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# Web Services Infrastructure

*The global utility for real-time business*

*A white paper*

*by Phil Wainewright*

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**Loosely Coupled** is an online media site providing news, comment and resources on the use of on-demand web services for business process automation. The site publishes daily news and commentary, a weekly email bulletin, industry directories and occasional white papers, and will introduce paid content and services in late 2002.

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# Web Services Infrastructure

*The global utility for real-time business*

# Light dawns

> *"Computing that is as available, reliable and secure as electricity, water services and telephony."*
>
> *— Bill Gates, Microsoft, 17th January 2002*

Suddenly, people are talking about utility computing again. This time, it's for real.

With the emergence of web services, the convergence of telecoms and computing is finally reaching maturity in a unified platform for doing business in the 21st century:

- The IP-based telecoms infrastructure puts businesses in constant, real-time contact with customers and suppliers.
- Web-based software-as-a-service architectures provide the tools to automate delivery of transactions and services from businesses to their customers.

The delivery of real-time business services over the WorldWide Web is a development that makes *business sense* of the Internet.

It promises a new era of unprecedented efficiency and productivity — but *only if* the right infrastructure is in place.

This white paper describes the emerging shape of that web services infrastructure and the nature of the providers who will bring it into being. It sets out:

**The landscape** of the emerging global infrastructure for real-time business

**The players** who share the task of building and safeguarding that infrastructure

**The contest** for new roles and positioning that some of those players will face

Readers will learn how the creation of the global infrastructure for real-time business will add new meaning to the roles of service providers and of software vendors, transforming their relationships not only with each other, but also with many of their most important enterprise customers.

# The landscape

In just ten years, the Internet has evolved from an academic curiosity into an integral foundation for doing business. The deployment of web services for real-time business automation marks the culmination of that transformation into the rich fabric of today's Internet.

## Network + software

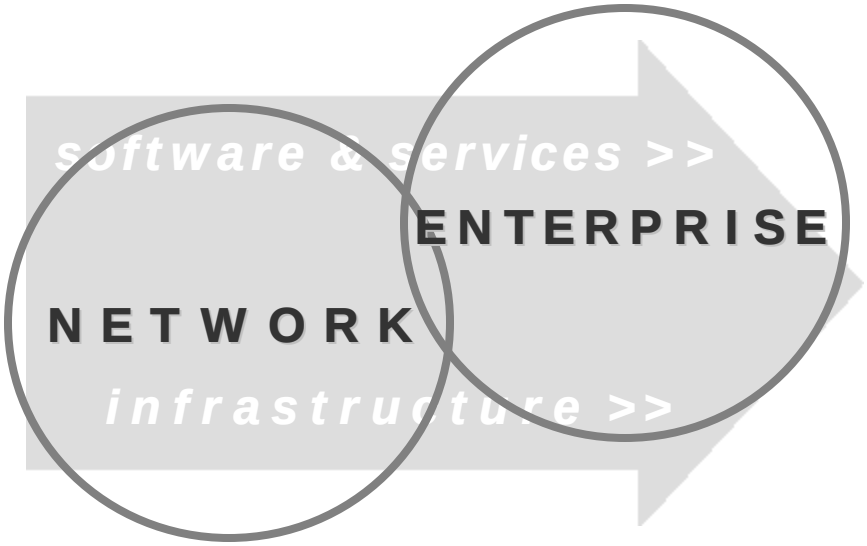
Today, the Internet is more than just a physical network. The software layer of the WorldWide Web is as much a part of the infrastructure as the underlying network components.

- Routers, fibre and cable provide a foundation of IP (Internet protocol) networking
- Servers, databases and application platforms support the web-based software and services that run over the network

Web services run over this software infrastructure. With their emergence, the Internet has ceased to be solely a content transmission network. It has become a computing execution network, processing commercial transactions and business applications.

## Network + enterprise

The dividing lines separating the enterprise from the Internet are fading away. Internet technology permeates every network, public or private. Intranets, extranets and ISP backbones all share the same architecture.



