Integrating x86 Applications into Linux on System z Environments

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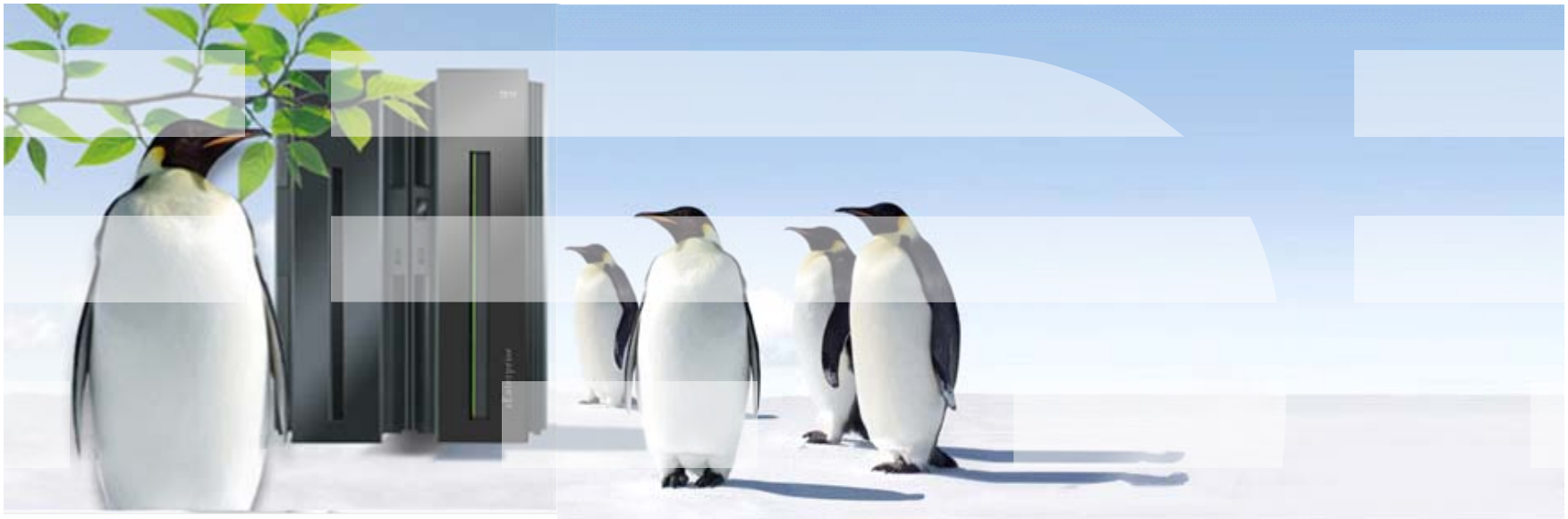

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The Vision

- **Run any application in Linux on System z**
  - particularly including x86 applications
  - scope: zEnterprise
- **Blade virtual servers considered “co-processors” to Linux on System z**
- **Linux on System z manages application lifecycle**

