Orchestrating a brighter world

NEC

Ultimate Integrated Solution for Business Continuity & Disaster Recovery

April, 2021

NEC Corporation,
Cloud Platform Division,
(EXPRESSCLUSTER)

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Orchestrating a brighter world

NEC creates the social values of
safety, security, fairness and efficiency
to promote a more sustainable world
where everyone has the chance to reach
their full potential.

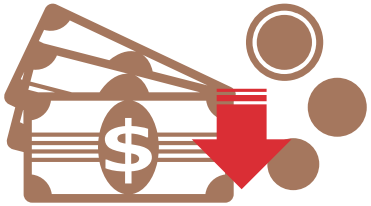
Index

1. Customer Challenges
2. Key Advantages
3. Other Functions / Features
4. Successful Case Studies

Requirement for HA Cluster

Availability and reliability of ICT is one of the most important issue in IT related strategies

- Dependency/importance of ICT in business activity is increasing.
- Unexpected disruption of IT system directly affects business operation and service provision, leading to financial loss such as business opportunity and credibility loss



Reduction of revenue

Credibility loss

Business opportunity loss

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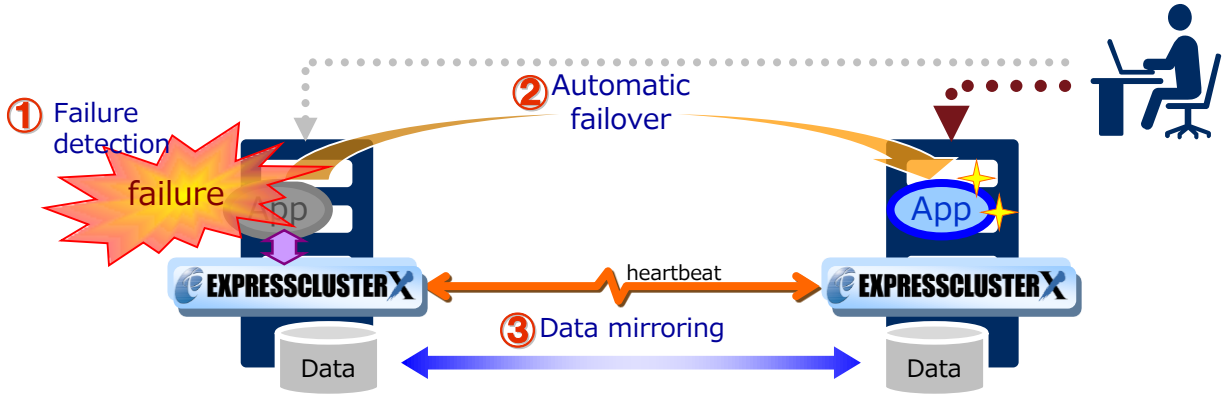
What is EXPRESSCLUSTER X?

EXPRESSCLUSTER X is a “High Availability Clustering Software” which is designed to maximize uptime for any critical system.

① Assured failure detection of wide range of system resources such as network, hardware, OS, and applications

② Automatic / Quick application-level failover

③ Data mirroring between clustered servers (also supports shared disk type clustering)



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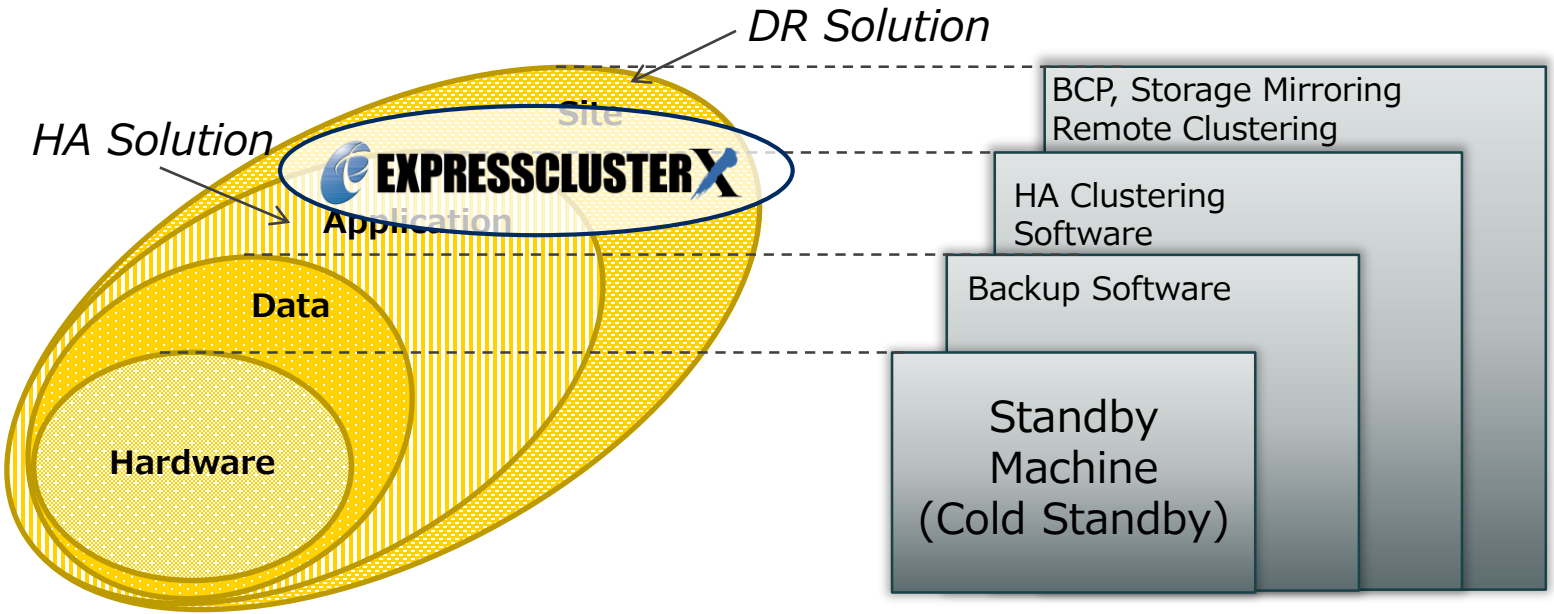
Market Positioning of EXPRESSCLUSTER

EXPRESSCLUSTER is Categorized as Clustering Software



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1. Customer Challenges

Negative Impact of System Disruption

System disruption impacts not only your company, but also other companies or social infrastructure and causes serious damage to your company management.

Negative Impacts

by Enterprise Business

Industry	Negative Impacts
Financial	• Social impact to nation's economy • Damages to company's credibility
Manufacturing	• Economic loss due to stoppage of production activity • Damage to credibility due to having negative impact to related companies • Opportunity loss
Retail	• Economic loss due to stoppage of sales activities

by Type of System

System	Negative Impacts
Mail system	• Loss of productivity due to communication issue
Production system	• Opportunity loss due to disruption of manufacturing activities • Damage to customer satisfaction
Ordering system	• Opportunity loss due to disruption of receiving orders from customers • Damage to customer satisfaction
File Server	• Loss of productivity

Economic Loss Caused by System Disruption

Average amount of economic loss per 1 hour downtime

Domain	Amount of Loss/hour (US$)
Financial	9,997,500
Retail	397,500
Healthcare	157,500
Manufacturing	59,930

Source : IDC Research

Other Negative Impacts

- Resource / Cost issue for recovering
- Restitution to customer
- Loss of customer/partner goodwill
- Brand damage
- Driving business to competitors
- Bad publicity/press
- Administrative penalty
- etc ...

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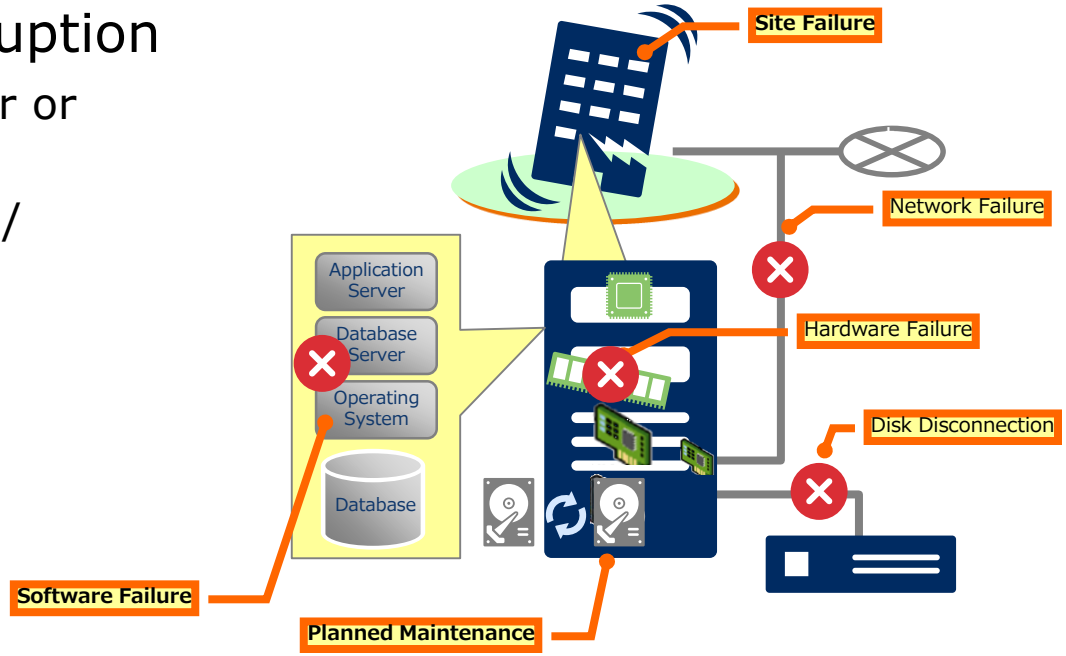
Cause of System Disruption

Major causes of system disruption

- Site failure due to natural disaster or fire etc
- Hardware failure such as servers / storages failure
- Software failure such as OS, middleware, business application failures
- Access failure to disk
- Network failure
- Temporary system outage due to planned maintenance



Cause of system disruption ranges from software failure to natural disaster. Minimizing these risks will lead to maximizing the company revenue!