Activities that used to operate in closed separate networks are now starting to coalesce across this common infrastructure, giving rise to new concepts of shared endeavour such as the extended enterprise and collaborative commerce. The difference between a corporate intranet, a shared private extranet and the public Internet is defined today not by their physical extent but by who has access to them.

> The common infrastructure is merging to form a single, shared web services infrastructure.

But there was a reason why enterprises used to keep their computing encased within secure, private networks. If they are to have confidence in the shared Web for real-time business, it must operate reliably and predictably to enterprise-class standards.

## Shared, end-to-end infrastructure

The shared infrastructure is the foundation for business communication, collaboration and trade. As such, it has to meet much higher expectations than the Internet of old. Delays, interruptions and errors in these activities cost the participants money.

Three prime characteristics raise the bar compared to its predecessors.

### Support for applications

The original Internet made it possible to send and receive email and to share access to files. The WorldWide Web added a software layer that made it easier to publish and access other content. The final development has been the emergence of web services, enriching the software layer with application functionality.

> The task of the web services infrastructure is to support commercial-grade application functionality.

The difference between content and applications comes from the addition of process — the sequence of events that need to happen in order to produce a result. When participants in the application are distributed across the web, the need to complete processes adds some important new operating requirements:

- **Consistency** — Each separate component must act within certain parameters, such as response times and availability.
- **Authenticity** — There must be some way of assuring the identity of each of the participants in the process.
- **Timeliness** — Each step in the process must execute in the correct order, and promptly — especially if a user is waiting on the result in order to continue with their work

- **Integrity** — There must be mechanisms to avoid data becoming corrupted as it passes between participants

- **Persistence** — Each participant in the process must maintain a permanent record of their part in the transaction.

The web services infrastructure must provide a platform that supports these requirements and more. That demands an array of tools and services to enhance, monitor and maintain quality-of-service.

## Multiple providers

Unlike a traditional telecoms or enterprise network, this multi-layered network and software infrastructure is shared by many different providers.

While a select group of dominant telcos provide backbone and last-mile wireline network services, other providers contribute server management, data storage, edge cacheing, security, VPN and wireless services. All are interchangeable on the whim of each individual customer.

Much of the infrastructure, both at the network and software layers, is within individual enterprises. They too thus participate as providers. Note also that an increasing proportion of enterprise computing infrastructure is itself multi-provider in nature. Web-based applications in particular are often hosted at outside providers rather than within the physical network of the enterprise.

Creating an integrated, end-to-end application delivery infrastructure requires close co-operation between these multiple providers and enterprises.

## Essential standards

The only effective mechanism to enable co-operation between so many different and varied participants is standardisation.

Many of the standards required for web services are not yet fully defined. Until those standards have been created and put into effect, providers will have to 'plug the gaps' with proprietary workarounds, using one of two alternatives:

- A vertically-integrated infrastructure owned by a single provider or enterprise

- A co-operatively managed infrastructure co-ordinated by partnership between multiple participants

Many enterprises and providers will prefer the former as being closest to their existing infrastructure and easier to control and manage. Those who opt for the latter will take on a bigger challenge, but will find their efforts

rewarded. They will gain competitive advantage through their early investment in the resources and skills required to participate fully in the universal, standards-based shared infrastructure that is destined to emerge.

## Software meets business services

Over the past two decades, the word application has become firmly associated with the notion of boxed software packages. That notion becomes obsolete in the era of web services.

> The role of software in the business web is to automate business processes.

Those processes do not need to be packaged into discrete applications. Now that the software is online, it has become feasible to dynamically assemble applications by combining individual process components in the form of web services. The resulting applications are not software artefacts but live, software-based business services.

Web services have arisen in response to the network environment, which encourages highly modular software componentisation. Evolving web services protocols allow communications among a web of interconnected, autonomous participants. This enables the assembly of web services applications from multiple providers. The software layer of the web is, in effect, taking on the same standards-based, multi-provider characteristics as the underlying network infrastructure.

