Running Linux-HA on an IBM System z
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Agenda

- High Availability
- Challenges
- Linux-HA
- Examples
Computer Cluster

A computer cluster consists of a set of loosely connected computers that work together so that in many respects they can be viewed as a single system.

(wikipedia: Computer Cluster)

High Availability Cluster

- When one node fails another node is taking over IP address, services, etc.
- The key of High Availability is avoiding single points of failure
- High Availability adds costs because you need redundant resources
High Availability

Amazon
- 2005 - 3 hours offline first European sites spreading to amazon.com
- 2010 - 30 min offline for Europe during Christmas time
- protecting mission-critical applications
- 24x7 availability
- keep interruptions as short as possible
High Availability

- It is like a Magician’s (Illusionist’s) trick
  - When it goes well, the hand is faster than the eye
  - When it goes not-so-well, it can be reasonably visible
- Adds one 9 to the availability

<table>
<thead>
<tr>
<th>Availability</th>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>99.9%</td>
<td>9 h</td>
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<tr>
<td>99.99%</td>
<td>53 min</td>
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<tr>
<td>99.999%</td>
<td>5 min</td>
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<tr>
<td>99.9999%</td>
<td>32 sec</td>
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<tr>
<td>99.99999%</td>
<td>3 sec</td>
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</table>

System z Application Availability
High Availability

99.9%  Washington DC  250 miles
High Availability

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<th>Availability</th>
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<tr>
<td>99.9%</td>
<td>Washington DC</td>
<td>250 miles</td>
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</tr>
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</tr>
<tr>
<td>99.9999%</td>
<td>Moon</td>
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High Availability

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System z Application Availability

- It’s like respawn on a cluster-wide scale
  - Like init on steroids
- HA Clustering is designed to recover from single faults
High Availability

The Three R’s of High Availability
- Redundancy
- Redundancy
- Redundancy

This might sound redundant, but that’s probably ok

Most Single Points of Failure are managed by redundancy

HA Clustering is a technique to provide and manage redundancy
HA vs DR

- **High Availability**
  - Fast and reliable inter-node communication
  - Failover is cheap
  - Failover needs to be fast - measured in seconds

- **Disaster Recovery**
  - No special requirements for inter-node communication
  - Failover is expensive - sometimes not automatic
  - Automatic failback may be impossible
  - Failover times often longer - can be hours
Agenda

- High Availability
- Challenges
- Linux-HA
- Examples
Challenges

- **Early detection**
  - To keep the offline time as short as possible a failure has to be detected fast
  - Risk of false positive interpretation and unnecessary failover
  - Keep offline time as short as possible (mean-time-to-repair MTTR)
  - Reliable detection by reliable internal communication

- **Split-Brain**
- **Quorum**
- **Fencing**
- **Data sharing**
Challenges

- Early detection
- Split-Brain
  - When the connection between the nodes fails, all nodes can still be active but detect the other as failing
  - The status of an unreachable node is unknown
  - Especially in geographical displaced systems
- Quorum
- Fencing
- Data sharing
Challenges

- Early detection
- Split-Brain
- Quorum
  - Algorithms to decide which part of the cluster is active
  - A remote quorum server can decide more reliably
  - Quorum server is in client perspective
- Fencing
- Data sharing
Challenges

- Early detection
- Split-Brain
- Quorum
- Fencing
  - Keep a node that was detected as failed from working to prevent damage
  - self-fencing
  - STONITH
- Data sharing
Challenges

- Early detection
- Split-Brain
- Quorum
- Fencing
- Data sharing
  - Mirror data e.g. DRBD
  - Synchronize database
Agenda

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High Availability Solutions

- Tivoli System Automation
- Linux-HA
- HACMP for AIX
Tivoli System Automation

- Automation Manager
  - Starting
  - Stopping
  - Restarting
  - Failover

- Supports
  - Quorum
  - Dead-man switch
  - disk and network tiebreaker

- Advantages
  - Policy-based and Goal-driven automation
  - Integrated in Tivoli Systems Management Portfolio
Tivoli System Automation

- Apache
- HTTP WebServer
- IBM Tivoli Directory Server
- inetd
- MaxDB SAP 7.5
- NFS Server
- Samba
- Sendmail
- TSM
- TWS 8.3
- WAS 6.0
- WebSphere MQ 7
- DP for my SAP 5.3
- TSAM - Tivoli Service Automation Manager
Tivoli System Automation

samadmin tool

- Domain Management
- Resource and Group Management
- Equivalency Management
- Relationship Management
- TieBreaker Management
- Cluster Overview
RedBooks

