

Testing service-oriented architecture (SOA) applications and services

White paper



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Introduction

Few other innovations in IT offer the transformative potential of service-oriented architecture (SOA). SOA is centered around a transformation of your enterprise IT architecture into a set of services that can be shared and reused across application development initiatives. This introduces new levels of business agility and drives down IT costs. SOA allows you to:

- **Coordinate services instead of large, monolithic applications.** You can reduce development costs through the reuse of services across multiple applications, and you can more efficiently leverage existing enterprise assets by coordinating services across any number of applications.
- **Decouple applications from underlying infrastructure.** SOA abstracts development from underlying detail and complexity, and it relies on loosely coupled and self-contained services that enable greater flexibility.
- **Shift the orientation from technology to business.** SOA allows for rapid change by enabling services to be easily added, removed, composed\assembled and recomposed as a business grows.

Without a strategy for SOA, you risk being outperformed by competitors that are better equipped to serve customers, seize opportunities and respond to changes. The successful deployment of services requires the ability to manage the quality of these services so you can increase the use of IT resources and reuse services across multiple applications to enhance business agility.

Understanding SOA

With SOA, you can move toward a new enterprise architecture, with business functionality exposed as standards-based, shared and reusable services. SOA is a collection of declared services that are independent and loosely coupled, but controlled through policies. The services are self-describing, and they are assembled ad hoc to orchestrate business processes. SOA is an approach to constructing enterprise systems from components in which a system consists of a set of collaborating services corresponding to higher-level business use cases—each of which provides a well-defined collection of functionality available over the network.

SOA is an implementation process of having services that are shared among applications. Service providers create services, and service consumers utilize these services. Composite services are made up of two or more services, and web services create a common platform that enables SOA. There are multiple components to web services:

- Simple Object Access Protocol (SOAP) provides the envelope for sending the web services messages.
- The Web Services Definition Language (WSDL) forms the basis for web services. A service provider describes its service using WSDL.
- Universal Description, Discovery and Integration (UDDI) registries can be searched to quickly, easily and dynamically find and use web services.

The services used in SOA are not limited to web services, but can include other technologies such as Distributed Component Object Model (DCOM) and XML over Remote Method Invocation (RMI).

Aligning IT resources and business objectives

Companies are looking for ways to move faster to respond to changing business drivers, such as market conditions, customer requirements and competitive threats. SOA allows businesses to react more quickly—with greater agility—and promises to:

- Allow IT to better and more economically support business initiatives
- Reduce time-to-delivery for new services because the implementation of business processes will be highly configurable
- Streamline application integration
- Better utilize development resources through the reuse of existing assets

SOA offers tremendous business advantages, but it also places pressure on your IT organizations to make sure that services and infrastructure continue to meet the changing needs of your business. You need to implement Business Technology Optimization (BTO) solutions that bring IT into full alignment with the business to ensure that IT is focused on addressing business priorities and delivering maximum value.

BTO optimizes the strategic touch points where technology and the business meet, and HP allows IT to enable an SOA lifecycle approach. You can manage service quality and conformance, enabling services to scale in a production environment. HP Software offerings can monitor services to enable compliance and quickly identify problems before they impact the business.

HP offers SOA application delivery solutions for testing the functionality and performance of individual services and composite applications comprised of multiple services, and SOA application management solutions for monitoring and measuring services and composite applications in production based on service level agreements (SLAs).

HP also offers SOA governance solutions for managing the consistency, predictability, change and interdependencies of services and composite applications. By selecting solutions from HP, you can develop, manage and evolve composite applications over time to address new business requirements and enable the successful delivery of the functionality and performance expected by users throughout your organization.

Implications of SOA on testing

The shift toward SOA is not risk-free. Many moving parts must work together closely amid constant change. Services have diverse characteristics. With SOA comes multiple stakeholders—such as service providers and service consumers—and services have independent lifecycles tied to how they are developed and maintained. Successful implementations of SOA require that services remain interoperable despite all of the inevitable changes they face.