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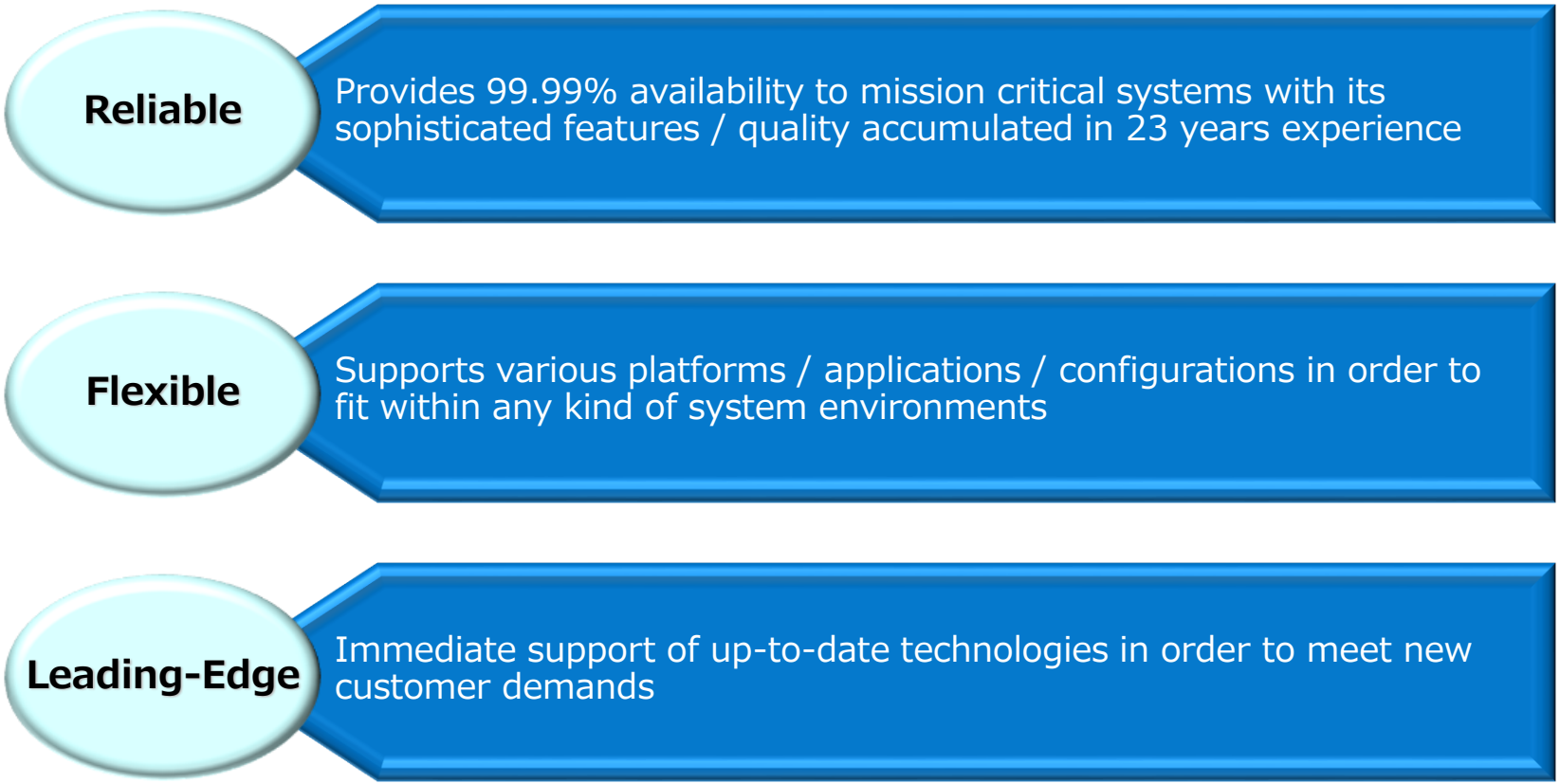
2. Key Advantages

Key Advantages Of EXPRESSCLUSTER X



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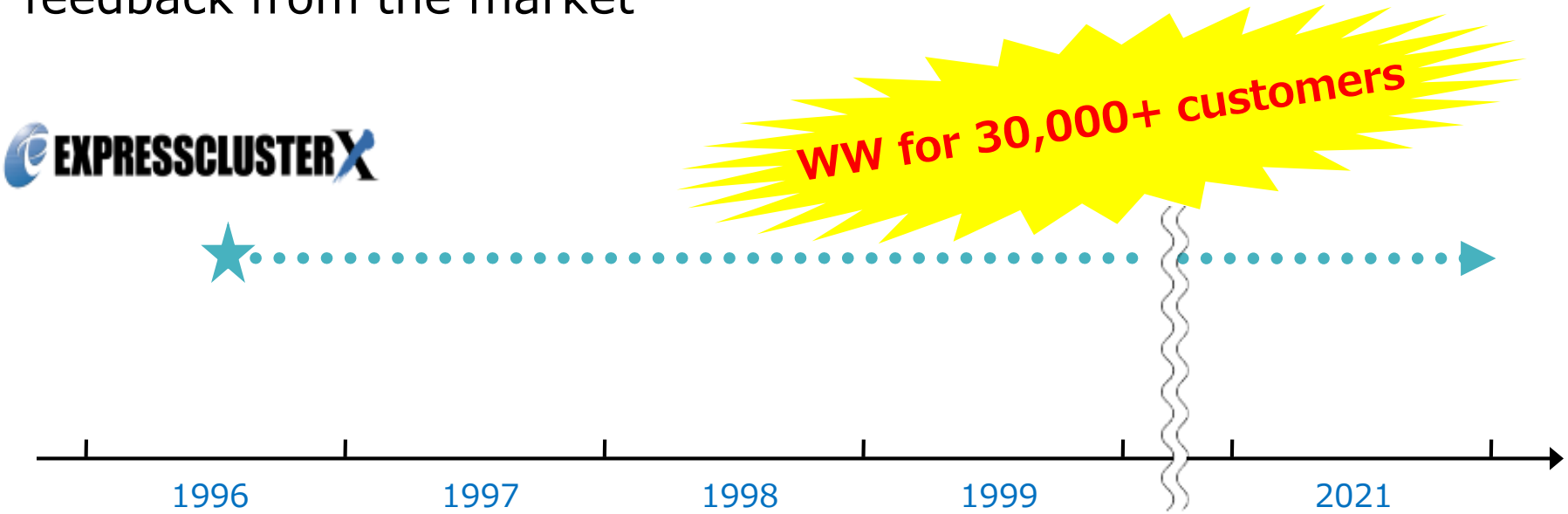
Reliable: Long History

- EXPRESSCLUSTER X was released in Oct, 1996 which was earlier than other major clustering solutions.
- The product has been improved continuously based on direct feedback from the market



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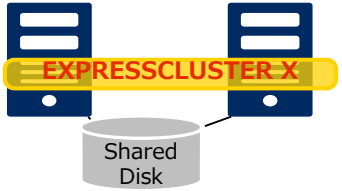
Flexible-1: Supported Cluster Configuration

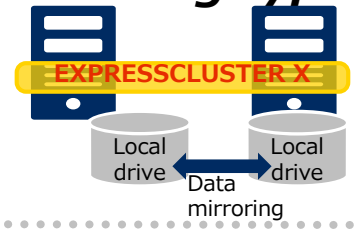
Supporting three different data sharing mechanism

1) Shared disk type



- For larger data volume
- High reliability provided by storage system
- Simple configuration

2) Data mirroring type



- For less data volume
- Lower cost
- Avoiding HDD to be the Single Point Of Failure

3) Hybrid clustering type

- Combination of shared disk & data mirroring type
- Provides higher flexibility / operability for WAN clustering (disaster recovery)

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Flexible-2: No Hardware / Application Dependency

EXPRESSCLUSTER X supports all types of IA servers and storages

Server	Storage
• Express5800 • ProLiant • PowerEdge • PRIMERGY ... and more	• iStorage • Smart Array • FAS2040 • EMC: Symmetrix ... and more

EXPRESSCLUSTER X supports various applications

Database	Oracle, SQL Server, MySQL, DB2, Sybase, etc…
Backup	Arcserve, BackupExec, NetBackup, NetVault, NTBackup
Web Server	IIS, apache, httpd, sendmail, Postfix
Groupware	Exchange, Domino
Security	OfficeScan, ServerProtect, InfoCage
System Management	MasterScope, Tivoli, OpenView
Application Server	WebLogic, WebSphere, JBOSS
ERP	SAP, TASY **… and more!**

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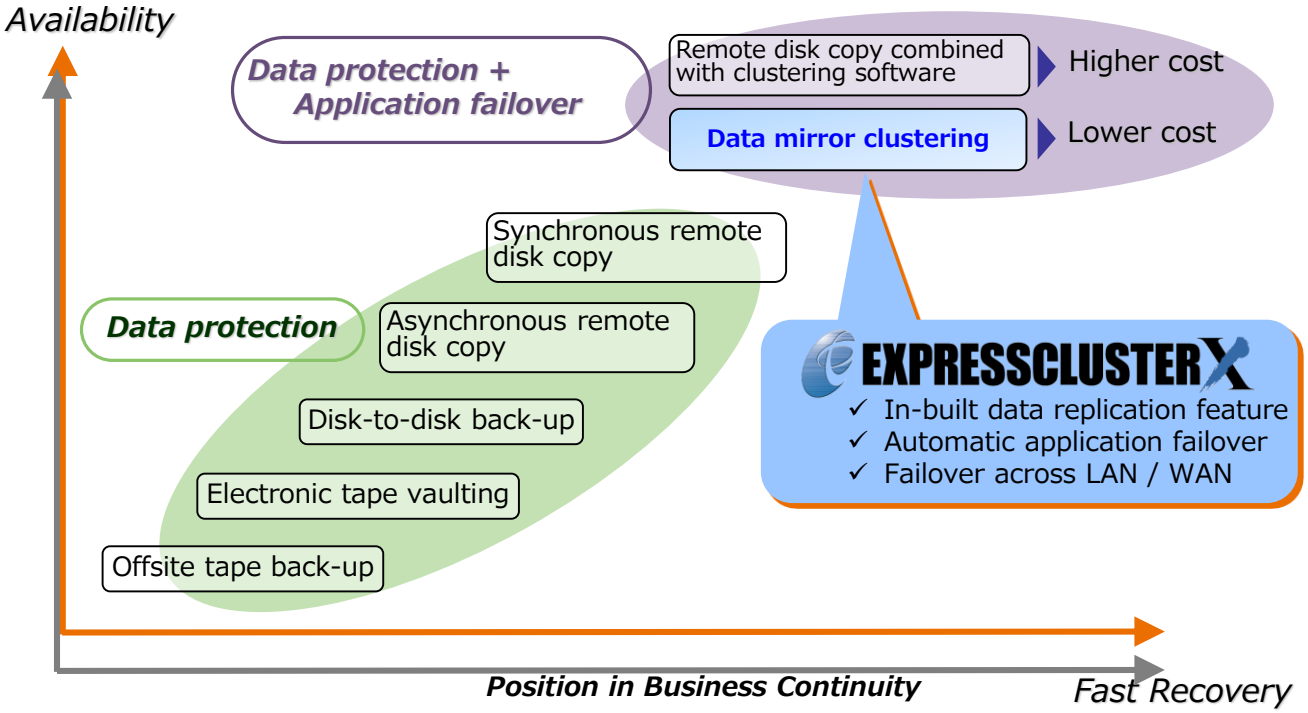
Leading-Edge-1: Disaster Recovery Supported

- EXPRESSCLUSTER X has been offering WAN clustering feature since 2004 which enables lower-cost disaster recovery solution



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Leading-Edge-2: Cloud Environment Supported

- Redundancy is becoming more important in terms of the challenges for cloud utilization such as:
  - Applying cloud service SLA (Service Level Agreement)
  - Measures against planned outage
  - Disaster Recovery
- EXPRESSCLUSTER supports many Cloud Services (IaaS):

※Cloud environment with the operation record by EXPRESSCLUSTER X.