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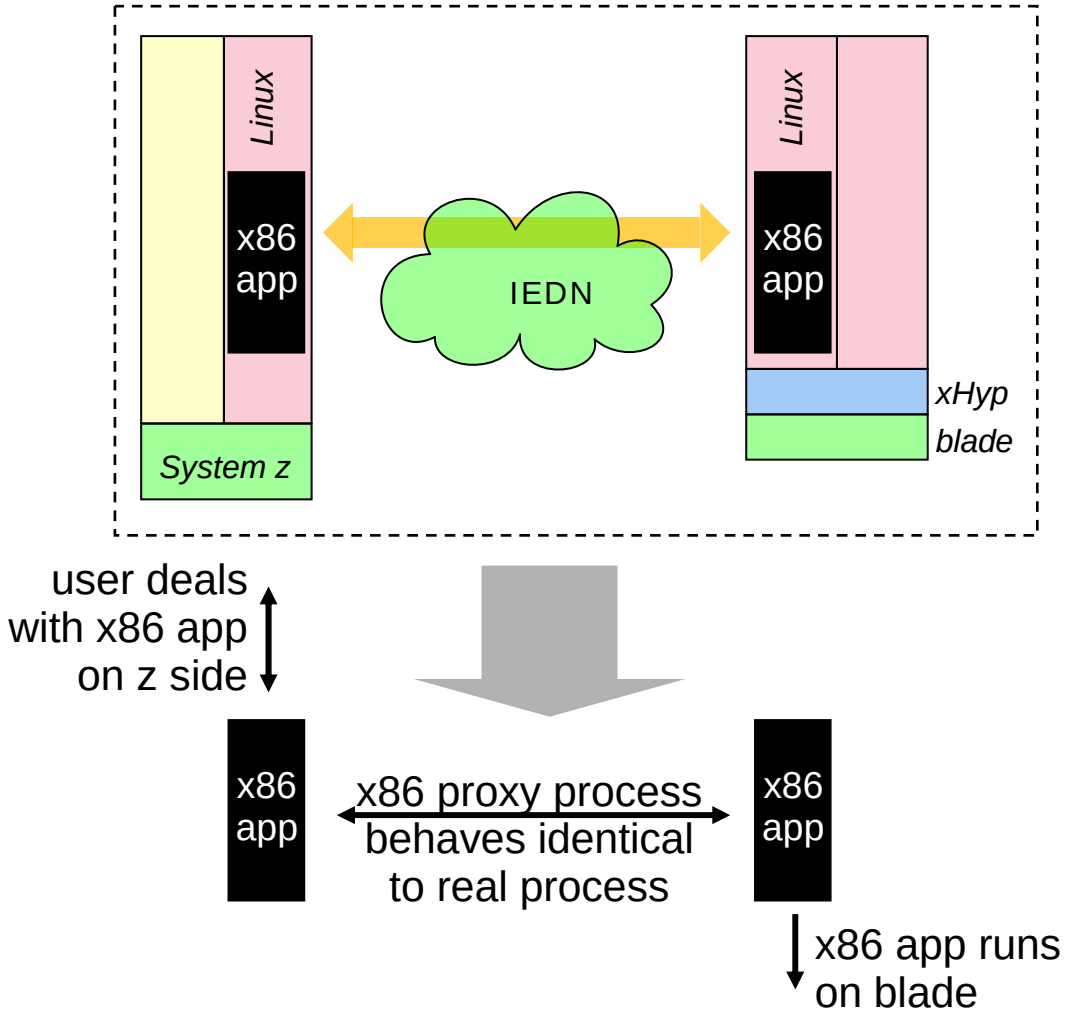
Application Integration: Implementation Details

- **Run x86 Linux applications from Linux on System z**
  - lifecycle of x86 applications and resources are entirely managed from Linux on System z
  - x86 applications and resources are represented through proxy entities on Linux on System z
    - proxy processes on System z do not use (lots of) cycles or memory
    - proxy resources allow for managing x86 system resources
  - retains certified x86 distribution environments (no kernel changes required)



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Application Integration: Aspects Covered

- x86 Blade Virtual Server Attachment
- File System Integration
- Network Integration
- Userids, Authorization, Authentication
- Software Package Management
- Execution of x86 Binaries
- Process Management
- Logging
- Time Synchronization

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Customer Segmentation

Providing significant value for customers ...	Providing no specific value for customers ...
... wanting to augment their exising business solution on System z with x86 components	... managing dozens of images or more from zManager, mostly on a virtual server granularity
... centering everything around their existing System z procedures and solution	... leveraging their x86 procedures and personnell for managing their zBX x86 nodes

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Value Proposition

- **Embrace fit for purpose paradigm: compose your business solution based on your needs**
  - combine architectural strengths and properties of System z and x86
  - employ x86 application ecosystem
- **Reduce management complexity of hybrid business solutions**
  - x86 blades simply feel like additional processor and memory capacity: hybrid made easy
  - extend Unified Resource Manager philosophy to the Operating System level
- **Leverage operations and procedures existing in Linux on System z for distributed components of solutions**
  - unified management for System z and x86 components of solution

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Outline of 4Q2011 Technology Study

- **Technology Study provided on developerWorks**
  - binary only
  - targetting SLES 11 SP1 and RHEL 6.1
  - free of charge
  - Linux on System z—Linux on x86 only
  - uses IEDN for z—x86 communication
- **Service on best-can-do basis only**
  - Q&A via functional email ID
  - production support to be discussed based on customer demand
- **Direction of future development depends on feedback from the field**

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What Is It?

- **After attaching, blades will feel like additional x86 execution capacity to a Linux on System z image**
  - Install, run and control x86 applications from Linux on System z, as if they were System z binaries
  - Most Linux on System z operations can be extended to attached x86 images
  - Single System appearance for the operator

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Content of 4Q Technology Study (1)

- **Execution of x86 Binaries**
  - transparent execution of x86 applications on a single blade virtual server
    - applies to x86 binaries and scripts residing on x86 file systems
    - results in a proxy process on System z
  - no multi-blade virtual server support yet
- **Process Management**
  - basic functionality complete to run applications
  - proxy behaves like real process for process life cycle (forks, renames, daemons, termination), threads, sessions, open file descriptors (incl. tty support), signals, real and effective uid/gid environment variables (with some adequate mapping), X11
  - resource consumption monitoring
  - no full performance monitoring yet
  - no IPC; no IPC monitoring yet

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Content of 4Q Technology Study (2)