### But what are web services?

Just like the ASP acronym, 'web services' is a term that has come to mean many different things to many different people. Some use it very loosely to describe any kind of functionality delivered using web technologies. Others have a precise definition relating to the use of XML-based web standards, such as SOAP and WSDL, to enable program-to-program transactions in software.

All the definitions describe emerging techniques for delivering and integrating online functionality. The important unifying theme is a general move towards adoption of dynamic coupling of software-based service components at all levels of the online infrastructure.

Practical applications of web services technologies fall into three groups:

- **Plug-in functionality**. The simplest and most prevalent web services in use today add third-party functions to web pages and portals. Common examples include external news feeds and stock quotes, banner ad serving, and search boxes. Few use XML and SOAP, relying instead on HTML-based technologies such as JavaScript, CGI and Java.

- **Remote infrastructure services**. Third-party providers use web services technologies to deliver behind-the-scenes functionality for commercial websites, such as user authentication, payment processing and visitor traffic analysis.

- **Enterprise application integration**. Web services technologies are rapidly finding favour as a solution to the complex integration challenges of linking applications within the enterprise, or across a value chain. EAI implementations are the most likely to use formal web services standards.

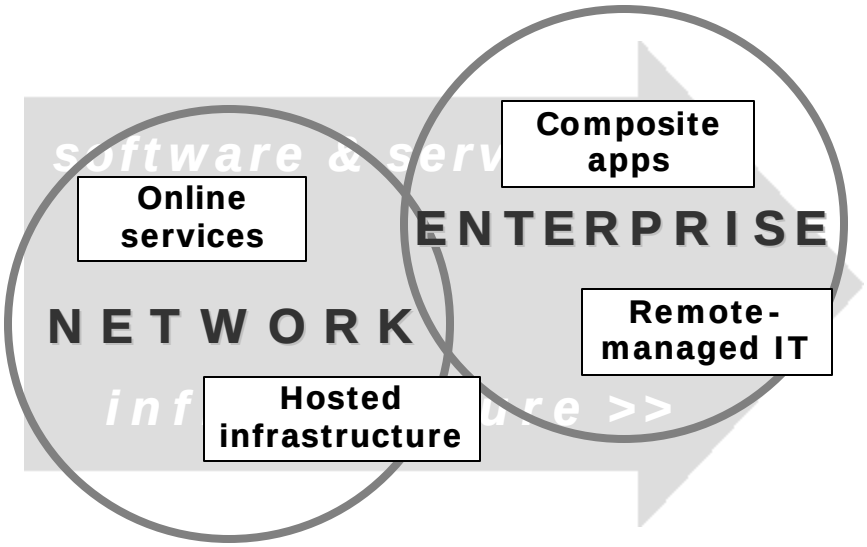
Even though the primary purpose of web services technologies is to permit access to remote functions, it is their use for EAI purposes within enterprise or private network infrastructures that is currently attracting the most attention from mainstream IT vendors and suppliers.

A rapidly-expanding band of web services software vendors provide tools and platforms for building web services, including many who specialise in integration wrappers and tools for EAI.

Initially, most EAI projects will remain inwardly focussed. Nevertheless, the use of web services brings the target applications into the same common architecture as the wider shared web. It is the penultimate step on the way to joining the shared web services infrastructure.

## Four hotspots

In the era of web services, the networked infrastructure embraces software, and it embraces the enterprise. This focusses attention on four principal areas of activity within the landscape, highlighted in the diagram below.



Across all of these hotspots, there is one overriding theme. Having reliable, real-time access to business services makes it easier to outsource non-core activities. Every participant is encouraged to focus on enhancing the quality and cost-effectiveness of their core competence, while tapping the expertise and infrastructure of outside specialists for other elements of their business operations.

## Infrastructure: hosted

Hosting is increasingly becoming the norm for Internet and web infrastructure, including web servers and software. In this respect, the web services infrastructure is merely replicating the same progression made long ago by the utility infrastructures of electricity, water and telephony.

Hosted infrastructure is any part of the infrastructure that is owned by providers and operated on behalf of their customers rather than being part of the enterprise.