Setup Guide: https://www.nec.com/en/global/prod/expresscluster/en/support/Setup.html#Cloud

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3. Other Functions / Features

Other Functions / Features

- **Supported Configuration / Failover Scenario**
- Monitoring Capabilities
- Prevention of Split-Brain
- Disaster Recovery Capabilities
- Virtualization Supported
- Usability / Operability
- System Requirements

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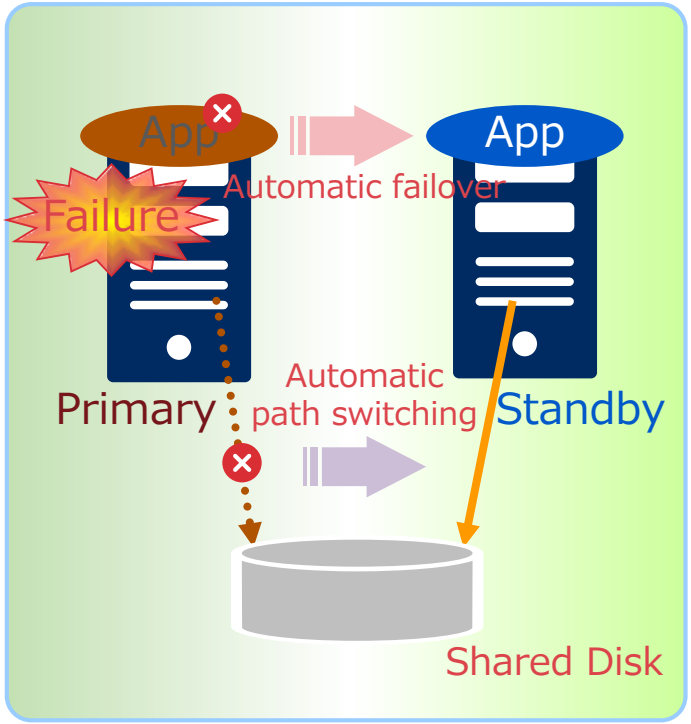
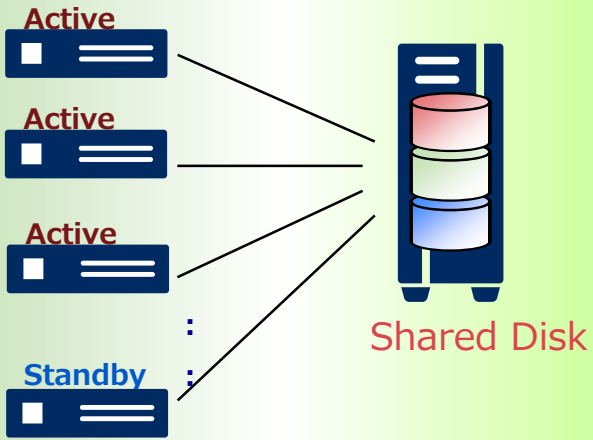
Shared Disk Clustering

Shared disk type clustering offers best reliable storage system and high performance with supporting larger data !



- Maximum 32 nodes in a single cluster is supported
- *M* + *n* clustering (*M* active servers and *n* standby servers) is also supported!



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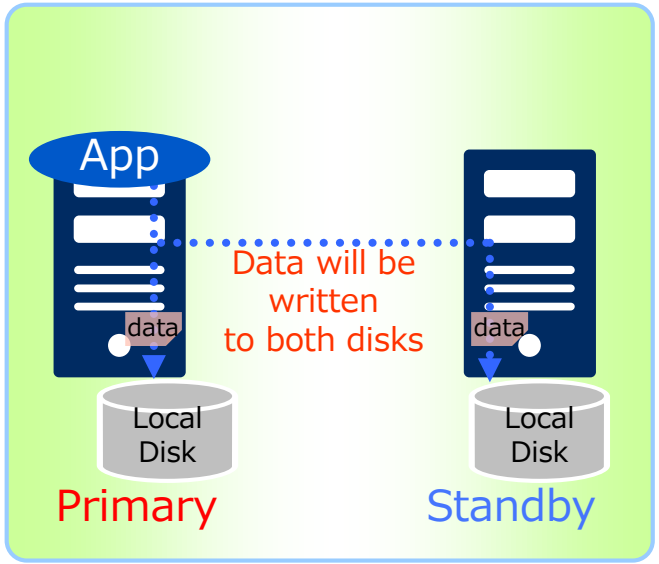
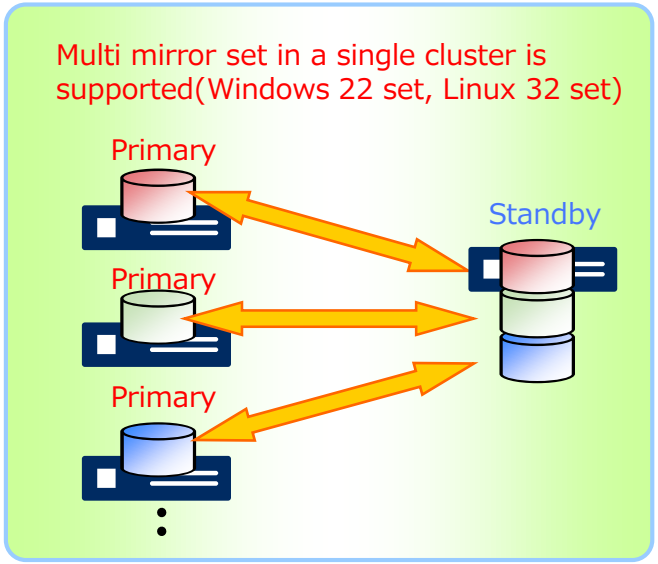
Data Mirroring Clustering

Data mirroring type clustering does NOT require any external storage device and thus offers high cost performance !

- Data in local HDD of active server is real-time mirrored to local HDD of standby server.
- Lower cost, small-footprint HA solution.





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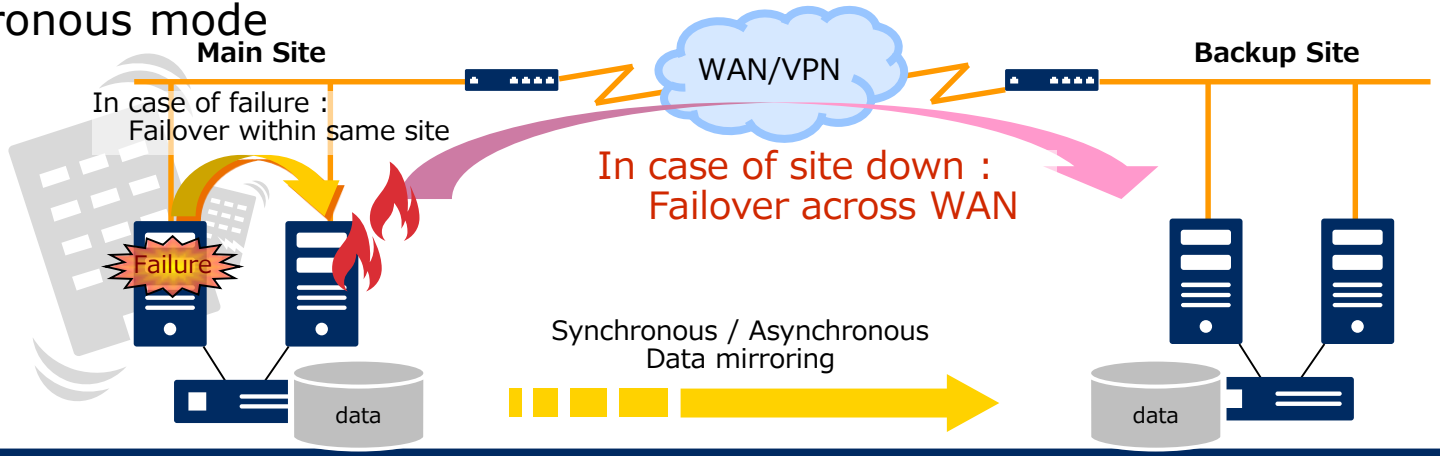
Hybrid Clustering

Combined configuration of shared disk clustering and data mirroring clustering for disaster recovery scenario

- 2 failover scenarios for higher operability:
  - In case of component failure such as HW, OS, application failure, application will failed over to standby server locating in same site
  - In case of site down due to disaster, fire etc, application will failed over to standby server located in backup site
- Data stored in SAN will be mirrored to backup site in either synchronous / asynchronous mode



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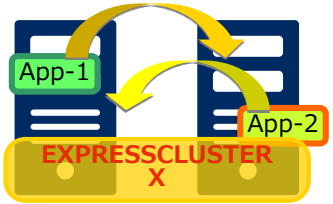
Supported Failover Scenario

Supports various configuration flexibly

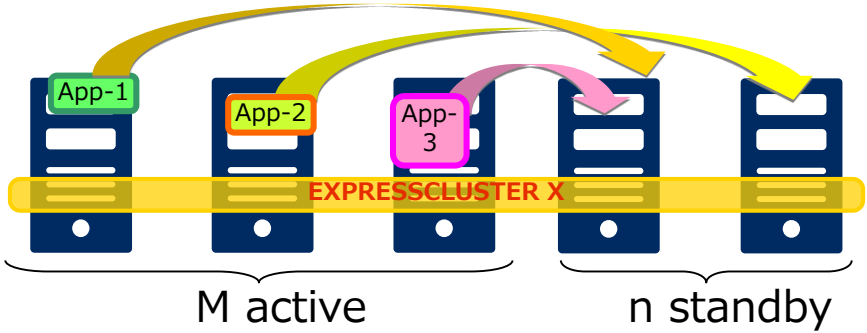
1) Active - Standby

2) Active - Active



3) M+1 Standby

4) M+n Standby



… and more !