SOA introduces increased complexity to IT, and these complexities center on new relationships that need to be managed. There are technical relationships, since services depend on infrastructure and applications depend on services. But there are also organizational

relationships. Providers of services need to collaborate across roles and functions to define, develop and manage services, and consumers and providers need to collaborate to negotiate SLAs and other terms and conditions for using a service. Throughout the lifecycle of a service, providers are inevitably going to change the service and consumer needs are inevitably going to evolve. You need to be able to address ongoing questions throughout the lifecycle of a service, such as:

- How do we enable services to meet functional requirements?
- How do we enable services to scale in production?
- How do we manage the complexity of testing dozens—or even hundreds—of services?
- How do we quickly identify and resolve response-time issues for services?
- How can QA understand the overall impact of testing coverage needed when services change?
- How can we enable services to be interoperable throughout the enterprise and comply with industry standards?
- How can we start testing as early as possible in the development cycle?
- How can we test services and systems even when their supporting infrastructure is not present or is down?
- How can we continue to share services across multiple applications as services change and evolve?

All of this complexity needs to be managed to improve the outcomes of SOA initiatives. IT needs the ability to test the shared SOA abstraction layer as a self-entity—regardless of changing application lifecycles. By testing an SOA abstraction layer, IT can verify that it continues to deliver expected functionality and performance over time to diverse enterprise applications. SOA has many other implications on testing, including the needs to:

- **Gain visibility of shared services.** You need to provide broad visibility into shared services so that different departments and individuals can play key roles in the quality process. One of the greatest challenges is to understand both the business impact and the proper prioritization of deployment-related issues by gaining visibility into both the broader business layer and shared services.
- **Understand the vulnerabilities of shared services.** Services can be provided by different departments, and shared services can be utilized by multiple applications. Testing is essential throughout the lifecycle of services to verify that changes in services do not harm other applications that utilize them. Service providers can change services developed for a specific application without realizing the impact that these

changes might make on other applications sharing these services. Shared services include security and reliable messaging, which are managed according to policies, and there are many potential points of failure for any given service. Services therefore need to be continuously tested to ensure that they do not create bottlenecks or fail to perform as expected throughout their lifecycles.

- **Manage quality over time.** Services need to encompass a quality assurance focus, and IT needs to build and manage a QA process to manage quality over time. Quality objectives must be carefully defined with centralized quality assurance and distributed tasks to optimize the use of IT resources in supporting services.
- **Manage massive numbers of services and data.** Composite applications rely on shared services that may be used throughout the enterprise. QA may need to manage hundreds—or even thousands—of shared services that are often changing and evolving.
- **Manage new SOA testing aspects.** Since WSDL is used to describe web services, you need to develop common standards so different applications can rely on shared services. For example, if your architect defines internal standards, your developers need to program against those standards. But different departments may use different programming toolkits, so interoperability testing is essential. The need for interoperability introduces more moving parts and less control than development organizations have ever managed in the past.

Services must be compliant with organizational standards so they can be consistently tested by different QA teams throughout the enterprise, and organizations need the ability to validate that services conform to established standards. QA also needs to be able to perform boundary testing by invoking each service operation with data and meta-data that surpasses the WSDL specification; for example, QA may need the ability to test the boundaries of SOAP headers. They also need the ability to test the performance of services and simulate performance under different thresholds to ensure that services will scale over time.

- **Enable service availability for testing.** Services need to be available for testing early in the development cycle. When a WSDL service description is agreed upon, QA can start implementing actual tests before the service arrives from development. You also need the ability to test complex environments with missing service back-ends. For example, a service that relies on accessing sensitive data such as employee social security numbers could be tested without making that data freely available throughout the QA cycle.

HP quality management solutions

- **Create a lifecycle quality process.** Services must be tested throughout their lifecycles, from the development stage through production deployment until end of life. Testing should be integrated into the lifecycle process so that services can evolve over time while ensuring that they work successfully with multiple applications.
- **Analyze the impact of changes.** One of the major challenges in QA is the decision of how to effectively test changes that occur. You need to determine which changes potentially cause major risks, and where the best places are for QA to invest their efforts and where they can perform minimal validation to optimize resources. In traditional application testing processes, the QA challenge has been to understand the changes development made and decide whether they needed to be tested. Understanding the impact of changes is more significant in shared services due to the number of services involved, the number of internal dependencies and the number of applications using shared services.
- **Implement functional and performance testing.** Services need to be tested throughout their lifecycles to ensure they function as promised and provide the expected performance and throughput. SOA encompasses additional functional and performance testing challenges. In traditional testing of enterprise applications, a test engineer could test against the graphical user interface (GUI). The GUI client made it easier to understand business processes and data flows, but with SOA, services are tested against the WSDL without a GUI available to simplify business processes and data flows.
- **Perform asynchronous testing.** With SOA, services are often not synchronized, so QA must be able to test business processes out of sequence when necessary. QA needs the ability to address asynchronous communications mechanisms such as the polling of data, polling-through-proxy and callbacks through WS-Addressing as well as other standards.
- **Test other technologies that can expose services.** You also need the ability to run tests that support other technologies that can expose services, such as Java™ Message Service (JMS), which is a middleware Application Programming Interface (API) for sending messages between two or more clients; and RMI, which is an API for performing remote procedure calls.

