Local and Remote Disaster Recovery Sites:
Securing Information to Protect Business

Port of Long Beach

Information Management Division

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1. Port of Long Beach

Celebrating its Centennial Anniversary this year, the Port of Long Beach stands strong as one of the world's busiest seaports. As a leading gateway for trade between the United States and Asia, the Port of Long Beach is the second busiest container port in the United States and supports approximately 1.5 million jobs throughout the nation.

The Port of Long Beach moves about $140 billion in goods each year. As a landlord port, the Port develops and leases shipping terminals to tenants and continually reinvests revenues into new facilities and Port-related improvements for the benefit of all tenants. The Port is supported by its own revenues and does not rely on taxpayer funds to operate.

Named the best seaport in North America by *Cargonews Asia* for 13 out of the last 14 years, the Port of Long Beach is the premier gateway for Trans-Pacific trade. The Port is served by more than 140 shipping lines with connections to 217 seaports worldwide. Nearly half of all the cargo passing through the Port of Long Beach is destined for locations outside the immediate vicinity, making Long Beach critical to the national economy.

The Port's Information Management Division is responsible for providing information technology geared towards improving business processes and implementing business-critical systems, as well as providing technology expertise and ensuring that the Port's technology users receive the highest level of customer service.

2. Introduction

With the rise in information technology and the reliance on business-critical information, the protection of irreplaceable data is critically necessary. Our clients depend on accurate data to conduct their day-to-day business operations. Being able to provide our clients with a solution that will ensure rapid data recovery in an emergency is a key element in maintaining our competitiveness in today's world.

When the Port of Long Beach developed its disaster recovery plan, the Information Management division recognized the opportunity to strengthen the Port's efforts to withstand disasters by developing and implementing a reliable, highly accessible, and cost effective system that can recover data with minimal to no downtime in the event of an isolated incident or major disaster.

The Port of Long Beach's Information Management (IM) Team developed an innovative solution specifically to meet the needs of the Port by analyzing the demands of the business, studying the industry's best practices, and applying state-of-the-art methodology and technology. As a result, the Local and Remote Disaster Recovery Sites project was created to ensure that the Port's automated business systems will continue to operate unaffected. Further, critical business data and systems will be readily available for "business as usual" despite a technical outage. Not only does this benefit the Port directly, it assures terminals and shippers that their operations will continue with minimal disruption. In addition to disaster recovery capabilities, this project enables the IM team to conduct infrastructure updates and testing with zero disruption to the Port's normal operations.

The project implemented by the Port of Long Beach is highly transferable to other ports, locally and globally. The methodology of the project is straightforward and accessible, creating a practical yet expert solution that can be readily shared.

The Port's Local and Disaster Recovery Sites project is cost effective, dependable, easy to implement, and beneficial to the port and its business clients every day.

3. Business Problem

Given its strategic role in the economy of the United States, the Port of Long Beach relies on information technology in its everyday operations. Technology allows us to provide world class services to our customers, develop and improve our terminals, and plan for the future. Reliability and accuracy of the data utilized by the Port of Long Beach is critical for its business operations and, ultimately, for the economy of the region and the nation.

Like any geographical region, southern California has its share of natural disasters. It's also well known that any port is susceptible to malicious activity that could interrupt trade. Starting in 2007, the Port of Long Beach developed a Local and Remote Disaster Recovery Sites plan. This plan addresses business processes, people, location and other critical assets to be sure they are available as quickly as possible in the event of an interruption.

The Information Management division identified a unique opportunity to leverage the latest in virtual technology to enhance the disaster recovery plan. The State of California agreed with this vision and awarded the Port a $2 million grant to design and implement the enhancements.

4. Discussion

a. Background

Prior to implementing the Local and Remote Disaster Recovery Sites project, data storage and retrieval was maintained solely through the use of server backup tapes housed in a third-party offsite location. Although this method afforded the Port the ability to recover data during any type of system failure or emergency situation, it did not offer a synchronous data backup system that protected and restored data in a timely and reliable manner.