: Failover

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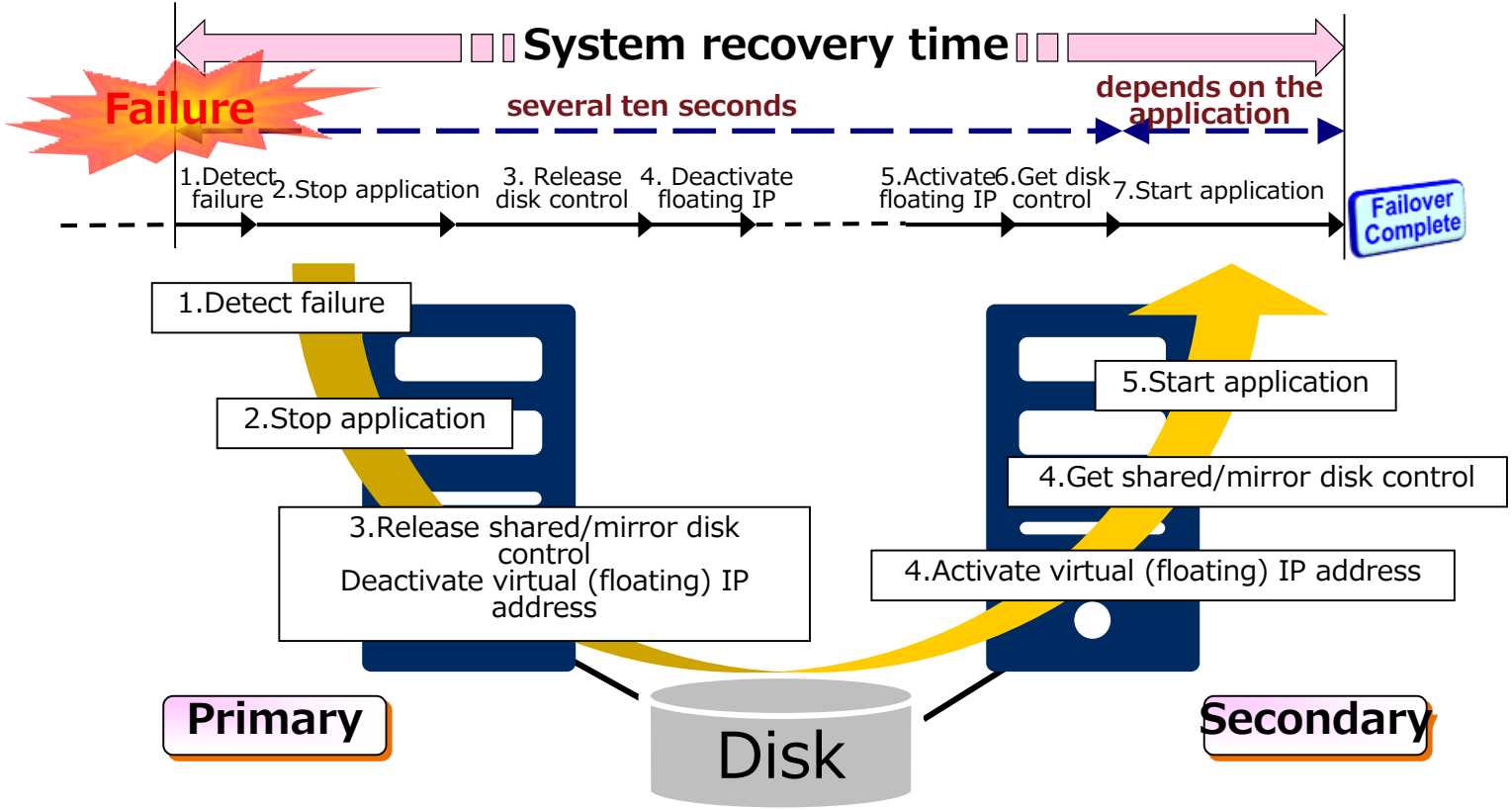
Failover Process

Takes only several ten seconds for switching server



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Minimizing Downtime During Planned Maintenance

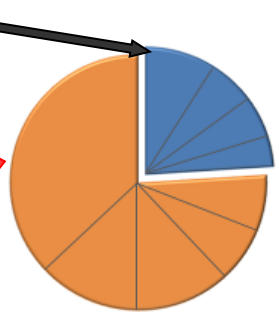
Major Causes Of System Disruption

Unexpected Failure : 24%

broken down as;

- 9% : OS / Driver failure
- 6% : Application error
- 5% : Hardware failure
- 4% : Other failures

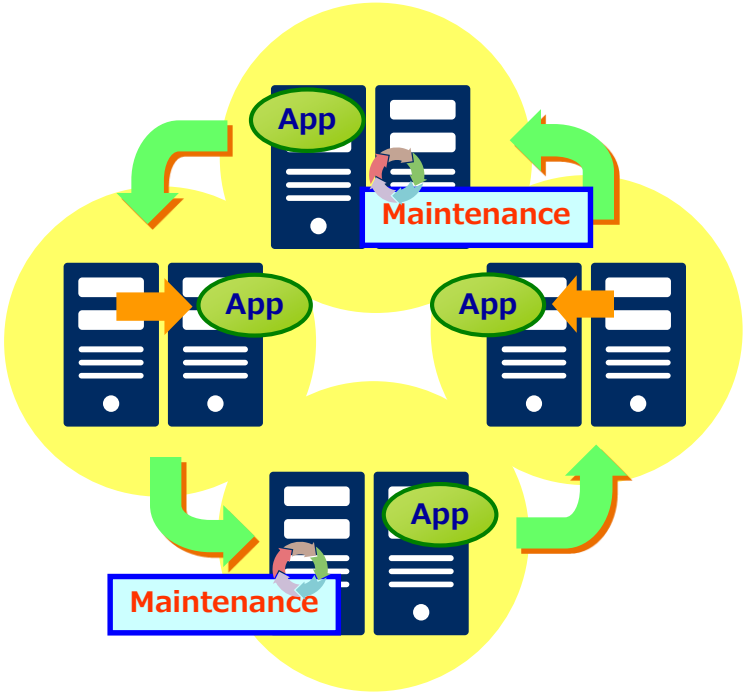
Planned Maintenance : 76%



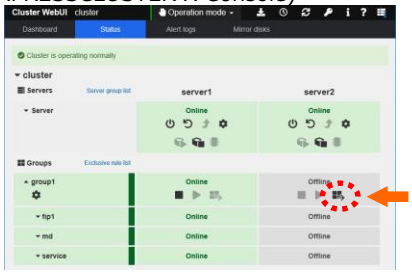
broken down as;

- 37% : OS Upgrade / Service Pack / Patch application or OS restart relating to these works
- 13% : Application installation and maintenance
- 12% : OS restart relating to configuration change of OS
- 7% : OS restart relating to hardware configuration changes
- 7% : Other OS restart

Source : Microsoft Research



(EXPRESSCLUSTER X Console)



Manual failover can be done with simple operation!

System downtime caused by planned maintenance can be also minimized by switching active server with simple operation!

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Other Functions / Features

- Supported Configuration / Failover Scenario
- **Monitoring Capabilities**
- Prevention of Split-Brain
- Disaster Recovery Capabilities
- Virtualization Supported
- Usability / Operability
- System Requirements

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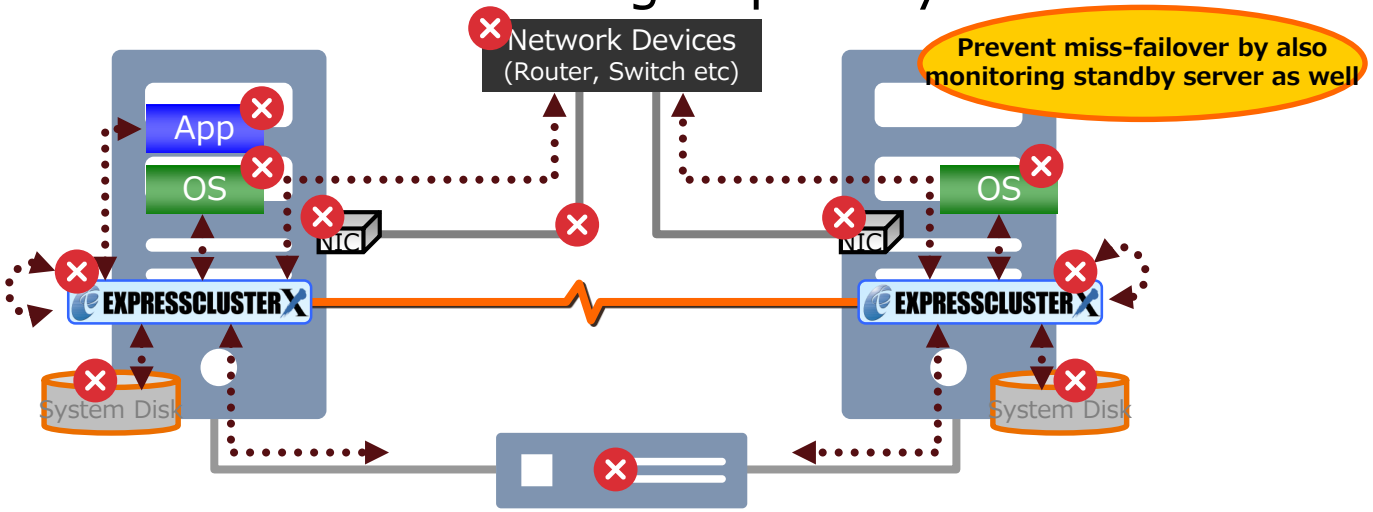
Various Monitoring Targets (AP, OS, HW, NW)

In order to minimize the risk of system disruption,
application failover should be done in any kind of failures!

EXPRESSCLUSTER X's Monitoring Capability



EXPRESSCLUSTER X monitors wide range of resources from NW to application
and do not miss a failure which leads to system disruption!

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Deeper Application Monitoring

Dedicated monitoring agent* for major applications detects not only application termination, but also abnormal status or hang-up status of the application through its proactive response monitoring.

* Offered as optional add-on

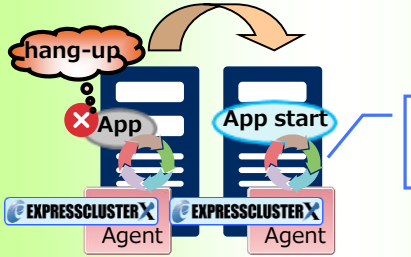
without Monitoring Agent

Termination of the application process will be detected as an error.

Application hang-up will not be detected.

N/A	Detection of application hang-up
N/A	Abnormal response from application
✓	Abnormal termination of application

with Monitoring Agent



Real time monitoring of application healthiness

✓	Detection of application hang-up
✓	Abnormal response from application
✓	Abnormal termination of application