End-to-end Automation with IBM Tivoli System Automation for Multiplatforms

Achieve proactive high availability of heterogeneous environments
Covers multiplatforms, Linux, AIX, and z/OS
Includes real world case study scenarios

Edson Manoel
Desmond Krishna
Randy R. Watson
Creighton Hicks

ibm.com/redbooks
Linux-HA

Components
- heartbeat
  - Messaging between nodes to make sure they are available and take action if not
- cluster-glue
  - Everything that is not messaging layer and not resource manager
- resource-agents
  - Scripts that start/stop clustered services
  - Templates and scripts for many applications
- pacemaker
  - cluster resource manager (CRM)
Linux-HA

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Optional
- STONITH
  - Shoot The Other Node In The Head
  - Fence a node to ensure unique access to data and reliably manage shared storage
Heartbeat connection between nodes
- HiperSockets
- VLAN
- OSA Ethernet

Heartbeat timeout determines MTTR

Integrated IP address takeover

Integrated filesystem support
Applications

Examples

- IP address
- Webserver
- Firewall
- DNS
- DB2

- Complex scenarios can be managed with constraints and dependencies
Advantages

- Strongly authenticated communication
- Highly extensible
- Connectivity monitoring using voting protocol
- Subsecond failure detection
- SAF data checkpoint API
  - store application state to disk
    used to restore state in failover
  - not working if state changes too fast for disk
  - SAF provides an API to replicate data
    without storing to disk
- Standard init scripts as resource agents
- API for monitoring and control
Limitations

- Linux-HA can not provide 100% availability
- Applications which can not deal with the timeout need to be cluster aware
  - i.e. store the state to disk for restore
  - or use SAF data checkpoint API which provides a replication API for faster change rates
- Short outage due to failover detection
- TCP connection is broken
Linux-HA on System z

- seems like the system is redundant and highly available
  but
  
- Hardware is redundant and highly available
Linux-HA on System z

- Improve availability of applications
- Shared Resources in z/VM
  - Standby nodes can use overcommitment of memory and PUs
- z/VM Guests as test systems
- Use HiperSockets for reliable cluster communication
- Take care about scheduling issues
- Time to page in inactive guest
Linux-HA on System z

- Packages are available as extension for SUSE
  - SLES 10
  - SLES 11

- Packages can be compiled for RedHat
  - RHEL 4
  - RHEL 5
Linux-HA Tools

- crm
- crm_mon
- crm_verify
- crm_simulate
- crm_resource
- crm_gui
Agenda

- High Availability
- Challenges
- Linux-HA
- Examples
2 Node - Active-Passive

Customers
2 Node - Active-Passive
2 Node - Active-Passive

- Higher costs
- In good case
  - No idle resources

- In case of failure
  - Constant performance
  - Application topology remains unchanged
2 Node - Active-Active

Customers
2 Node - Active-Active
2 Node - Active-Active

- Lower costs
- In good case
  - No idle resources

- In case of failure
  - Degradation of performance
  - Different application topology
3 Nodes with Quorum
Quorum Server
Quorum Server

- Costs for Quorum server
- Monitoring from customer/service perspective

In case of failure
- No split brain situation
- Application topology remains unchanged
Summary

- Linux-HA can improve application availability
- Resource Agents for many applications
- Leverage z/VM resource sharing
  - Redundant resources
  - z/VM guests as test systems
- Systems have to be carefully designed and thoroughly tested
Links

- Linux-HA Wiki - Talks and Papers
  http://linux-ha.org/wiki/Talks_and_Papers

- IBM Redbooks
  http://www.redbooks.ibm.com
Achieving High Availability on Linux for System z with Linux-HA Release 2

Understand Linux-HA architecture, concepts, and terminology
Learn what is new in Linux-HA Release 2
Experience a Linux-HA implementation

Lydia Parziale
Antonio Dias
Livio Teixeira Filho
Dulce Smith
Jin VanSlee
Mark Ver

ibm.com/redbooks
Thank You!

Alan Robertson
for using his Linux-HA Tutorial
Questions?

Dr. Stefan Reimbold

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