This encompasses the network backbone, colocation centres, managed server farms, last-mile wireless and wireline connections, and the associated network management services.

## Infrastructure: remote-managed

Inside the enterprise sits a mirror image of the hosted infrastructure. It comprises networks, servers, software and client devices. In some cases there are data centres and server farms too.

Much of this enterprise-resident infrastructure is getting too complex and mission-critical for enterprises to be able to manage it effectively using their own resources. They could cope when it consisted of discrete client-server networks accessed mainly during the working day. But managing an Internet-connected, wide area network 24x7 goes way beyond their core competence.

Remote management is now gaining acceptance as a means of contracting outside providers to take on responsibility for day-to-day management of the in-house infrastructure, without giving up ownership. Standards-based architectures and ubiquitous network infrastructure have made such services both reliable and cost-effective.

## Software and services: component functions

Outside of the enterprise in the software layer are the providers of component functionality. This may take the form of complete application packages or business services, or it may be single-component web services such as Passport authentication, instant messaging, a news feed or a search engine.

The vendors of platform software and packaged applications are players in this part of the landscape. The software they supply is also a component for installation into provider-hosted or enterprise infrastructure. Onetime distribution on a CD is one among several delivery options — many vendors offer the option of hosting or remote management services.

Once they are made available online, business services such as payroll administration, credit card payment processing or courier delivery also become component services. The common web services infrastructure makes it possible to seamlessly assemble traditional real-world services along with software and web services using a single component architecture.

## Software and services: composite applications

Web services turn applications, business services and component services alike into standardised building blocks of online functionality. Aggregated together, they are easily assembled into a new generation of adaptable, web-centric composite applications.

> Enterprise information portals, content management platforms, public and private trading exchanges, integrated supply chains, customer self-service portals and partner relationship management systems are all converging on this model.

They assemble core application software together with third-party business services and components into a single composite interface. Web services architectures smooth integration between the various components and make it easy to add, subtract or reconfigure individual participants at will within the composite whole.

Engineered by large corporations, or by providers on behalf of enterprise clients, they often target individual users in their millions or small businesses in their thousands. As so often in the first stages of a powerful new technology wave, it is visionaries working in large enterprises who have seized the early initiative to win competitive advantage for their businesses.

Those efforts are now coming to fruition in a gathering tornado of activity.

# The players

The major players in this new landscape are not confined to the traditional service provider industries. The extension of the common, shared infrastructure into the enterprise has brought businesses from all kinds of industries into the online service provider arena.

## Enterprises become ASPs

In the new always-on web services landscape, enterprises are no longer at the end of the value chain. They are part of it, using the shared infrastructure to automate interaction and transactions with their suppliers, employees and customers.

As aggregators and providers of the online functionality that makes up their composite applications, they effectively act as ASPs to the users of those applications. But this is not a label that gets applied to them, since the applications merely support their core business activities. In many cases too, a service provider remains involved, albeit in a behind-the-scenes role.

Enterprises deploy their composite applications infrastructure in one of three modes:

- **Self-hosted, self-managed:** This is the traditional enterprise computing model, in which the enterprise has complete ownership of the applications infrastructure. It remains a suitable model for enterprises whose operations are large enough to support the high costs of maintaining sufficient resources to meet all of their application deployment, delivery and management needs.

- **Self-hosted, remote-managed:** This model maintains substantial in-house investments in applications infrastructure, but subcontracts outside expertise and management infrastructure to supplement the in-house skills base and help meet day-to-day operational requirements.

- **Private-label hosted:** In this model, the application infrastructure belongs to and is operated by an external provider, who delivers it on behalf of the enterprise and under its brand. In this type of relationship, the enterprise is sometimes referred to as a "virtual ASP" or V-ASP.