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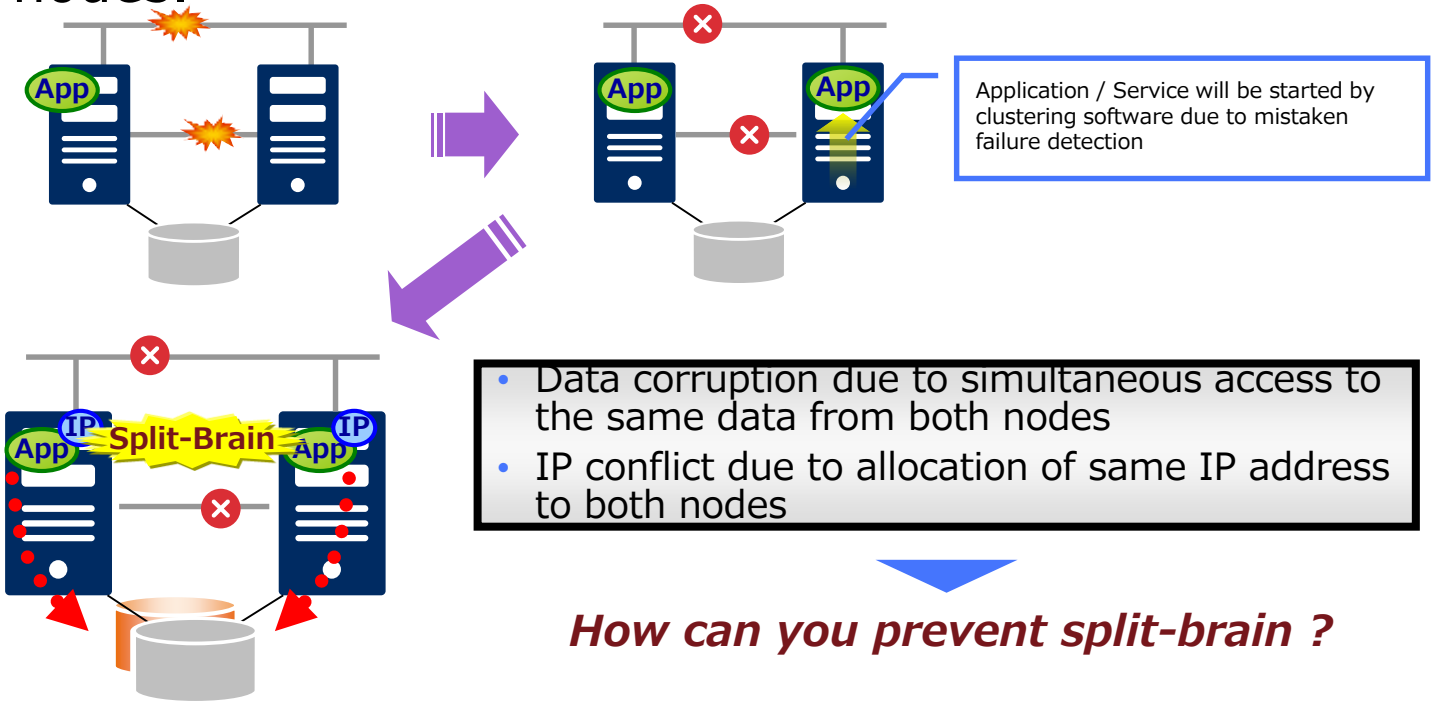
What is Split-Brain?

Split-Brain is the condition where two or more nodes in the cluster becomes active due to disconnection of all the network between nodes.



- Data corruption due to simultaneous access to the same data from both nodes
- IP conflict due to allocation of same IP address to both nodes

How can you prevent split-brain ?

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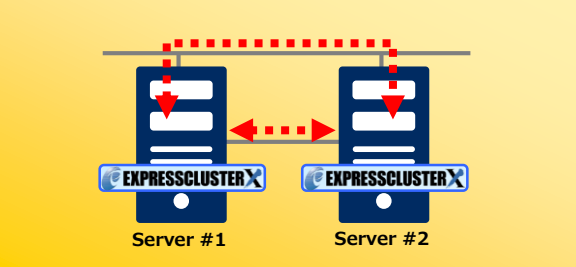
Prevention of Split-Brain - Redundancy of HB path -

Realize accurate alive monitoring against other servers
by multiple use of heartbeat path

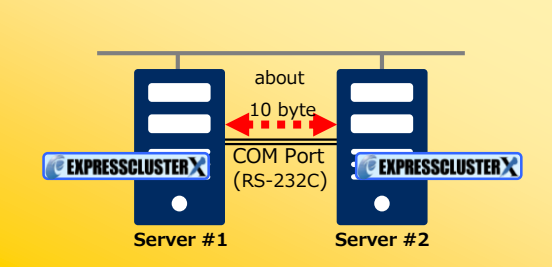
LAN Heartbeat

- Heartbeat connection through LAN



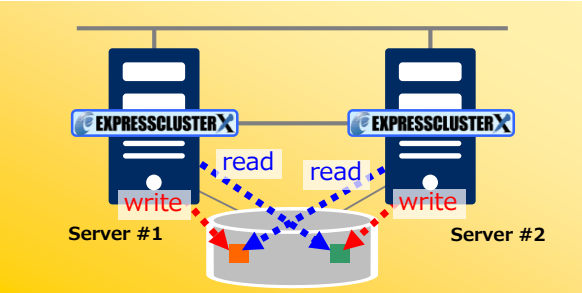
COM Heartbeat

- Heartbeat connection through COM connection



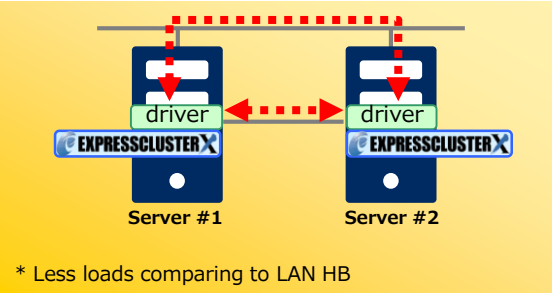
Disk Heartbeat

- Alive monitoring by writing / reading the data on shared storage



LAN Kernel Heartbeat

- Send/receive heartbeats between each servers at kernel space.



* Less loads comparing to LAN HB

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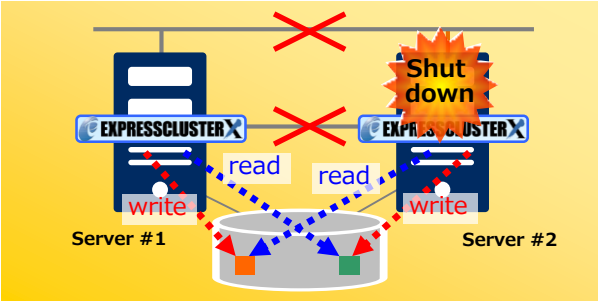
Prevention of Split-Brain - Resolution method -

Accurately detect the risk of split-brain and prevent beforehand

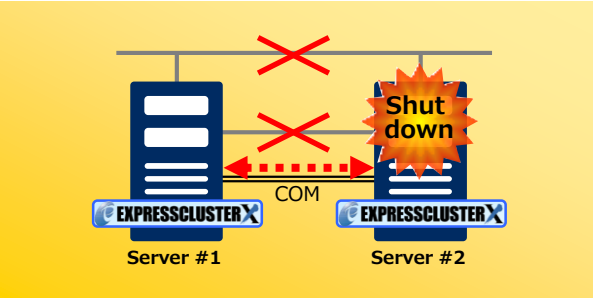
Disk method

- The lower priority server will be shut down to prevent split-brain



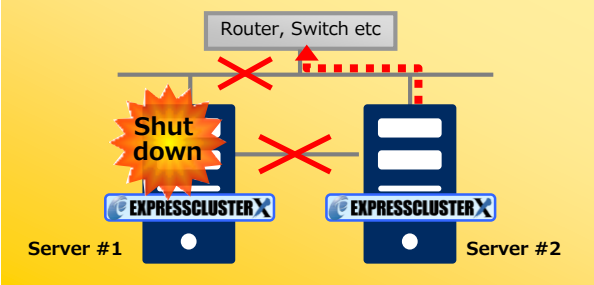
COM method

- The lower priority server will be shut down to prevent split-brain



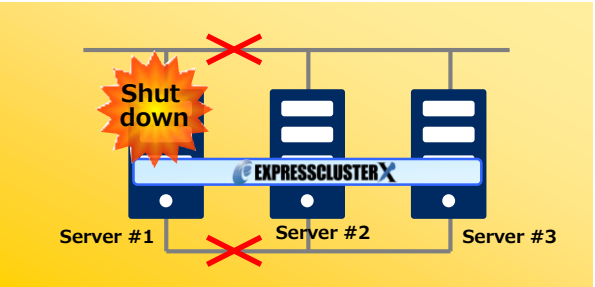
Ping method

- If no ping response comes back, lower priority server will be shut down



Majority method

- shutting down a server that can no longer communicate with the majority of the servers in the entire cluster



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Other Functions / Features

- Supported Configuration / Failover Scenario
- Monitoring Capabilities
- **Prevention of Split-Brain**
- Disaster Recovery Capabilities
- Virtualization Supported
- Usability / Operability
- System Requirements

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Disaster Recovery Achieved by WAN Clustering

Disaster recovery can be also achieved by EXPRESSCLUSTER X with lower cost!

✓ Challenges

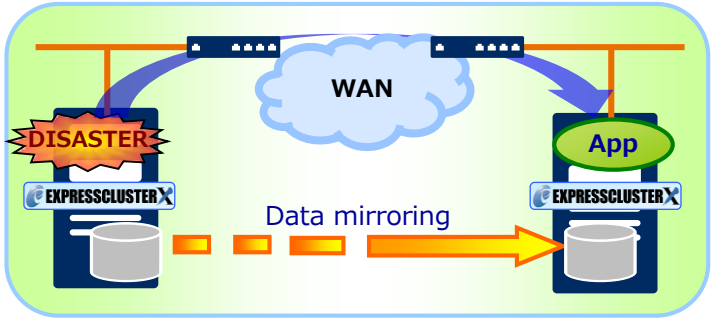
- Only data backup has been done.
- When servers and network has been damaged due to disaster, business will be disrupted.

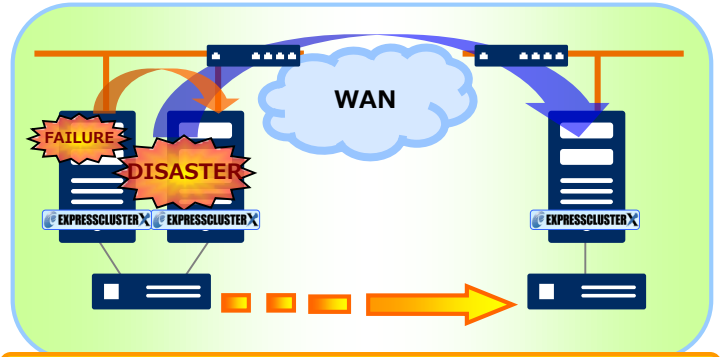
✓ Measures

- Always mirror the data to backup site with EXPRESSCLUSTER X's mirroring feature.
- In case of failure / disaster, automatically failover the application to backup site.