Today, how quickly you add or enhance services for critical applications can be the difference between keeping or losing a customer. Winning companies manage costs and risk while ensuring their software applications are aligned with business goals. That's why enhancing the quality and performance of shared services in pre-production has become critical to the viability of the business.

Our BTO approach to delivering high-quality, high-performance application delivery solutions helps drive business outcomes. By increasing quality and performance of services and managing change throughout their entire lifecycles, IT can have a direct impact on the business value associated with critical services. HP application delivery solutions—HP Quality Center software and HP Performance Center suite—allow you to:

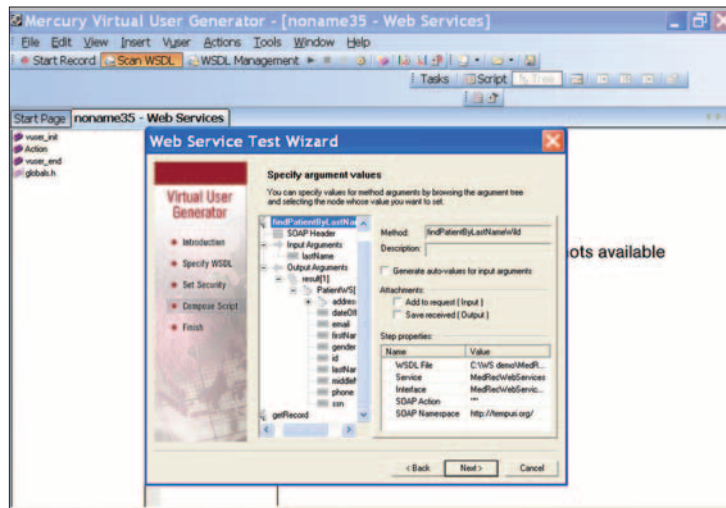
- Drive the rapid delivery of services and composite services
- Make better-informed “go-live” decisions
- Reduce the time and cost of deploying new services
- Decrease software defects
- Gain real-time visibility into the health of services and infrastructure
- Verify services are ready to deliver their intended business results

Ease of use

HP offers solutions that allow QA engineers to simplify the ongoing testing of services and decrease scripting through automation. These solutions are designed to help QA professionals swiftly develop and execute tests. They simplify the service invocation and security aspects of testing, and allow QA to test services in parallel to the development cycle.

For example, HP supports non-GUI testing so QA can create tests against the WSDL. HP also simplifies the data, especially XML, so that QA can focus on developing and driving tests that will provide the greatest value to the organization. Application delivery solutions from HP allow organizations to efficiently enable compliance with corporate standards, even in organizations that use multiple development tools.

Figure 1. HP supports non-GUI testing.



HP Quality Center software

Many of the challenges identified earlier in this paper were focused on management, and HP Quality Center software provides a web-based system for automated software quality testing and management across a wide range of services. HP Service Test Management module provides integration with HP SOA Systinet software and other third-party SOA registries, providing full visibility for QA teams. HP Quality Center enables the IT team to engage in service testing even before the development process is complete. This shortens release schedules while enabling the highest level of quality. With HP Quality Center, IT can:

- Make go-live decisions with confidence
- Standardize and manage the entire quality process
- Reduce service deployment risk
- Improve service quality and reliability
- Manage service change impact through manual and automated functional testing
- Enable quality in strategic sourcing initiatives
- Warehouse critical service quality project data

HP Quality Center along with HP Service Test Management provides major advantages in testing SOA services and allows you to benefit from:

Management

Solutions from HP map the SOA to the application development cycle and drive the QA process. HP Quality Center Dashboard module is used by managers to access a simple, comprehensive view of system quality. It provides the ability to centrally manage masses of assets, including services, messages, requirements and tests. IT can allocate resources, track changes, measure

results and provide management with the information needed to monitor the status of application development and delivery.