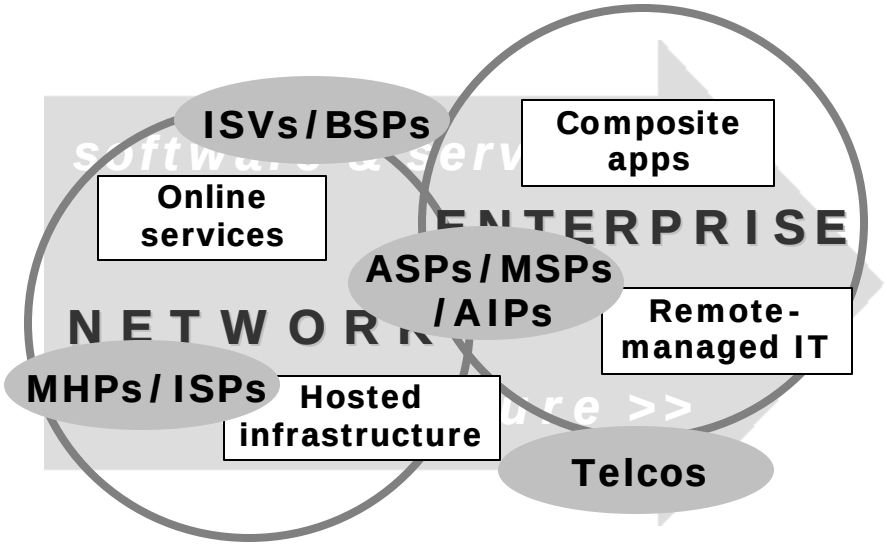
Similarly, the component software and services that make up the composite application come from three sources:

- **In-house:** These are normally the components that reflect the enterprise's core competence, and are originated by in-house resources.
- **Packaged software:** Automation of routine functions is often best implemented using conventional packaged software, particularly when tight integration with the organisation's core operations is required.
- **3rd party services:** Supplementary content, functions and services that are peripheral rather than core, or which rely on specialist outside expertise, are often best implemented using external service providers.

A composite application will often combine all three sources and will quite frequently combine all three of the deployment modes. For example, a bank might build and operate its own online small business banking service, while using remotely managed CRM software to automate user support for the application, and delivering a third-party payroll management service under its own brand as an optional extension to the core service.

## Infrastructure operators

Hidden behind the aggregated façade of the composite application lies a thriving community of providers. Once hyped under a dazzling array of xSP acronyms, these providers are barely noticed now, and yet the scope and influence of their activities continues to grow.



Even an enterprise that remains intent on keeping all of its applications infrastructure in-house still relies on external providers for elements of the underlying architecture.

> The majority of enterprises will increasingly seek to outsource as much as possible of the infrastructure, since they will find themselves unable to achieve sufficient scale to compete with the lower cost and higher operating efficiency of dedicated providers.

Among the infrastructure operators, providers fall into two main clusters. ASPs, MSPs and AIPs focus on enterprise-facing, application-level infrastructure, while MHPs and ISPs look after the physical, network-centric infrastructure.

Telcos form a third group, with a crucial role to play in co-ordinating the delivery of reliable, end-to-end network services.

## ASPs/MSPs/AIPs

These are the providers that operate elements of application-level infrastructure for the enterprise. For clarity, they are divided here into three separate types, although in practice many of the companies operating in the sector blend various functions into a composite offering. But it remains possible to define some core characteristics for each of the three types.

- **ASPs** (application service providers) are the application software experts. Many companies in this group prefer not to use an ASP or xSP label, instead describing themselves as outsourcers, solution providers, or some other form of service provider. Nevertheless, their core competence is the same: deploying and managing applications to deliver reliable business functionality. Within this group, there are several distinct variations worth highlighting:

  **VSPs** (vertical service providers) tailor their application offerings to suit the needs of companies in specific vertical markets. Their portfolios usually include a high proportion of proprietary software.

  **Enterprise ASPs** are the best-known (although not necessarily the most successful) type of ASP. They offer a portfolio of third-party branded applications, relying on the use of repeatable methodologies and automation to achieve economies of scale.

  **Private-label ASPs** operate applications for sale and delivery by partners under their own brand. The applications offered by this type of ASP range from custom-assembled composite applications and proprietary software to popular brand-name applications.