Moreover, the data storage servers were not efficient in protecting the Port's technological resources. In the long term, these servers could not keep pace with the rapid changes in technology and could not accommodate the increasing demands for storage without significant expansion of space and considerable added cost. The Port is currently undergoing aggressive modernization of its information technologies, and expansion capabilities are essential to its strategic goals.

b. Objectives

Objective 1: Design Disaster Recovery Infrastructure

Methodology: The success of the project depended on research and development and proof of concepts (POC). The Port of Long Beach analyzed its previous recovery plans to determine their strengths and weaknesses. By testing and combining different hardware and software technologies in a lab environment, the Port was able to discover the best solution at the best possible cost. The benefit of the POCs is that the technologies could be tested and validated in real case scenarios, rather than rely solely upon theoretic functionality. The selection process also enabled the Port to create and document a set of standards for hardware and software used for the infrastructure and the disaster recovery plan.

Hardware/Software Used: Our selection process allowed us to test hardware and software from many different vendors. Hardware and software included (detailed information follows in section “e”):

- Blade Enclosures
- Storage Area Networks (SAN)
- Firewalls
- Intrusion Prevention Systems
- Communication/Satellite equipment
- Virtualization software
- Replication software
- Site Recovery management software

Objective 2: Implement Corporate Private Cloud

Methodology: Identifying the necessary building blocks to accomplish the Port’s goal was the starting point for the project. The Port of Long Beach utilized a highly skilled team to assemble and configure the components and followed a set of concepts, procedures, and best practices defined in the Information Technology Infrastructure Library (ITIL). Virtualization, clustering, and replication components

were installed on top of the hardware layer to accomplish the resilience, high availability, and fault tolerance necessary for a successful project.

Objective 3: Validate Disaster Recovery Plan

Methodology: With the hardware and software selected, the Port was able to build a foundation for disaster recovery and business continuity capabilities. To ensure complete success, a detailed matrix outlining a set of failover specs, test plans, training, and a functional failover was compiled. These components were identified as necessary to respond quickly, react effectively and communicate efficiently (Appendix 1: Disaster Recovery Failover Matrix).

c. Methodology

To implement the optimal solution for the Port's business, the Information Management Division created a task group led by the Network Operations Center (NOC) team of five people. The Network Operations Center staff conducted thorough research of hardware and software solutions prior to selecting a vendor. The NOC evaluated software by comparing Port applications to determine compatibility, operational effectiveness, and business value. The end result of this research and development was a selection of hardware and software that the Port would eventually deploy as the Local and Remote Disaster Recovery Sites Project. Table 1 summarizes key methods considered for the DR project design.

Table 1: DR Sites Project Methodology

Methodology	Application
Virtualization	The use of software to allow a single physical platform to run multiple server systems and business applications concurrently. Virtualization is the core component for successful cloud computing.
Cloud Computing	Unites computing, networking, storage access, and virtualization into a cohesive system without geographic constraints. Cloud computing provides service continuity without interruption even in the event of a single disaster.
Disaster recovery site	Geographically remote facility/data center providing recovery operations for the private cloud infrastructure.
Private cloud	Privately owned corporate cloud designed to offer greater control over the infrastructure and to avoid losing control of information security.
Internet network resiliency	Design, implementation and management of internet interconnects providing network communication resiliency.
Replication	The process of sharing information so as to ensure consistency between redundant resources.
ITIL	The Information Technology Infrastructure Library (ITIL) is a set of concepts and practices for Information Technology Services Management, Information Technology (IT) development, and IT operations.
Terminal services	A service that permits users to access applications and data on a remote network.

One of the challenges in designing the project was to customize the technological solutions currently available to meet the specific needs of the Port's complex data structure and end users. This required a comprehensive collaboration among the various divisions of the Port to identify critical systems and applications and develop a strategy that was straightforward and reliable, yet easy to implement under time constraints and in crisis situations. The NOC team worked with the Port's Risk Management team to gather and analyze information about the Port's business needs in relation to the project.

In addition, to assist with the full range of services required for the implementation, Information Management released a Request for Proposal (RFP). This RFP allowed the NOC team to engage a qualified vendor to install and configure the approved solutions, recommend best practices, develop and test recovery scenarios, and provide on-going support services for one local site and one remote site. The parameters that were considered for the design of the DR project are noted in Table 2.

