuses on enabling the development of N-tier applications; it does not address the problems of discovery, invocation, brokering, or the other distinguishing factors of an E-Service.

IBM [8,9,22,28,31,33,36] has also been developing new pilot applications for fundamental business rules techniques in intelligent agents and e-commerce. These applications include especially: negotiations, including procurements & auction configuration; catalogs & storefronts; security authorization & trust management; and also other applications such as financial. For example, IBM's AlphaWorks division has produced the following efforts:

- **Web Intermediary (WBI) Developer Kit** for Java (released June 1999) includes elements of agents, proxies, and Java servlets that represent approximately 80 percent of the code needed to build many applications (e.g., an XML/XSL transcoder).
- **DIPLOMAT** is a Java library that addresses the problem of heterogenous rule systems and syntaxes and the challenge of how to resolve conflicts that arise during updating or merging rules. DIPLOMAT provides an executable interlingua and enables "courteous" conflict handling for E-Commerce Agent Applications. For example, DIPLOMAT could be used to represent and communicate dynamically contractural agreements in business-to-business Web agent negotiation between two enterprises in a manufacturing supply chain.
- **CommonRules** is a pure Java library that enables Web communication of executable business rules between enterprises using heterogeneous rule systems, and enables incremental specification of executable business rules by non-programmer business domain experts. CommonRules is being piloted in EECOMS, a $29 Million 3-year NIST ATP-funded industry consortium effort begun in 1998, which is focused on business rules and human collaborative workflow, for business-to-business e-commerce in the domain of manufacturing supply-chain integration and agility.

IBM also offers **T-Spaces**, a Java-based system that enables computing devices (including very small devices) to share network services such as messages, database queries, print jobs, etc.

3.6 Lucent

Several articles have identified Lucent's Inferno as under-marketed, yet the most likely Jini-competitor[2,10,11,14-16]. In fact, some sources reportedly consider Inferno the superior product. However, Lucent appears to be targeting the telephony and webphone market, rather than striving for E-Services.

Commercially launched in March 1997, Inferno is designed to be a complete solution for the embedded market, uniting operating system (OS) functionality, networking and security within a small footprint OS platform. The Inferno suite includes the following components:

- In its embedded solution (**native Inferno**), Inferno is the primary operating system, offering full operating system functionality, including memory management, graphics capabilities, process management, namespace management, and built-in security, within a small memory footprint.
- In its network solution (**hosted Inferno**), Inferno functions as an application on top of the native operating system (e.g., Windows NT™, Windows 95™ and Solaris™) and provides a simple environment for the development of scalable network-based solutions.
- **InfernoSpaces** is a set of software libraries (or components) that provides a simple framework for secure, distributed applications. InfernoSpaces allows application deployment across an heterogeneous environment, independent of hardware platform, network protocols, programming languages, and operating systems.
- The **Inferno distributed web browser** for memory- and processor-constrained environments (i.e., internet appliances).

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