- **MSPs** (management service providers) are the platform software experts. They leave all the top-level application deployment and management in the hands of their clients, concentrating instead on managing the underlying server platforms such as application servers, databases and operating systems. They'll provide remote management of servers in an enterprise data centre, sending alerts in case of problems or fixing them if the fault's within their remit, and running stress testing on request. Just don't ask them to change the way the application works; that's where they draw the line.

- **AIPs** (application infrastructure providers) are the network software experts. They provide network management infrastructure and services to ensure reliable application deployment via multiple providers all the way to the end user — a kind of MSP for the distributed network. (This is the least well defined of the three categories, and not all analysts agree with this definition. Some use AIP as an alternative name for private-label ASPs, while others use it for high-end managed hosting providers.)

## MHPs/ISPs

These are the providers who collectively operate the Internet network infrastructure, made up of the Internet backbone, access points and data centres.

- **MHPs** (managed hosting providers) operate Internet data centres where they manage servers on behalf of clients, effectively acting as an MSP for the servers on their premises. They often position themselves as AIPs to the enterprise market.

- **ISPs** (Internet service providers) are a broad category, including both network backbone operators and Internet data centre operators as well as network access providers. They often team up with MSPs to compete with MHPs and can also position themselves as AIPs.

## Telcos have a foundation role

The emergence of the shared, end-to-end infrastructure opens up an important potential role for telecoms providers as the co-ordinators and ultimate guarantors of service quality across the network. With a dominant position at the point of physical service delivery at every step of the end-to-end infrastructure, telcos are best placed to execute the AIP function, thereby adding substantial new value to their core service offering.

But they cannot do it all by themselves. They must learn how best to work with providers at other layers of the infrastructure to ensure the effective delivery of applications and services across the network. Co-operation between wireless and wireline providers over the last mile will become increasingly important too, ensuring users maintain seamless access to applications as they switch from office-based to mobile devices and back again.

## Software and service providers

Software and services are the raw components from which enterprises assemble deliverable business services. Two main groups of providers create these crucial building-block components.

- ISVs design and build the software that automates the fulfilment and delivery of business functions.
- BSPs employ skilled professionals to perform the specialised business functions that software cannot automate.

### ISVs

There are several types of independent software vendor (ISV). Each operates at a different level of software architecture:

- **Application ISVs** form the mainstream bulk of conventional ISVs. They deliver complete packages of software that automate a suite of related business functions. Their application packages are tuned to maximise performance as an integrated whole, and are often poorly adapted for linking to external web services.
- **Infrastructure ISVs** develop platforms and tools that are used to design, build and manage software components and applications. Since their products provide the foundation for the creation and operation of finished applications, they are very influential in aiding or obstructing the adoption of standards.
- **Web service ISVs** develop software components that deliver specific functionality for use either at an infrastructure or an application level.

ISVs have traditionally delivered their software as a packaged product for installation by their customers, but the emergence of a shared connected infrastructure has opened up alternative delivery models:

- Large numbers of ISVs are now offering customers a hosted option as an alternative to installation, either acting as their own ASPs or appointing recognised ASP partners.

- Some ISVs have adopted a "service-assisted" model, in which the ISV acts as an MSP for the installed software. Services delivered under this model may include remote supervision or management of the initial installation and later upgrades, online shadowing and remote fixes during support calls, and continuous monitoring of application performance.

- Other ISVs, particularly those in the web services segment, deliver their software exclusively online, without offering the option of customer installation. In effect, they act as ASPs of their own software. Any client-side code that needs to reside on the customer's machine is installed and managed remotely by the ISV.

## BSPs

Business service providers (BSPs) use the web services model to deliver professional service content of some kind. Present-day examples include online information providers, credit card payment processors and payroll processing services.

In each case, there some element of skilled human intervention involved in the provision of the service, even though that professional service core may be surrounded by a great deal of software automation. (Some analysts go further and count as BSPs those ISVs who deliver their own business applications as an online provider).

In the modern world, it is the objective of every business to automate as much as possible of the human element in order to increase efficiency and lower costs. To some extent, therefore, the emergence of the web services infrastructure for real-time business will ultimately mean that every enterprise can become an online business service provider.