Table 2: Parameters for DR Sites Project Design:

Parameter	DR System Requirements
Scalability	Capability to cope and perform under an increased or expanding workload
High Availability	Minimal to zero downtime for data recovery in the event of an incident/disaster
Acceptability	Acceptability by the Port business units and effectiveness for its business operations
Operational Simplicity	Ease of implementation and operation
Compatibility	Seamless integration with existing plans and processes
Cost Effectiveness	Project's budget is $2 million, funded through a state grant
Environmental Impact	Minimal environmental impact

d. Project Design

Taking into consideration the business needs of the Port, project management best practices, and details of the project (budget and existing infrastructure), the NOC team developed a design of the Local and Remote Disaster Recovery Sites that fully meets all the above mentioned parameters.

The project includes the local and remote recovery sites that are necessary for the continual operation of essential Port systems. The local site is located within a 10-mile radius of the Port's headquarters as more frequent physical access is required to test and implement upgrades, fixes, or patches with minimal disruption to the Port's production environment. The remote site, located outside California, serves as a secure data center should a local or regional disaster prevent access to the local sites. Having two separate offsite operational facilities decreases the risk of damage to critical data and equipment during any disaster that may strike the Port. The design for the Local and Remote Disaster Recovery Sites project is detailed in Appendix 2.

e. Hardware and Software Used

Hardware

- Blade Enclosures – Server blade farm that hosts the ESX virtualization servers and other infrastructure server components.
- Storage Area Network (SAN) – Clustered enterprise storage provides scalable, resilient, high performing storage to the infrastructure's core systems.
- Network Equipment (Routers/Switches) – The backbone of intersystem communication. Provides the high speed and low latency communication necessary for successful cloud computing. Also manages the internet and satellite interconnects to ensure communication performance and resiliency.
- Security Equipment: Intrusion Prevention Systems and Firewalls – Appliances that inspect, filter, monitor and enforce a set of rules on all network traffic. These mechanisms secure and protect the infrastructure's data and adhere to the Port's security policy.

Software

- VMware vSphere – Virtualization software. One of the core components necessary to achieve cloud computing.
- DoubleTake – Replication software used to copy data and create a real-time mirror of systems that are difficult to virtualize.
- VMware Site Recovery Manager (SRM) – Software that automates the process of spinning up a highly complex replicated environment. Minimizes the amount of time to bring the disaster recovery site into production mode in the event of an incident or disaster.

f. Project Cost

The Port of Long Beach was awarded a grant of $2 million for the Disaster Recovery Center Project under the FY 2007 California Port and Maritime Security Grant Program Grant (CPMSGP). This program was funded by the Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006, approved by California voters as Proposition 1B at the November 7, 2006, general election.

The total cost to design and implement the project was $1.62 million.

Infrastructure cost:

- Blade Enclosures/servers - $260,000
- Storage Area Network - $232,000
- Communication and Security equipment - $ 315,000

Software cost:

- Virtualization software - $150,000
- Site Recovery Management - $53,000
- Replication software - $35,000

Consulting cost:

- R&D, Project Management, Implementation - $575,000

Total Project Cost: $1.62 million*

*The project was completed under budget. A few additional items need to be procured and the Port will return any remaining funds to the State.

Monthly re-occurring costs:

- Arizona Disaster Recovery Data Center - $4800/mo
- Backup to Cloud - $2100/mo
- Spacenet Satellite Communication - $650/mo

g. Performance Measures

The following measures were considered in determining the project's success:

Table 3: Performance Measures

Measure	Objective	Achievement(s)
Scalability *The ability for business applications to grow without down-time as demand increases.*	Create a flexible environment that would allow expansion of the private cloud without business application downtime.	Successfully designed and implemented VMWare vSphere private cloud and have demonstrated explanation without causing application interruptions
Availability *The measurement of accessibility of business applications*	Create resilient systems supporting business applications that provide minimal outages.	Service level outages have nearly disappeared – application/service availability at 99.9+% since project completion.
Compatibility *The measurement of application or service interoperability with other applications or services*	Allow applications, virtual servers, and services to function on any cloud components.	Business applications and servers have been successfully moved from data center to data center without any service outage.
Survivability *The ability for applications to survive with the loss of one or more data centers.*	Create private cloud that would allow full operations from any of the data centers in the cloud.	At completion of project tested site-survivability during maintenance outage and have successfully been able to operate services from any of the three data centers.
Cost Effectiveness *Ability to deliver business applications quickly and timely without requiring new infrastructure*	Provide the ability to support business application growth cost effectively.	Through private cloud, several new business applications are supported without need to purchase significant hardware.
Environmental Impact *Impact to environment through power and cooling demands for systems supporting business applications*.	Provide services while minimizing environmental impact, and, if possible, reduce environmental effects.	Have been able to support 190+ servers while reducing power and cooling demands by virtualizing nearly 90+% of environment.