A full quality process

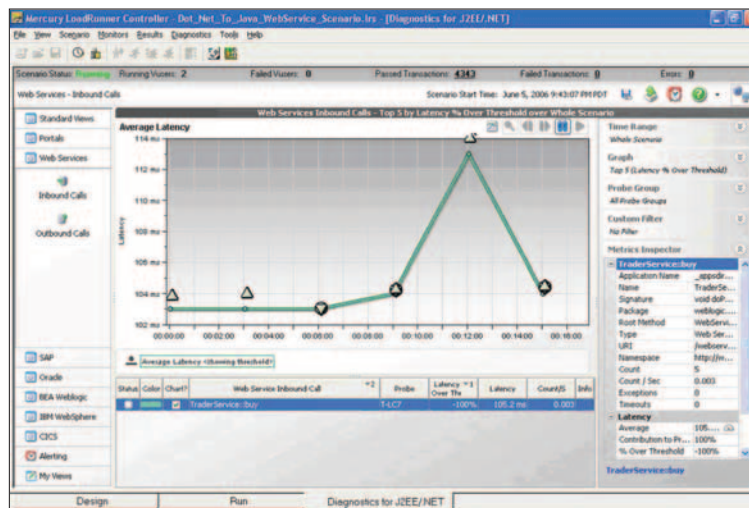
IT can implement a complete testing process that includes unit testing, functional testing and performance testing so that SOA services can be validated to deliver the functionality and performance that the organization expects from them.

Quality over time

Services will undoubtedly change throughout their lifecycles, which can potentially result in unintended negative consequences to some or all of the applications that utilize them. HP Quality Center provides the ability to understand changes and evaluate the impact that changes in a service can have on different applications. An HP Quality Center user can refresh the service definitions, which will result in comparing the current WSDLs to the WSDLs stored in HP Quality Center. Services that have been changed and their related tests will be highlighted so the user will know that changed services should be verified again.

Throughout the lifecycle of a service, providers are inevitably going to change the service and consumer needs are inevitably going to evolve. Key performance indicators (KPIs) can be measured and tracked so that QA can understand the scalability demands on an application, and HP Quality Center Dashboard technology provides management with the ability to view KPIs to instantly assess quality levels across all pre-deployment projects and track KPIs across all projects and over time.

Figure 2. Sample HP LoadRunner software diagnostics for SOA



HP Business Process Testing software

HP Quality Center also offers HP Business Process Testing, which is the industry's first web-based test design solution that bridges the quality chasm between subject-matter experts and quality engineers. It is a system purpose-built to enable subject-matter experts to build, data-drive and execute manual and automated tests without any programming knowledge. HP Business Process Testing introduces the concept of reusable business components for test design, which drastically reduces test maintenance and improves test creation efficiency.

Every business process is built from multiple services, and each of these services is a component within HP Business Process Testing. When a single component changes, the tester can update the component and the change will be automatically populated into other business processes that use the service. With HP Business Process Testing, users can copy and paste components, business process tests and test sets. This allows organizations to leverage testing assets across multiple applications and different testing teams. It also saves testers time and effort, leading to improved productivity and efficiency.

Functional and performance testing

HP offers solutions for testing the functionality and performance of services. HP Service Test software provides a solution that allows QA engineers to simplify the ongoing testing of services and decrease scripting through automation. Users can efficiently enable compliance with corporate standards, even in organizations that use multiple development tools. HP Service Test does not require a UI for services testing, and the scripts created can be used for both functional and performance testing.

HP Service Test is an offering within HP Quality Center that provides an outstanding solution for functional test and regression test automation, and it addresses every major software application and environment. HP Service Test satisfies the needs of both technical and non-technical users. It enables IT to deploy higher-quality services faster, cheaper and with less risk.

HP Performance Center suite allows QA to test the performance of services. It includes integrated applications and a business dashboard for key performance optimization activities, including load testing and J2EE diagnostics across complex, heterogeneous computing environments. HP LoadRunner software prevents costly performance problems in production by detecting bottlenecks before a new system or upgrade is deployed. QA can verify that new or upgraded services will deliver intended business outcomes before they go live, preventing over-spending on hardware and infrastructure.

HP LoadRunner is the industry-standard load testing solution for predicting system behavior and performance, and the only integrated load testing and diagnostics solution in the market today. Using limited hardware resources, HP LoadRunner emulates hundreds of thousands of concurrent users to put services through the rigors of actual user-load conditions. IT can stress services from end to end and measure the response time of key business processes. QA can measure end-to-end performance, diagnose service and system bottlenecks and enhance performance—all from a single point of control. It supports a wide range of enterprise environments, including web services, J2EE and .NET.