✓ Features

- Synchronous / Asynchronous mirroring
- Supporting single heartbeat connection
- Supporting failover across WAN
- Data in the shared storage can be also mirrored to backup site





Combination of "LAN Cluster" and "WAN Cluster"

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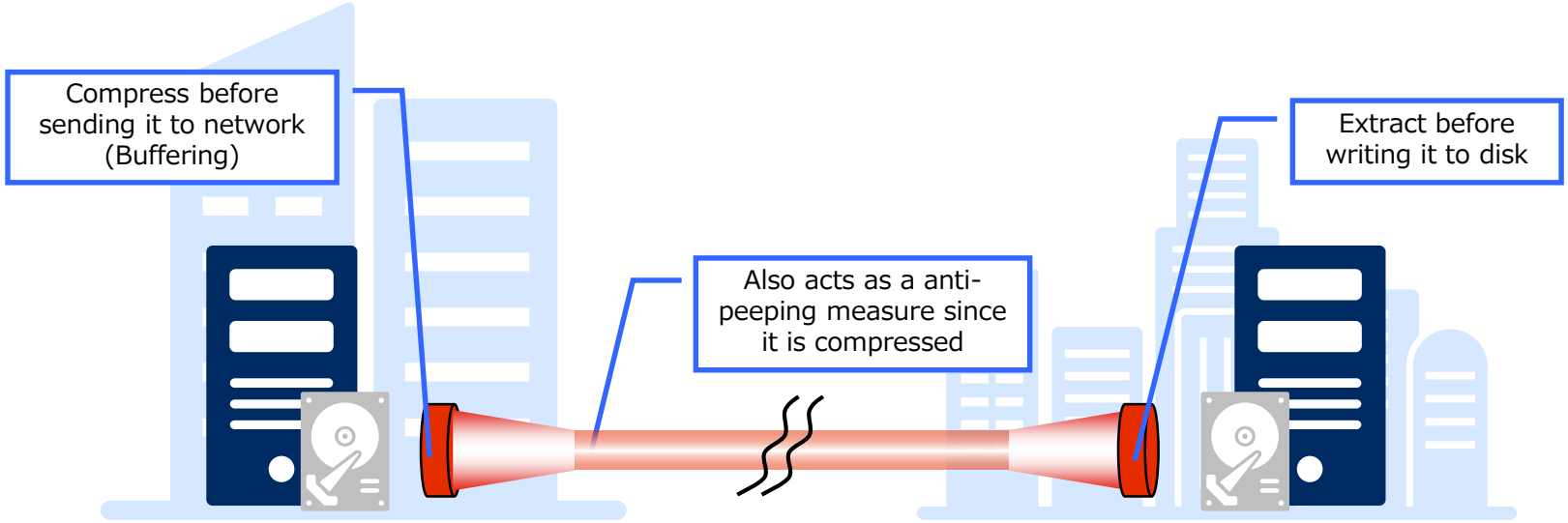
Compression of Mirrored Data

Efficient data transfer by compressing the data to be mirrored



Average 50% reduction in data size as compared to the previous version
(Results differ depending on file type)

* This feature is only valid in asynchronous mirroring mode.

Convenient at the time of using narrow network for remote clustering!

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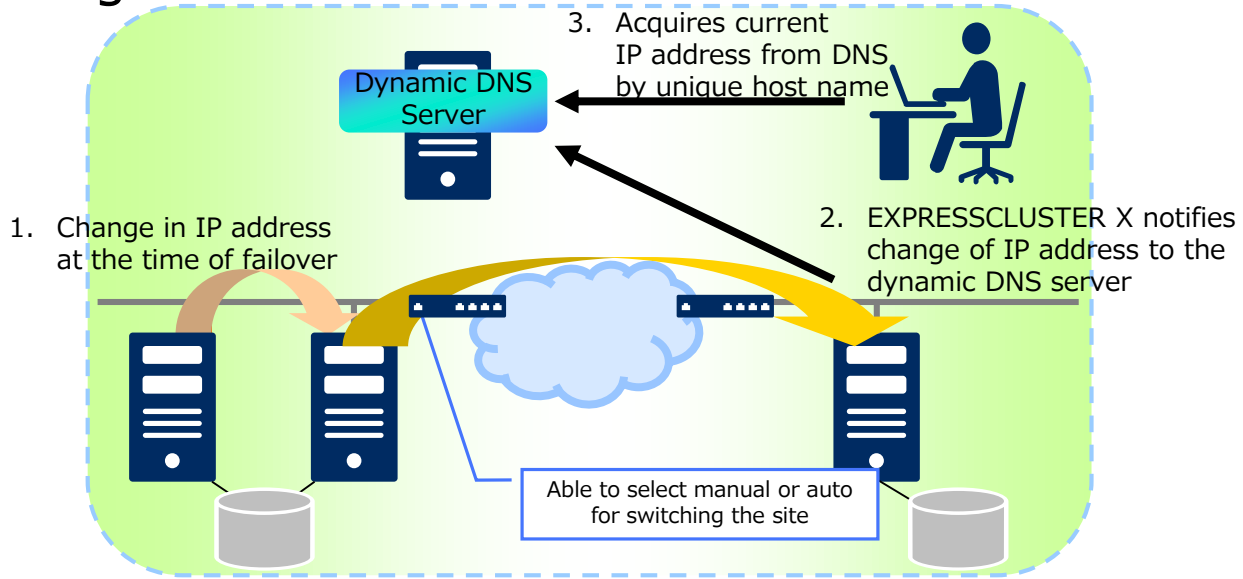
Other Features for WAN Clustering

More simple / convenient operations for WAN clustering!

- Dynamic DNS function
- Manual / Automatic select enabled in case of site failover in hybrid configuration



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- **Virtualization Supported**
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EXPRESSCLUSTER HA Solutions On VMware

EXPRESSCLUSTER is also compatible with VMware HA solutions

Scenario1: vMotion + EXPRESSCLUSTER X

✓**vMotion :** VM migration at the time of planned maintenance
>>> Minimize downtime caused by planned maintenance

✓**EXPRESSCLUSTER :** Automatic failover in case of VM / application failure
>>> Minimize downtime caused by unexpected failure

Scenario2: VMware HA + EXPRESSCLUSTER X

- ✓ **VMware HA :** Automatic failover in case of EC standby server fails.
  >>> Ensure HA configuration of EXPRESSCLUSTER X is always available.
- ✓ **EXPRESSCLUSTER :** Automatic failover in case of VM / application failure
  >>> Ensure maximum uptime for business critical applications

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Other Functions / Features

- Supported Configuration / Failover Scenario
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- Disaster Recovery Capabilities
- Virtualization Supported
- **Usability / Operability**
- System Requirements

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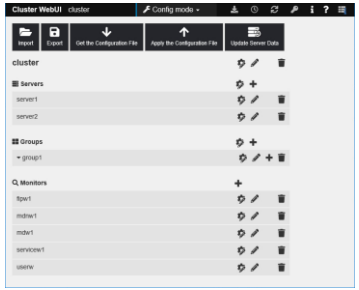
Easy configuration by applying configuration file

Configuration file enables to configure clustering system very simply

Cluster WebUI Config mode
GUI tool for building cluster configuration



Configuration File
Cluster.conf

- Cluster configuration can be extracted to configuration file which can be applied to another cluster

Customer Benefit

Scenario	Benefit
Server Replacement	In case of replacement of old server with new server, the same cluster configuration can be easily configured by simply applying the configuration file.
Deployment of same configuration to multiple sites	In case of deploying clusters with similar configuration to multiple site, only first cluster should be configured and other can be configured by just applying the configuration file. Time required for implementation will be significantly reduced.
Trouble Shooting	By using configuration file, support team can easily reproduce the cluster for investigation purpose.

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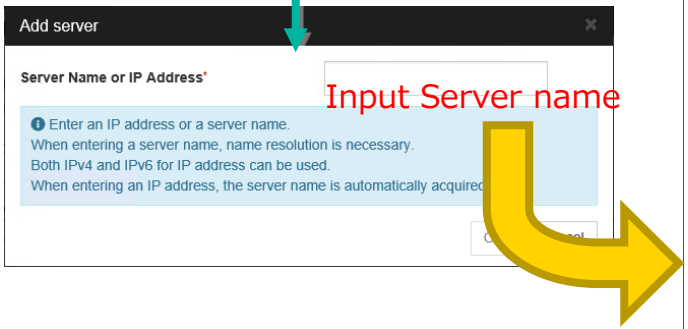
Intuitive Cluster Generation GUI

User-friendly GUI for cluster configuration to prevent setting mistakes

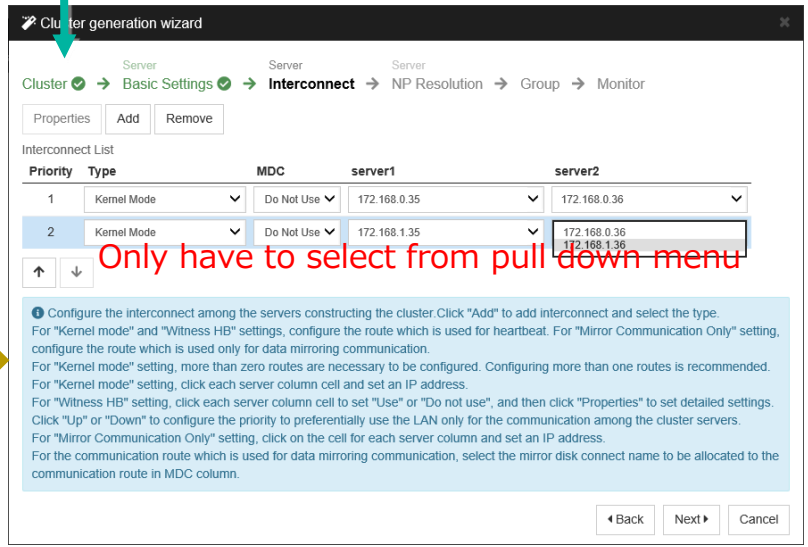
Point 2

IP address and device name are automatically acquired just by entering server name and it prevents committing mistakes!



Point 1

Steps of the current settings can be understood in a glance!



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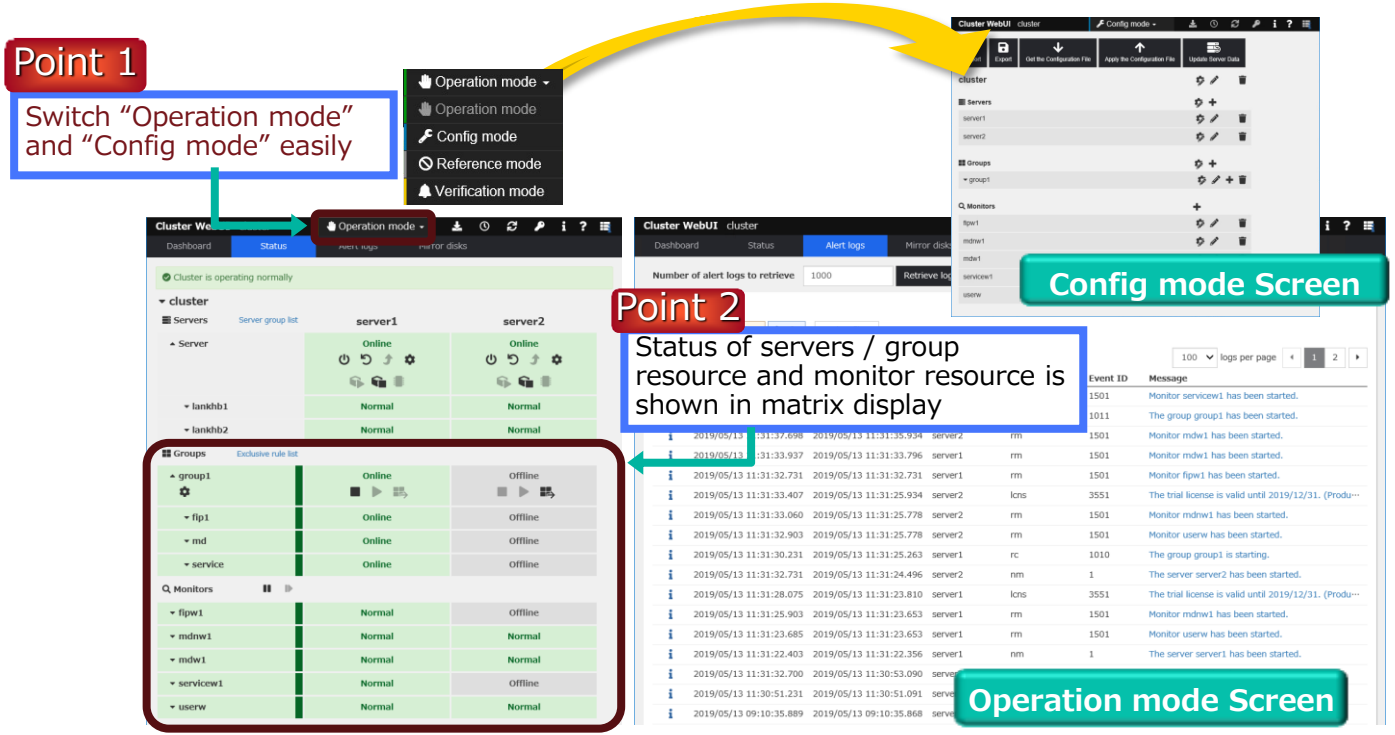
User Friendly GUI