- **Userids, Authorization, Authentication**
  - sharing of users, groups, passwords
    - allows to extend reach of common Linux tools to x86
    - allows for considering x86-based userid changes (e.g. during application installation)
  - no advanced authentication forwarding yet (pam, nsswitch)
- **File System Integration**
  - NFS based integration of full x86 file system – full access to x86 data from System z
  - proc file integration (merged into different path) between System z and x86
  - no symbolic link integration yet
- **Network Integration**
  - IP Masquerading (NAT)
  - no IPv6 support yet

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Content of 4Q Technology Study (3)

- **Time Synchronization**
  - time synchronization of x86 to System z‘s clock (release 0.3-34.1)
- **Logging**
  - centralized log files on System z
- **Software Package Management**
  - full rpm integration via meta-rpms
  - dependencies can be honored or disregarded (user configurable)
  - rpm repository integration possible
  - no offline package management yet

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Content of 4Q Technology Study (4)

- **x86 Blade Virtual Server Attachment**
  - installation, deinstallation of application integration
  - attachment and detachment of blades establishes and cuts all links between System z and x86
- **Documentation**
  - manual describing concept and Technology Study content
  - man pages for all AI commands and specifics available on System z
- **zEnterprise integration**
  - communication through IEDN
  - no zEnterprise API exploitation yet

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Target: Consolidate Heterogeneous Solutions

Scenario:

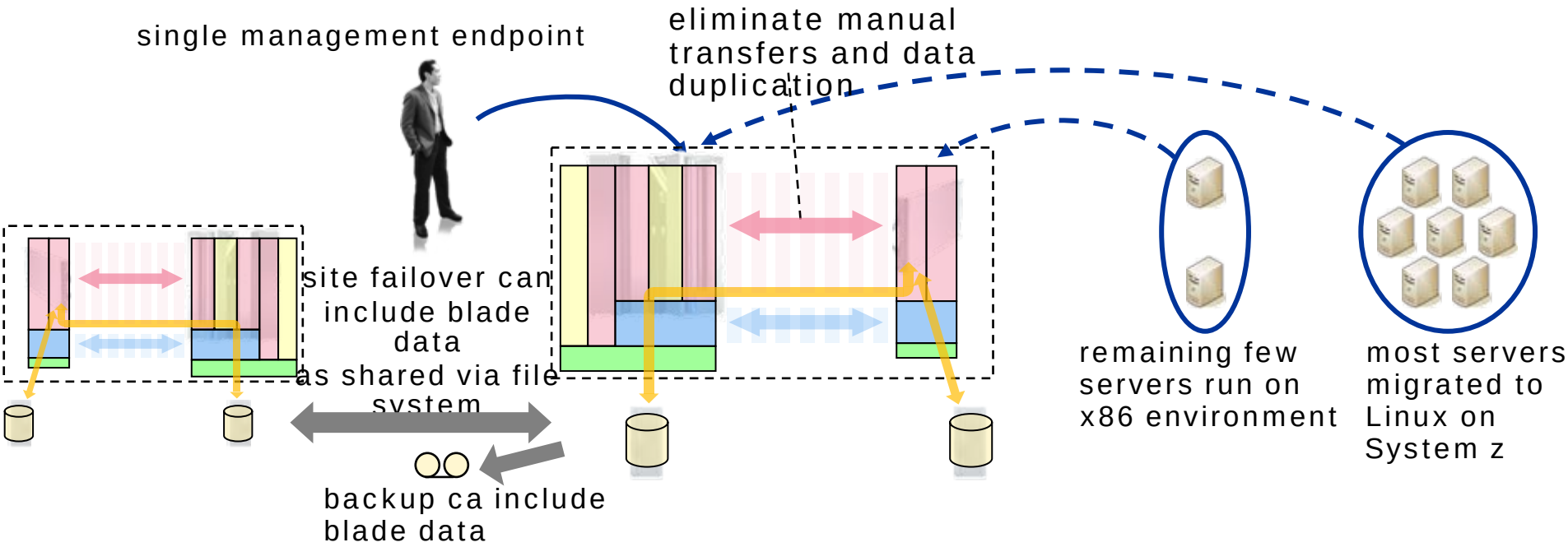
- consolidate all systems to System z, even if
  - applications not available on z
  - applications not running economically on z
- can include blade data in z-managed resiliency (on file basis as shared with z master)
  - data replication and site failover
  - z/OS managed backup/restore

Examples:

- application serving
- data analytics and risk management (commercial HPC)
- x86 legacy applications

Customer value:

- single management endpoint
- improved availability and resiliency for overall solution
- complete consolidation and approach pure System z TCO
- converge data to better comply to regulatory requirements



