Running Linux-HA on a IBM System z

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Agenda

- High Availability
- Challenges
- Linux-HA
- Examples
What is it?

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
High availability is a system design approach and associated service implementation that ensures a prearranged level of operational performance will be met during a contractual measurement period.

(wikipedia: High Availability)

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 cost because you need redundant resources.
High Availability

- Amazon
  - 2005 – 3 hours offline, first the European sites, then spreading to amazon.com
  - 2010 – 30 minutes 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

- HA Clustering is designed to recover from single faults
  - It is like re-spawn on a cluster-wide scale
  - Like 'init' on steroids

- Add on 9 to the availability
  99.9% 9h
  99.99% 53min
  99.999% 5min System z Application Availability
  99.9999% 32sec
  99.99999% 3sec
High Availability

- Compared to distances
  - 99.9% Moon: 250,000 miles
High Availability

- Compared to distances
  - 99.9% Moon 250000 miles
  - 99.99% Around the world 25000 miles
High Availability

- Compared to distances
  - 99.9% Moon 250000 miles
  - 99.99% Around the world 25000 miles
  - 99.999% New York City 2500 miles
High Availability

- Compared to distances

  99.9%      Moon        250000 miles
  99.99%     Around the world  25000 miles
  99.999%    New York City    2500 miles
  99.9999%   Las Vegas      250 miles
High Availability

- Compared to distances

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Location</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.9%</td>
<td>Moon</td>
<td>250000 miles</td>
</tr>
<tr>
<td>99.99%</td>
<td>Around the world</td>
<td>25000 miles</td>
</tr>
<tr>
<td>99.999%</td>
<td>New York City</td>
<td>2500 miles</td>
</tr>
<tr>
<td>99.9999%</td>
<td>Las Vegas</td>
<td>250 miles</td>
</tr>
<tr>
<td>99.99999%</td>
<td>LA Airport</td>
<td>25 miles</td>
</tr>
</tbody>
</table>
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
Agenda

- High Availability
- Challenges
- Linux-HA
- Examples
HA 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 fail-over
  - Keep offline time as short as possible (mean-time-to-repair MTTR)
  - Reliable detection by reliable internal communication
- Split-Brain
- Quorum
- Fencing
- Data Sharing
HA challenges

- Early detection
- Split-Brain
  - When the connection between 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
HA 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
HA 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
HA challenges

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

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

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

- Automation Manager
  - Starting
  - Stopping
  - Restarting
  - Fail-over

- 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
Tivoli System Automation RedBook

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

- 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 components

- 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
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    - Scripts that start/stop clustered services
    - Templates and scripts for many applications
  - pacemaker
    - cluster resource manager (CRM)
- Optional
  - STONITH
    - Shoot The Other Node In The Head
    - Fence a node to ensure unique access to data and reliably manage shared storage
Linux-HA heartbeat

- Heartbeat connection between nodes
  - HiperSockets
  - VLAN
  - OSA Ethernet
- Heartbeat timeout determines MTTR
- Integrated IP address takeover
- Integrated file system support
Linux-HA applications

- Examples
  - IP address
  - Webserver
  - Firewall
  - DNS
  - DB2
  - Complex scenarios can be managed with constraints and dependencies
Linux-HA advantages

- Strongly authenticated communication
- Highly extensible
- Connectivity monitoring using voting protocol
- Sub-second failure detection
- SAF data checkpoint API
  - store application state to disk used to restore state in fail-over
  - not working if state changes to 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
Linux-HA 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 fail-over detection
- TCP connection is broken
Linux-HA on System z

- System is redundant and highly available already
- Hardware is redundant and highly available
- 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
  - RHEL 6
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
  - One side idle

- 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
3 Nodes with Quorum
3 Nodes with Quorum

- 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
Linux-HA RedBook

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 VanStee
Mark Ver

ibm.com/redbooks
Links

- Linux-HA Wiki – Talks and Papers
  http://linux-ha.org/wiki/Talks_and_Papers
- IBM RedBooks
  http://www.redbooks.ibm.com
Thank You!

- Alan Robertson for using his Linux-HA Tutorial
- Stefan Reimbold for creating this presentation
Questions?

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Please Evaluate