Empowering business agility with HP network storage services: defining an adaptive storage reference architecture

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Business agility is the competitive advantage companies seek in today's complex, fast-paced and constantly changing business environment. It is the foundation of business success in an increasingly competitive world, and is essential for long-term survival. An organization is agile when it can quickly identify change in customer demand and/or market conditions and adapt its value proposition and value delivery system accordingly. Business agility allows an organization to harness change to create and maintain a winning business model. This is done by (1) increasing the range of benefits that result from embracing change, (2) reducing the time needed to react to, make and promote change, and (3) easing the cost and burden required to enact change.

Business agility is achieved with an adaptive IT infrastructure and a business culture that leverages that infrastructure. Both are critical for successful results. An adaptive IT infrastructure is built by applying, in a systematic way, the concepts of simplicity, standardization, modularity and integration to the resource domains that comprise the infrastructure. The diagram below illustrates an adaptive IT infrastructure operating environment. Storage is the foundation of infrastructure resources.

This paper focuses on storage and its potential contributions to business agility. An adaptive storage reference architecture is described that optimizes the impact of storage on business agility. Since storage is the foundation of adaptive IT infrastructure resources, creating an adaptive storage domain is a fundamental key to empowering business agility.
evolution of the storage domain

Primary online storage was originally attached to a single mainframe or server using storage channel technology. Storage was essentially a peripheral of the mainframe/server in this architecture. This exclusive, one-to-one relationship was required to deliver the data processing performance, availability and security demanded by business applications developed in the twentieth century. These applications, which were designed for stability rather than flexibility, were served well by this architecture.

As distributed computing became widespread, this architecture began to reveal its limitations. The proliferation of servers with their attached storage devices brought a storage management nightmare and exposed the inability of the technology to easily support IT infrastructure changes. To respond to these limitations, new storage systems were developed in the 1990s that consolidated large amounts of capacity into a single box that could be shared by several servers. This simplified the storage management effort and made it easier to modify the storage environment as application needs changed.

When Internet computing became pervasive around the turn of the century, a whole new set of demands for rapid change in the IT infrastructure arose. Unpredictable web site hit rates often forced IT to re-architect applications in a matter of days to keep the company in business. At the same time, annual storage growth rates made quantum leaps in many enterprises. New requirements for storage availability, performance, scalability and manageability emerged, and they could only be satisfied with a new architecture that networked storage devices and servers. This new architecture broke the traditional server/storage relationship, and put storage in its own domain that today is the very foundation of the IT infrastructure.

In the beginning of the new millennium, events such as the World Trade Center bombing (a.k.a. 9/11), the collapse of the Internet bubble and worldwide economic uncertainty took the need for business change in a new direction – instead of continually growing, some IT infrastructures needed to be scaled back. Today, nearly all IT infrastructures need to achieve higher levels of efficiency, availability, performance and flexibility. In short, virtually every organization around the globe needs an adaptive IT infrastructure for business agility to meet objectives and stay competitive.

The current business environment demands a storage domain that is optimized for business agility. HP provides the architecture, technologies and products to achieve this model today, plus the expert services required to make it a reality.
the adaptive storage domain

In order to optimize the storage domain for business agility, the following attributes must be integrated into the domain. Each attribute provides specific and substantial contributions to business agility. These attributes address the key properties that make storage compliant with HP adaptive infrastructure initiatives and thus provide a solid foundation for achieving business agility.

Enterprise-wide data services access:

- Pool all storage in the domain
- Quickly replicate any data anytime, anywhere in the domain
- Flexibility to provide data as required by applications (either blocks or files)
- Data resilience

Enterprise-wide data services provisioning:

- Dynamically provision storage anywhere in the domain

Dynamic storage domain operations:

- Scale the domain up or down quickly and dynamically
- Reconfigure the domain quickly and dynamically
- Dynamically move data in the domain

Integrated storage domain management:

- Intelligent, easily-administered storage domain management
- Automated life cycle data management
- Multi-vendor environment support
- Management integrated with the entire IT infrastructure

The following table provides additional detail about the contribution each attribute makes to business agility. Also, associated design principles of business agility (standardization, simplification, integration, modularity) are shown for each attribute, as well as the business agility metrics (range, time, ease) each attribute influences.