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Target Scenarios

- Not available on Linux on System z, but relates to back end software on (Linux on) System z
- Customer not willing to use on System z, but relates to back end software on (Linux on) System z: compute intensive
- Customer not willing to use on System z, but relates to back end software on (Linux on) System z: high effort to move to System z

- Brownfield considerations: integration with higher level management products
  - integrated, where Linux on System z can be extended to build on zManager capabilities: *workload and energy management*
  - transparently, where Linux on System z represents x86 workload and is the only managed-to environment: *user and authentication management, automation*
  - explicitly, where management software requires specific agents on all x86 nodes: *monitoring not relying on consolidation* (requiring per-node information)
    - Linux on System z leveraged to deploy agents on x86 nodes

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Steps in Installing a Business Solution

- Server provisioning
  - hardware deployment
  - virtualization management
- OS deployment
  - OS install
  - OS customization: user setup, backup, etc. according to established processes
- Application deployment
  - installation
  - configuration
- Operation
  - hardware and virtual server management
  - monitoring, logfile analysis, automation, ...
  - maintenance of OS and applications

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Scenario with System z plus Distributed

	System z	Distributed
Server provisioning – hardware deployment – virtualization management	on z/VM or SE: create Linux guest or LPAR	deploy hardware create virtual server
OS deployment – OS install – OS customization: user setup, backup, etc. according to established processes	installation (or cloning) of Linux on System z customization of Linux on System z image	installation (or cloning) of Linux on x86 customization of Linux on x86 image
Application deployment – installation – configuration	on Linux on System z image: installation and configuration of System z applications	on Linux on x86 image: installation and configuration of System z applications
Operation – hardware and virtual server management – monitoring, logfile analysis, automation, ... – maintenance of OS and applications	on z/VM or SE: virtualization management on Linux on System z image: operational tasks	on hardware or hypervisor: server and virtualization management on Linux on x86 image: operational tasks

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Scenario with zEnterprise System

	System z	Distributed
Server provisioning – hardware deployment – virtualization management	on Unified Resource Manager: deploy hardware resources and create virtual server	
OS deployment – OS install – OS customization: user setup, backup, etc. according to established processes	installation (or cloning) of Linux on System z and x86 (covered in future releases of zEnterprise with tooling on top)	
	customization of Linux on System z image	customization of Linux on x86 image
Application deployment – installation – configuration	on Linux on System z image: installation and configuration of System z applications	on Linux on x86 image: installation and configuration of System z applications
Operation – hardware and virtual server management – monitoring, logfile analysis, automation, ... – maintenance of OS and applications	on Unified Resource Manager: hardware and virtualization management	
	on z/VM or SE: virtualization management on Linux on System z image: operational tasks	on hardware or hypervisor: server and virtualization management on Linux on x86 image: operational tasks

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Scenario with System zEnterprise and Application Integration

<table>
<tr><th></th><th>System z</th><th>Distributed</th></tr>
<tr><td>Server provisioning
– hardware deployment
– virtualization management</td><td colspan="2">on Unified Resource Manager: deploy hardware resources and create virtual server</td></tr>
<tr><td rowspan="3">OS deployment
– OS install
– OS customization: user setup, backup, etc. according to established processes</td><td colspan="2">installation (or cloning) of Linux on System z and x86 (covered in future releases of zEnterprise with tooling on top)</td></tr>
<tr><td>installation of application integration package</td><td>installation of application integration package</td></tr>
<tr><td colspan="2">customization of converged Linux image</td></tr>
<tr><td>Application deployment
– installation
– configuration</td><td colspan="2">from Linux on System z image: installation and configuration of System z and x86 applications</td></tr>
<tr><td rowspan="2">Operation
– hardware and virtual server management
– monitoring, logfile analysis, automation, ...
– maintenance of OS and applications</td><td colspan="2">on Unified Resource Manager: hardware and virtualization management</td></tr>
<tr><td colspan="2">from Linux on System z image: operational tasks</td></tr>
</table>

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Customer Benefit

- **Reduced Complexity of zEnterprise Hybrid**
  - common operations across the hybrid solution centered around Linux on System z
    - reduced number of application management endpoints
    - allow for full consolidation to Linux on System z even with x86-only applications being part of the solution
    - extending Unified Resource Manager philosophy to the Operating System level
  - x86 blades simply feel like additional processor and memory capacity: hybrid made easy
- **Value through integration of x86 workload into Linux on System z solutions**
  - Linux on System z solutions acquires new capabilities: implement cost efficient solutions with x86 components
  - leverage System z storage capabilities for x86 workload (backup, failover)
  - Linux on x86 and System z data is converged – allows for easier compliance to regulatory requirements due to deduplication
  - leverage Linux on System z capabilities (e.g. user setup, firewalls, TSA, …) for x86 slave systems

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