5. Fulfillment of Award Criteria

The following is a summary of how the DR Sites project fulfills award criteria.

Table 4: Fulfillment of Award Criteria

Award Criteria	Fulfillment
The level and nature of benefits	Providing the Port's critical business applications disaster resiliency that will allow the Port to recover from physical or cyber losses quickly, allowing the continuation of trade.
The creativity of the solution	The solution implemented by the Port of Long Beach was both cost effective and cutting edge, riding the wave of the "cloud craze" while maintaining ownership of the equipment to insure the highest security and integrality of data.
Are project results apparent?	The Port has been able to successfully test hardware malfunctions and site connectivity loss without critical business applications becoming unavailable.
Cost effectiveness	Leveraging a private cloud powered by vSphere, the Port has been able to create expandable systems allowing growth with minimal, if any, hardware capital investment for new applications.
Transferability to the port industry	This disaster recovery model, the lessons learned, and the research that was conducted in vendor selection and technology selection can be provided to the AAPA to allow other ports to facilitate disaster recovery planning. The project implemented by the Port of Long Beach is highly transferable to other ports, locally and globally. The methodology of the project is straightforward and accessible, creating a practical yet expert solution that can be readily shared.
Environmental impact	Minimal environmental impact

6. Conclusion

The Local and Remote Disaster Recovery Sites project provides the Port of Long Beach and its customers with a wide range of benefits that were not available prior to its implementation. The project incorporates modern methodology and state-of-the art technology and yet is cost efficient with minimal environmental impact.

The most significant benefit provided by the project is disaster resilience for the Port's critical applications that support business continuity. More importantly, the Port's data disaster resilience secures the economic well being of the region and the nation. The project also helps the Port to maintain its competitiveness by providing the port's clients with peace of mind about the port's resiliency and ability to support operations even during a major emergency.

The Port of Long Beach's Local and Remote Disaster Recovery Sites project offers a solid model for other ports throughout the nation and worldwide and can be effectively modified to suit the needs of individual ports. The clear methodology offers an expert solution that is both sound and reasonable, yet is cost effective and easily implemented. Not only is it unique in design and practicality, the Port of Long Beach's Local and Remote Disaster Recovery Sites project is forward-thinking in its approach and concept. For these reasons, the Port of Long Beach feels that this project is worthy of the AAPA Award for Information Technology.

Appendix I:

Title: Disaster Recovery Failover Matrix

Scenario	Port physical access for customers	Primary Datacenter Status	Failover Datacenter Status	Description	Disaster Recovery Replication	Disaster Recovery for customers	Disaster Recovery Site Status
1	YES	PARTIALLY UP	UP	Affected services failover to Failover Datacenter	Replicate From Failover Datacenter	Not Activated	Not Activated
2	YES	DOWN	UP	All services failover to Failover Datacenter	Replicate from Failover Datacenter	Not Activated	Not Activated
3	YES	DOWN	DOWN	Activate Disaster Recovery Customer access through satellite or remotely via terminal services.	Replicate to Cloud Or Tape	Activated	Activated
4	PARTIAL ACCESS (Security Command Center only)	DOWN	UP	Customers work from Security Command Center or remotely via terminal services.	Replicate From Failover Datacenter	Activated	Not Activated
5	PARTIAL ACCESS (Security Command Center only)	DOWN	DOWN	Activate Disaster Recovery Customers work remotely via terminal services	Replicate to Cloud Or Tape	Activated	Activated
6	NO	UP	UP	Customer access via terminal services.	Replicate From Primary Datacenter	Activated	Not Activated
7	NO	DOWN	UP	Customer access via terminal services.	Replicate From Failover Datacenter	Activated	Not Activated
8	NO	DOWN	DOWN	Activate Disaster Recovery Customer access via terminal services.	Replicate to Cloud or Tape	Activated	Activated

Appendix II

Diagram 1: Local & Remote Disaster Recovery Sites Design