A storage domain that features these attributes is truly adaptable to change and provides the basic foundation required for achieving business agility.
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<th>Storage Domain Attribute</th>
<th>Contribution to Business Agility</th>
<th>Associated Business Agility Design Principles/Metrics</th>
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<tr>
<td>• Pool all storage in the domain</td>
<td>Any authorized server, and ultimately user, can access any data anywhere, anytime – promoting rapid deployment and redeployment of critical applications</td>
<td>design principles involved: standardization, simplification metrics influenced: time, ease</td>
</tr>
<tr>
<td>• Quickly replicate any data anytime, anywhere in the domain</td>
<td>Implement appropriate data protection to support service level agreement (SLA) and business continuity goals</td>
<td>design principles involved: integration, modularity metrics influenced: time, range</td>
</tr>
<tr>
<td>• Flexibility to provide data as required by applications (either blocks or files)</td>
<td>Access data efficiently and independently of underlying storage domain configuration details</td>
<td>design principles involved: integration metrics influenced: ease</td>
</tr>
<tr>
<td>• Data resilience</td>
<td>Keep scheduled/unscheduled downtime from disrupting business or missing SLA and quality of service (QoS) goals</td>
<td>design principles involved: integration metrics influenced: range</td>
</tr>
<tr>
<td>• Dynamically provision storage anywhere in the domain</td>
<td>Deploy new applications quickly without impacting SLA/QoS; respond to changing application needs with minimal impact</td>
<td>design principles involved: simplification, modularity metrics influenced: time, range, ease</td>
</tr>
<tr>
<td>• Scale the domain up or down quickly and dynamically</td>
<td>Adjust capacity and performance without impacting business operations to maintain SLA/QoS goals</td>
<td>design principles involved: modularity metrics influenced: time, range, ease</td>
</tr>
<tr>
<td>• Reconfigure the domain quickly and dynamically</td>
<td>Change devices, storage attributes, domain characteristics, etc. without impacting business operations to maintain SLA/QoS</td>
<td>design principles involved: modularity metrics influenced: time, range, ease</td>
</tr>
<tr>
<td>• Dynamically move data in the domain</td>
<td>Automatically optimize performance to achieve SLA/QoS goals</td>
<td>design principles involved: standardization metrics influenced: range</td>
</tr>
<tr>
<td>• Intelligent, easily administered storage domain management</td>
<td>Rapid, automated storage response to changing application requirements</td>
<td>design principles involved: simplification, integration, metrics influenced: time, ease</td>
</tr>
<tr>
<td>• Automated life cycle data management</td>
<td>QoS delivery according to business policies and application requirements</td>
<td>design principles involved: simplification, integration metrics influenced: ease</td>
</tr>
<tr>
<td>• Multivendor environment support</td>
<td>Minimize the impact of storage and OS interoperability finger pointing on business agility</td>
<td>design principles involved: standardization metrics influenced: range</td>
</tr>
<tr>
<td>• Management integrated with the entire IT infrastructure</td>
<td>Provide an adaptive infrastructure operating environment that unifies management across all domains of the infrastructure to facilitate SLA goals</td>
<td>design principles involved: integration metrics influenced: time, range, ease</td>
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The storage domain attributes described above can be realized with the reference architecture shown below.

This reference architecture is realized in HP Enterprise Network Storage Architecture Extended (ENSAextended), the industry’s leading storage architecture. An evolutionary extension to the original HP Enterprise Network Storage Architecture, ENSAextended provides a blueprint for creating a storage domain that is controllable, resilient and extensible – a storage domain that serves as the foundation for business agility. ENSAextended is based on state-of-the-art technologies that deliver a flexible and manageable storage environment that responds quickly and easily to changing business needs.
technologies and products that enable the adaptive storage domain

Through ENSAextended, HP offers advanced technologies implemented in StorageWorks hardware products and HP OpenView storage software products that can be integrated to create an adaptive storage domain. These technologies and products are summarized below.