IT can rely on HP Service Test for functional testing and HP LoadRunner for testing the performance of services. IT has unique, shared needs for both functional and load testing as well as specific needs for each, and HP integrates HP Service Test and HP LoadRunner so QA can efficiently manage functional and performance testing of services.

Shared SOA requirements

Both functional and performance testing tools require interoperability with diverse toolkits so services can be clearly defined, understood and shared throughout the enterprise. HP Service Test offers support for leading development environments, including the .NET 2.0 framework, and the APACHE Axis framework. HP Service Test offers JMS protocol support, and support for asynchronous testing.

HP Service Test offers automatic generation of testing aspects, such as positive/negative testing. HP Service Test also offers server-side recording that allows recoding on traffic when there is no client generating the traffic.

HP allows QA to implement non-GUI testing so that SOA services can be tested earlier in their development cycle, and supports service emulation so IT can quickly create a service whenever it is not available and easily parameterize its response so that it can be used for early test creation. Given an agreed-upon WSDL, an emulated service can be created and deliver expected return values so a full test suite can be implemented.

You can protect your investments in developing scripts by re-using functional testing scripts throughout the load testing process. Functional test scripts developed in HP Service Test can be used in HP LoadRunner to test the performance of services.

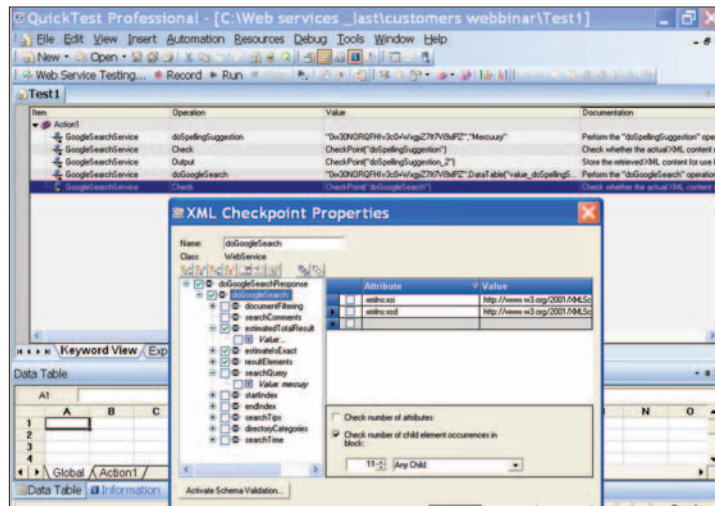
SOA performance testing

IT needs the ability to monitor services and predict their performance under loads. Using minimal hardware resources, HP LoadRunner emulates hundreds or thousands of concurrent users to put the services through the rigors of real-life user loads for virtually any client platform or environment. QA can stress a service from end to end across all architectural tiers—applying consistent, measurable and repeatable loads—then use the data to identify scalability issues before they impact end users.

HP LoadRunner measures the response times of key business processes and transactions, uncovering end-to-end performance problems. The product employs real-time performance monitors that capture and display performance data from every tier, server and component. HP LoadRunner's sophisticated analysis module allows IT to drill down to determine the specific source of bottlenecks and generate actionable reports. With HP LoadRunner, load testing scripts, scenarios and results can be stored and viewed in HP Quality Center to enable traceability of performance testing requirements.

You can create an SOA abstraction layer that requires diagnostics, and QA can test SOA services hosted on different logical and physical entities while enabling full traceability of any performance problems. HP Diagnostics software technology within HP LoadRunner helps you provide 24x7 performance and better quality of service throughout the enterprise. It allows you to test services across heterogeneous technology boundaries such as Java, J2EE and .NET, and allows management to gain end-to-end visibility into performance throughout the lifecycle of services.

Figure 3. HP QuickTest Professional can set a checkpoint against web services.



SOA functional testing

HP Service Test helps customers automate the testing process for non-UI testing of services. It provides the ability to import WSDL (Web Services Description Language) and validate its functionality and XML data. This functionality removes the need to create temporary UIs for QA and helps save time and money.

HP Service Test also provides a stub-simulation capability that allows customers to simulate multiple services in QA without having to replicate the production environment. This also helps QA conduct interoperability and validate that a service will perform the same under different client technologies. As with all HP testing solutions, HP Service Test is fully integrated with HP Quality Center as an automation tool for the execution of functional testing services.

For a combination of UI and web services testing, HP QuickTest Professional software allows IT to perform functional testing of GUI-based applications leveraging services.