User-friendly / Convenient management console “Cluster WebUI” offers higher operability for system administrators



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Monitoring Windows and Linux system with integrated viewer

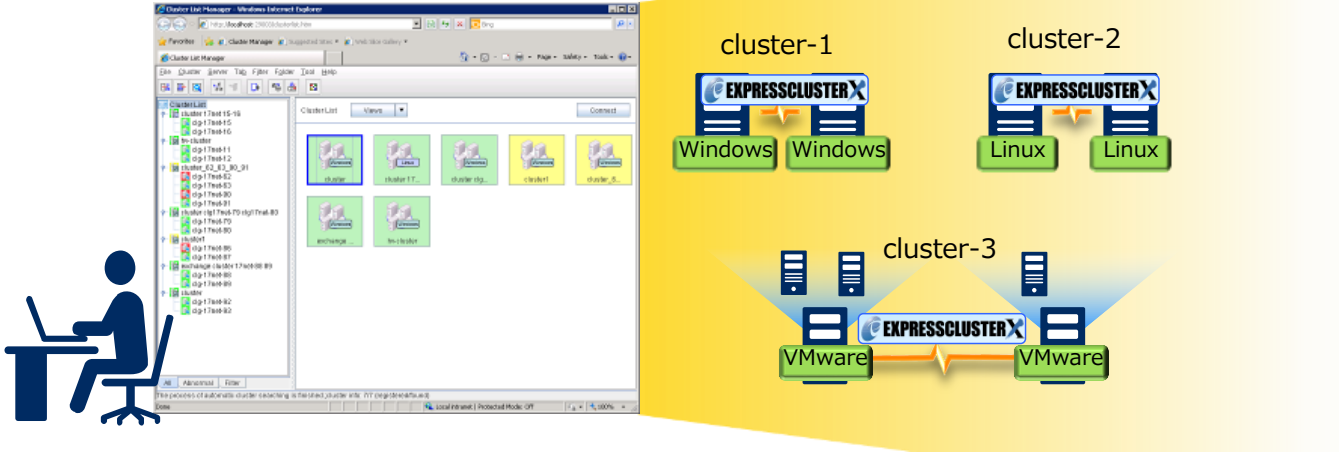
Enables to monitor Windows/Linux cluster system in Integrated WebManager

Features of Integrated WebManager

- Displays all cluster systems in a single console as well as its status
- Provides quick access to WebManager of each cluster

Customer Benefits

- No need to monitor clusters with multiple screens, and increases manageability
- Enables system administrator to realize status change of cluster immediately



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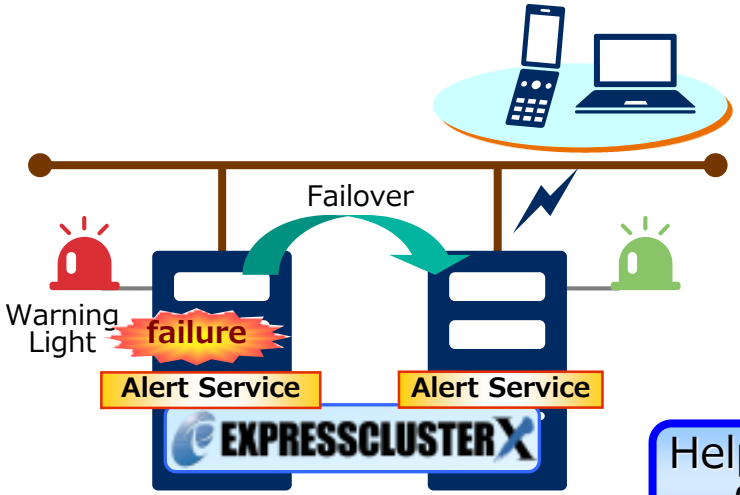
EXPRESSCLUSTER X Alert Function

In order to notify any event occurred on cluster system, EXPRESSCLUSTER X sends alert by email or warning light (*)

(*) Offered as optional add-on

For system administrators, knowing that the failure has occurred is also important for maintaining the HA configuration.



Alert service allows administrators to :

- receive information about failures while not physically located in the same place as the management PC.
- receive e-mail messages on your mobile phone.
- visually be alerted of failures by warning light.

Helps system administrator to be always aware of the event occurred on the cluster system

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Other Functions / Features

- Supported Configuration / Failover Scenario
- Monitoring Capabilities
- Prevention of Split-Brain
- Disaster Recovery Capabilities
- Virtualization Supported
- Usability / Operability
- **System Requirements**

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EXPRESSCLUSTER X System Requirements

	Windows	Linux
Hardware	x86_64	x86_64 server IBM POWER server(Replicator, Replicator DR, Agents except Database Agent are not supported) IBM POWER LE server(Replicator, Replicator DR and Agents are not supported)
Operating System	Windows Server, version 2004 Windows Server, version 1909 Windows Server, version 1903 Windows Server 2019 Windows Server, version 1809 Windows Server, version 1803 Windows Server, version 1709 Windows Server 2016 Windows Server 2012 R2 Windows Server 2012	Red Hat Enterprise Linux 8.2～8.1 Red Hat Enterprise Linux 7.9～7.3/6.10～6.8 Red Hat Enterprise Linux 7.2*2 MIRACLE LINUX 8 Asianux Inside Asianux Server7 （SP3～SP1） Asianux Server4 (SP7～SP6) Novell SUSE LINUX Enterprise Server 15(SP2,SP1) Novell SUSE LINUX Enterprise Server 12(SP5,SP4,SP2,SP1) Novell SUSE LINUX Enterprise Server 11(SP4～SP3) Oracle Linux 7.5/6.6 Oracle Linux 7.7 UEK5/7.3 UEK4 Ubuntu 20.04.1 LTS/18.04.3LTS/16.04.3 LTS/14.04 LTS Amazon Linux 2
Memory	**<x86_64>** User Mode: 256MB + Kernel Mode: 32MB + 4MB(*) x (number of mirror disk resource + number of hybrid disk resource) (*)A single mirror/hybrid disk resource needs 4 MB RAM. When changing to asynchronous method, changing the queue size or changing the difference bitmap size, it is required to add more memory. Memory size increases as disk load increases because memory is used corresponding to mirror disk I/O.	**<x86_64>** User Mode: 200MB + Kernel Mode: - When the synchronization mode is used: 1MB + (number of request queues x I/O size) + (2MB + Difference Bitmap Size x number of mirror disk resources and hybrid disk resources) - When the asynchronous mode is used: 1MB + (number of request queues x I/O size) + (3MB + (number of asynchronous queues x I/O size) + (I/O size / 4KB x 8B + 0.5KB) x (max size of history file / I/O size + number of asynchronous queues) + (Difference Bitmap Size)) x number of mirror disk resources and hybrid disk resources - When the kernel mode LAN heartbeat driver is used:8MB - When the keepalive driver is used:8MB **<IBM POWER/IBM POWER LE>** User Mode: 200MB +
Hard Disk	**<x86_64>** Right after installation:100MB During operation:5.0GB	**<x86_64>** Right after installation:300MB During operation:5.0GB

*1: The supported OS for Linux may be available by applying the update of EXPRESSCLUSTER. Please check our website for the latest information.
*2: To use supported kernels, Extended Update Support (EUS) of Red Hat Enterprise Linux or Advanced Mission Critical Update Support (AUS) is needed.

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4. Successful Case Studies

United Cooperative Assurance - Disaster Recovery -

Saudi Arabia

UCA is a one of the leading insurance company in Saudi Arabia where EXPRESSCLUSTER greatly contributed to the business continuity with its sophisticated HA&DR features when the flood attacked in Jeddah. UCA was the only insurance company that achieved successful business continuity while other companies faced critical business disruption.

المتحدة للتأمين التعاوني
United Cooperative Assurance
UCA

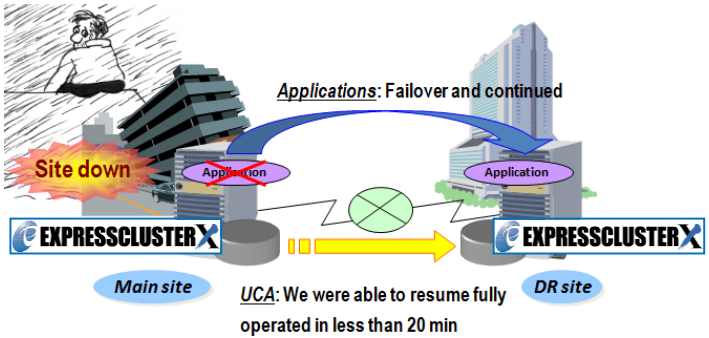
NAJTECH

* NEC technology partner

Jeddah Flood

"It was really wise decision we have taken to select NEC as technology partner. After what we have seen what happened to others duding the flood, and the fast and simple procedures we follow to recover the operation, we believe that NEC and NajTech are the best technology partners.

Mr. Labib Assah,
UCA IT Director



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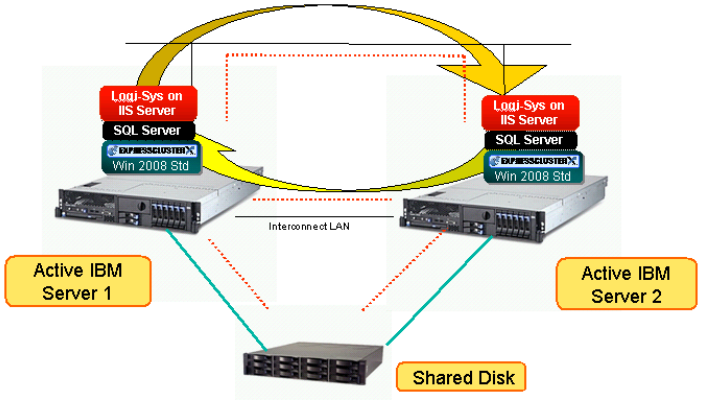
Application : Logi-Sys by Softlink (Application Vendor Partner)

Benefits :

- High availability solution with capability of scaling up to DR configuration
- Automatic failover within 2 minutes
- Protection against planned & unplanned downtime



"We are very pleased with the partnership relationship with NEC which has exceeded our expectations and delivered innovative technology to enhance our IT infrastructure experience. NEC India has always been keen and eager to support our requirements."