<table>
<thead>
<tr>
<th>Storage Domain Attribute</th>
<th>HP Technologies that Deliver the Attribute</th>
<th>Current HP Products Incorporating the Technologies</th>
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<tbody>
<tr>
<td>• Pool all storage in the domain</td>
<td>Switched fabrics with MAN and WAN extensions</td>
<td>StorageWorks Directors, switches, routers</td>
</tr>
<tr>
<td>• Quickly replicate any data anytime, anywhere in the domain</td>
<td>Xcopy, snapshots, clones, remote data mirroring across the extended fabric</td>
<td>StorageWorks libraries, disk arrays, DRM; OpenView EVM, VR, CASA</td>
</tr>
<tr>
<td>• Flexibility to provide data as required by applications (blocks or files)</td>
<td>NAS/SAN fusion</td>
<td>StorageWorks NAS8000, e7000</td>
</tr>
<tr>
<td>• Data resilience</td>
<td>Multipathing and load balancing software, dynamic data mobility</td>
<td>OpenView Storage Secure Path, Storage Performance Monitor; StorageWorks EVA and OpenView CASA</td>
</tr>
<tr>
<td>• Dynamically provision storage anywhere in the domain</td>
<td>Automatic, fabric-level storage provisioning</td>
<td>OpenView Storage Provisioner</td>
</tr>
<tr>
<td>• Scale the domain up or down quickly and dynamically</td>
<td>Modular, networked components configured in scalable topologies</td>
<td>StorageWorks infrastructure, online and nearline products</td>
</tr>
<tr>
<td>• Reconfigure the domain quickly and dynamically</td>
<td>Block-level storage virtualization</td>
<td>StorageWorks EVA and OpenView CASA</td>
</tr>
<tr>
<td>• Dynamically move data in the domain</td>
<td>Block-level storage virtualization</td>
<td>StorageWorks XP, EVA, VA; OpenView CASA</td>
</tr>
<tr>
<td>• Intelligent, easily-administered storage domain management</td>
<td>Storage area management</td>
<td>OpenView SAM</td>
</tr>
<tr>
<td>• Automated life cycle data management</td>
<td>Automated, rules-based management that translates business policies into storage management actions</td>
<td>OpenView Data Protector, EVM, Storage Provisioner</td>
</tr>
<tr>
<td>• Multivendor environment support</td>
<td>Management of EMC, IBM, HDS disk arrays based on API sharing; heterogeneous server platform support</td>
<td>OpenView SAM; StorageWorks infrastructure, online and nearline products</td>
</tr>
<tr>
<td>• Management integrated with the entire IT infrastructure</td>
<td>Enterprise management framework</td>
<td>OpenView products</td>
</tr>
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services that deliver the adaptive storage domain

As the non-outsourced storage services market leader, HP has developed the advanced skills, worldwide resources and proven capabilities to help customers implement an adaptive storage domain to achieve business agility. These market-leading services are summarized below:

### Table 3. Descriptions of HP services that deliver the adaptive storage domain

<table>
<thead>
<tr>
<th>HP Service</th>
<th>Description</th>
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<tbody>
<tr>
<td>Strategic storage consulting</td>
<td>In-depth consulting to link business goals, including business agility, with the storage infrastructure – includes financial decision assessment for recommended projects</td>
</tr>
<tr>
<td>Adaptive storage architecture/design consulting</td>
<td>Services that develop a customized, state-of-the-art architectural blueprint for an adaptive storage domain that integrates the attributes discussed above</td>
</tr>
<tr>
<td>Adaptive storage solutions</td>
<td>Implementation services to fulfill the blueprint described above – services to implement the networked/pooled domain, virtualization, backup/rapid recovery, data resilience, integrated/intelligent management, provisioning, etc.</td>
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<tr>
<td>Data migration</td>
<td>Flexible, nondisruptive migration services for DAS to SAN, databases and other applications coming from disparate operating systems (including mainframes)</td>
</tr>
<tr>
<td>Mission critical storage support</td>
<td>Integrated, 24x7 technical support that features a dedicated technical account manager, 30-minute response time with continuous effort and critical problem management, proactive fix notification, upgrade planning assistance, installation/configuration/migration assistance, annual site visit, monthly service review, technical newsletter</td>
</tr>
<tr>
<td>Multivendor storage environment support</td>
<td>Single point of contact to keep a diverse, multivendor storage domain running at optimal levels – includes SAN topology mapping/maintenance, proactive SAN and firmware upgrade planning, change management assistance, SAN-based backup and migration planning assistance</td>
</tr>
<tr>
<td>Managed storage solution</td>
<td>Pay-per-use management and support for a diverse, multivendor storage domain – includes 24x7 remote storage management, just-in-time online storage provisioning, capacity and performance management/reporting, real time data views through a secure web portal and complete implementation services</td>
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