Integration with application management and governance solutions

Our application delivery solutions are integrated with our application management and governance solutions so you can implement a lifecycle approach to SOA.

Application management with HP Business Availability Center software

The HP approach to application management for SOA services focuses on enabling companies to achieve the expected value from services during the normal day-to-day operations of the business. HP Business Availability Center software includes functionality that helps you manage and enhance services so that they can deliver better value to the enterprise. It delivers value in SOA implementations in three key areas:

1. Service level management. HP Business Availability Center enables business and IT to agree on, manage and enable visibility into how an application is delivering the actual business service in real time and over time.
2. Problem resolution. It facilitates fast problem detection and notification so that despite SOA complexity, performance issues can be quickly diagnosed and mean time to repair can be reduced.
3. Change impact. HP Business Availability Center lessens the risk of frequent changes in shared services by quickly detecting them and establishing their impact.

HP Business Availability Center consists of multiple applications that work together to deliver SOA management including a real-time, correlated centralized dashboard. HP Business Availability Center applications include:

- **HP End User Management software**, which provides real and synthetic monitoring of end-to-end web service transactions

- **HP Service Level Management software**, which enables setting, measuring and reporting on performance criteria as it relates to the business
- **HP System Availability software**, which delivers agentless monitoring of the underlying SOA infrastructure
- **HP Application Mapping software**, which automatically and dynamically discovers and maps SOA environments and provides the foundation for change impact
- **HP Diagnostics software**, which supplies critical, low-level problem analysis and troubleshooting for J2EE and .NET environments

Governance with HP SOA Systinet software

SOA governance consists of the corporate, business and IT processes and rules required to control and guide the business success of an SOA implementation. SOA governance provides a means to enable the quality, consistency, predictability, change and interdependencies of services. Its overarching goal is to manage the complexity created by SOA by enabling you to capitalize on the powerful promise of SOA without sacrificing control, predictability and efficiency. SOA governance is focused on:

- **Visibility.** You need a single “system of record” that captures all of the information about services. This information includes service descriptions, policies, technical documents like WSDLs and schema, contracts, and other metadata that help service consumers to fully understand the intent, operational realities and the trustworthiness of services.
- **Trust.** Without trustworthy services, consumers will typically recreate rather than reuse existing services, which undermines the overall purpose of SOA. Creating a system of record enables you to capture the information necessary to create a trust profile that makes the quality and trustworthiness of a service visible and apparent to consumers. Another aspect of trust is the ability to formalize consumer/provider relationships with an enforceable agreement that specifies service-level expectations and any other terms, conditions and details that need to be agreed upon as the basis for service consumption.

- **Control.** You need to manage services just as you manage other high-value IT assets—from introduction to final retirement and at every step in between. This means managing access to services, and ensuring they are visible and accessible to only authorized stakeholders. As services evolve, you need to be able to anticipate the impact of changes to ensure modifications to a service do not disrupt other services and applications where dependencies exist.

Visibility, trust and control are essential for you to capitalize on the promise of SOA. HP SOA Systinet software has been a leader in SOA for more than six years. HP SOA Systinet has earned a distinguished reputation of trust by consistently building award-winning products and guiding customers of all sizes to design and deploy effective SOA infrastructures. HP SOA Systinet software is the most complete SOA governance and lifecycle management platform, providing a trusted system of record and a complete set of capabilities for establishing the visibility, trust and control critical to SOA success. All services defined in HP SOA Systinet can be linked into the HP Quality Center to drive the QA process.

Summary

HP offers the only comprehensive solution available for testing SOA services and interfaces, managing quality and enabling performance throughout the lifecycle of services and composite applications.

With HP Quality Center and HP Performance Center, IT can integrate testing with the SOA ecosystem to test services throughout their lifecycles and enable shared services to be continuously used by composite applications. HP offers the diagnostics and monitors that enable IT to manage an abstraction layer for services, and also delivers integration with SOA governance so that companies can centrally focus on managing the quality, consistency, predictability, change and interdependencies of services.

You can better align IT investments with operational goals, and enhance the use of IT resources to support business objectives. SOA introduces increased complexity to IT, but the opportunity to reuse services across the enterprise creates increased business agility. HP offers SOA application delivery solutions for testing the functionality and performance of services, allowing IT to aggressively deploy high-quality services and more efficiently utilize development resources through the reuse of existing assets. HP has the only solution that can manage quality, test services and integrate with the SOA ecosystem. For more information, visit www.hp.com/go/software

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