Mr.Vijay Mehta
Managing Director / AV Global India.

Complete Story : http://www.nec.com/global/cases/avglobal/

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A large federal government procurement agency
- High Availability Solution For Physical Security Application -

USA

Realized high available disaster recovery solution by configuring remote clustering with EXPRESSCLUSTER and FT server for gate authorization system of federal agency.

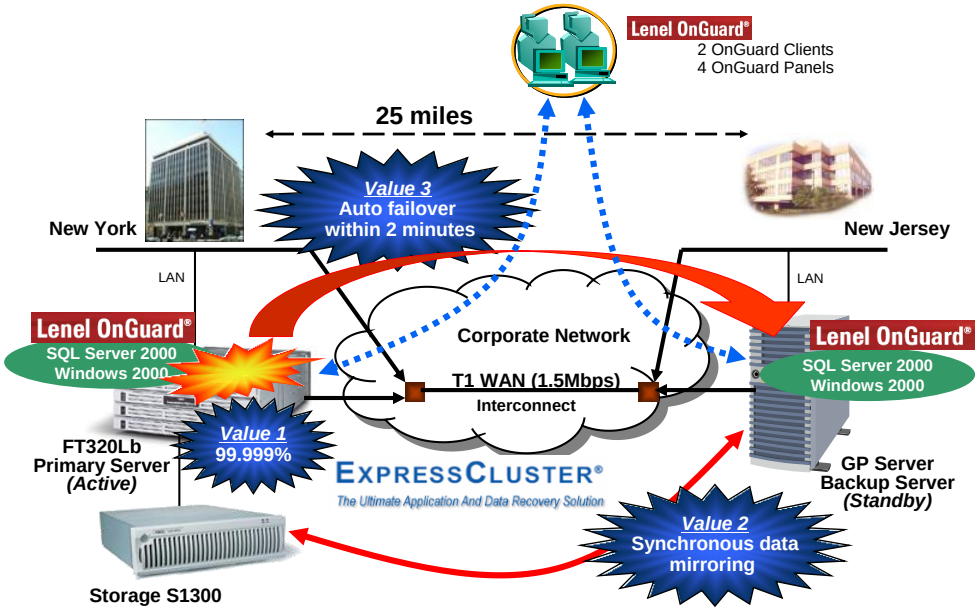
Objective of Introduction

For gate authorization system, solution to improve business continuity on back-up site was required just in case main site goes down due to disaster.

Benefit / System Configuration

Configured disaster recovery solution by **EXPRESCLUSTER**, which enables to continue business with minimum downtime and synchronous data protection, even in case disaster occurred and main site system goes down.

In addition, realized higher availability by using FT server for main site server.



<Overview of System Configuration>

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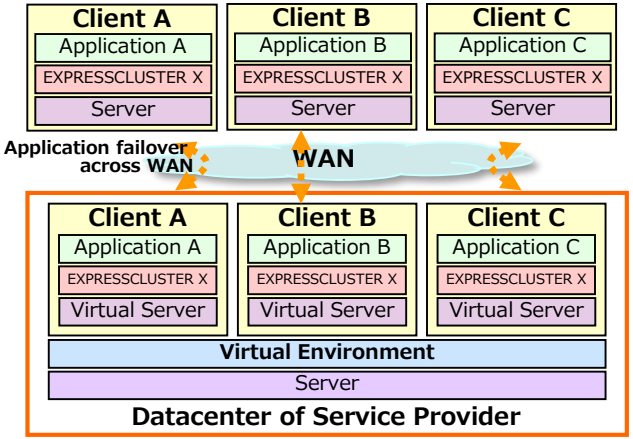
Toggle Networks
- High Availability Platform For Disaster Recovery Service -

Canada

Business Model

Service Provider can provide DR site and lines for the customer



Benefit For Customer;

- Low cost DR solution to protect critical application and data.
- Save investment of human resources to manage back-up site.

Benefit For Service Provider;

- Save investment by consolidating back-up servers on virtual environment.
- Value add solution for existing datacenter service business.

Case Study

EXPRESSCLUSTER X was selected as the foundation of business continuity service ffered by Toggle Networks, from numbers of common products.

Press Release: *(http://www.necam.com/press/read.cfm?Press_ID=2c1a9e79-8a59-409a-bb5c-462ccc5eec49)*

Requirement was the product which;

- based on an open platform
- delivers synchronous, WAN-level protection
- offers geo-distributed hosting capability for site-level business continuity capabilities
- leverages industry-proven hosting infrastructures
- provides an affordable, cost-effective, and turnkey solution

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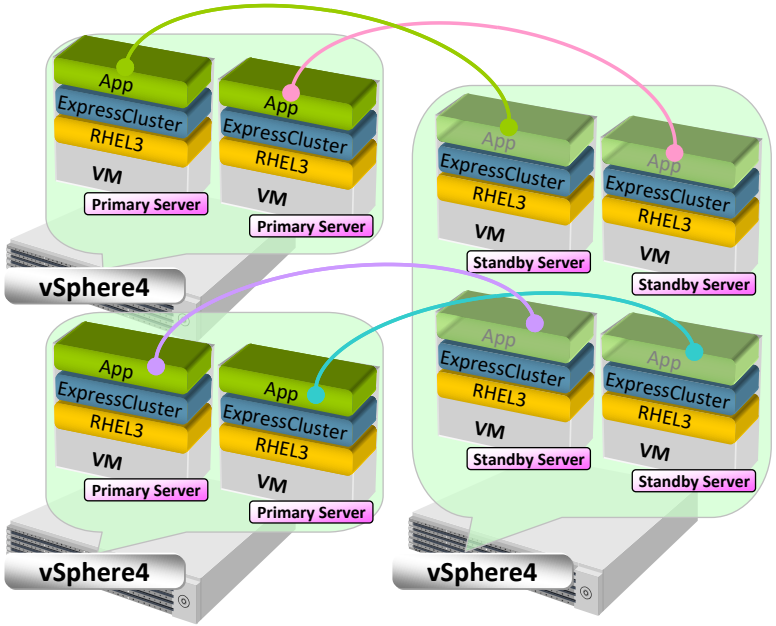
Major Securities Firm
- High Availability For Applications On Virtual Machines -

Japan

- ✓ Migration to virtual environment due to support expiration of servers
- ✓ Adopted EXPRESSCLUSTER as VMware HA cannot recover failures occurred inside the virtual machine
- ✓ Availability for 400 servers of Oracle and WebSphere used for the securities trading system has been ensured by EXPRESSCLUSTER.



Before system migration …

- ✓ **Data mirroring cluster for each 2 servers.**
  - ➢ **RHEL3, Oracle, WebSphere**
  - ➢ **EXPRESSCLUSTER LE Ver3.x**
- ✓ **Total 200 sets of cluster (400 servers)**

Migration to virtual environment

After migration …

- ✓ **Shared disk clustering for 2 servers**
  - ➢ **RHEL3, Oracle, WebSphere**
  - ➢ **EXPRESSCLUSTER LE Ver3.x**
- ✓ **8 virtual machines on 3 physical servers**
  - ➢ **Merged standby VM to single physical server**

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Dream Island Department Store Ltd.

- High Availability For Store POS System -

China

Country : Nanning city, Guangxi province, China

Industry : Large-scale retail store

Product : EXPRESSCLUSTER X

Challenges : To realize business continuity for cash register operations in each store.Each server failure took more than three hours to recover, resulting in huge losses to the tune of 1M RM loss per hour.

Solutions : Improve availability and reliability of the POS systems with EC.

- Data mirroring type cluster
  - Application servers in the headquarter office
  - POS system servers in the branch offices
- Shared disk type cluster
  - POS system servers in the headquarter office

Customer voice :

"Our POS system has been stable since EXPRESSCLUSTER X installation. For example, a failure of database in the POS system occurred on the day of the 2nd anniversary of one of our stores. However, with EXPRESSCLUSTER X, we could failover the system to the standby server within 2 minutes, continue our operations and prevent huge business loss."

Fan Jingzhao
IT Division Manager,
Dream Island Department Store

Complete story >> https://www.nec.com/en/global/prod/expresscluster/en/case_study/index.html

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CG36
- High Availability For Database & Print Server -

France

Customer issue :

High availability in a heterogeneous environment to protect against service interruption in case of server failure or maintenance

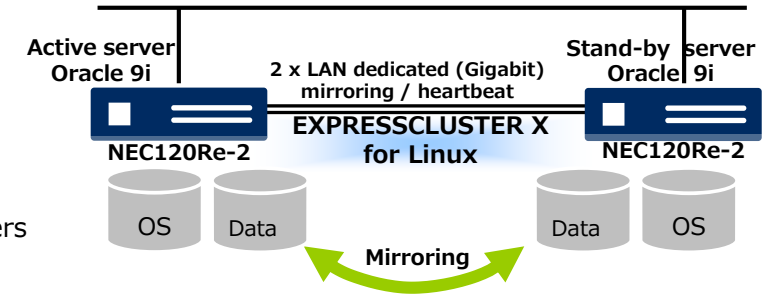
Customer and his needs :

CG36 : Conseil Général de l'Indre (Regional council)

- Very frequent database queries, constant use of print service
- Heterogeneous OS : Linux and Microsoft
- Just in time work process, rapid service delivery required by CG36's partners

Goal :

- Ensure a quasi permanent availability of database and printing services



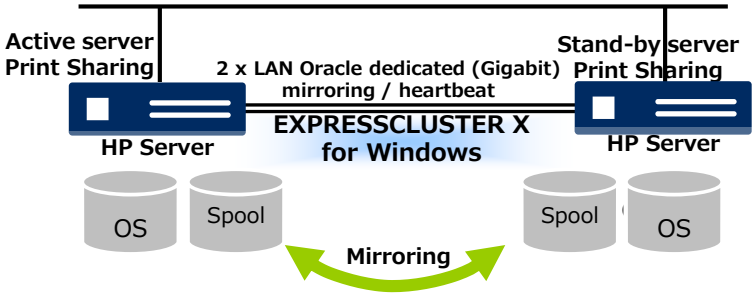
EXPRESSCLUSTER X LE : Clustering + Mirroring

Clusters LINUX (Red Hat 2.1) :

- Clustering of Oracle database service. Automatic fail-over to a standby server in case of crash or maintenance of the active server
- Database mirroring

Cluster WINDOWS :

- Clustering of the print server. Automatic fail-over to a standby server in case of crash or maintenance of the active server
- Mirroring of spool queue



Professional Services:

- Delivery, installation, configuration, training performed on site

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Other Case Studies

- More successful case studies available at https://www.nec.com/en/global/prod/expresscluster/en/case_study/index.html

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Thank You

EXPRESSCLUSTER X

An Integrated High Availability and Disaster Recovery Solution

For more product information & request for trial license,
visit >> https://www.nec.com/en/global/prod/expresscluster/

For more information, feel free to contact us - info@expresscluster.jp.nec.com

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