# The contest

The emergence of a common web services infrastructure will transform the roles of software vendors and telecoms providers, and will revolutionise the business models of many enterprises. Those who are slow to adapt will lose out to nimbler competitors.

## Enterprises as online providers

Enterprises recognise the potential benefits of doing business online, measured in such terms as faster time to market, lower overheads, better customer relationships and enhanced responsiveness to changes in market conditions.

Until now, they have held back from attempting to realise those benefits because they saw that the technology simply couldn't deliver. The utility-grade web services infrastructure finally delivers the assured predictability they have been waiting for.

> It is now time for enterprises to master online services.

They must become proficient in composite applications and how best to deploy them to enhance their relationships with customers, partners and suppliers. They must adapt their businesses to an online service provider model, becoming skilled in real-time, always-on service delivery.

Existing online service providers already have many of those skills and capabilities. Their expertise will be much in demand.

## Web services replace traditional applications

The fact that software vendors deliver applications today as a prepackaged set of functions is an accident of history, not a necessity.

Software applications are simply bundles of software components that automate repeatable business processes. The various components have all been tested together for compatibility and performance, saving the buyer the trouble of doing so.

> Web services architectures are designed to allow functional components to operate together on demand. They eliminate the need for compatibility testing, and therefore they eliminate the need for prepackaging of applications.

The only reason buyers will continue to buy packaged suites will be convenience, but they will not want to be locked in by doing so. They will expect to be able to separate any individual component and substitute an alternative should they wish to.

In the context of the composite application, compatibility with third-party components will become paramount. Any failure to adhere to web services standards will threaten the integrity of the entire edifice. When an enterprise has created all of its e-business operations as a series of interlinked composite applications, such a risk doesn't even bear thinking about.

Such considerations make the supremacy of web services over traditional application packages a foregone conclusion.

## Applications as infrastructure

Operating systems, databases, web servers and application servers are as much a part of the web services infrastructure as the physical network beneath them. The same applies to certain core applications.

Established business applications such as financials, messaging, sales automation and customer contact are based on a core set of tried-and-tested business objects and processes. Leading application packages comprise portfolios of objects and processes that are established as best practice in their field.

Most enterprises installing such an application today do not customise the core components. They simply configure the way the objects and processes interact, and how they are presented to users. The underlying component library has become a stable infrastructure.

Successful ASPs have taken advantage of this trend towards a core application infrastructure. They have built repeatability and economies of scale into their implementation of the core, while retaining their customers' freedom to configure the process interaction and presentation of the application as they please.

> Web services architectures now allow those ASPs to deliver their libraries of core application functionality as component services for integration into composite applications.

The automated business functionality has itself become an infrastructure component, and ASPs have become business process infrastructure operators, with a business model based on achieving economies of scale.

## The role of telecoms

The content-centric nature of the first-generation web deceived many observers. They concluded that the Internet's primary role would be as a mass medium for content, mainly information and entertainment.

Eager to sell extra bandwidth, telecoms carriers prepared themselves for an explosion in multimedia traffic. They are still waiting. The assumption was a fallacy, based on a failure to recognise the true nature of the web as a platform for computing.

> The Internet's primary role is the delivery of function — of automated processes, made available as web services.

Businesses are the main consumers of automated processes, and in volumes that will dwarf the potential demand from the consumer mass market alone. (Indeed, in the context of web services, the delivery of multimedia content to the mass market is just one set of applications within the specific industries of media and entertainment. Focussing exclusively on that single opportunity ignores the bigger picture.)

> The opportunity for telecoms carriers is in assuring the utility-grade strength of the web services infrastructure.

Carriers are best positioned to maintain oversight of the end-to-end network, providing co-ordination, monitoring and validation services that support the complex needs of the multi-provider networked application infrastructure.

It is up to carriers to become the standard bearers for web services, using their position and influence to ensure the success of the multi-provider infrastructure as a platform for business in the 21st century. They hold in their hands the key to the future productivity and efficiency of global business.