Red Hat Enterprise Linux for zSeries, S/390:

Extending Linux throughout the Datacenter

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Mike Ferris
Enterprise OS Product Manager
What Does Red Hat Do?

- From an engineering standpoint:
  - Works with the community, partners, and customers
  - Develops/ incorporate new features
  - Integrates open source packages, new features, drivers, bug fixes, & security updates
  - Tests, certifies, productizes, and supports the result

- From a business standpoint:
  - Engineers and sustains the platform
  - Provides services—training, consulting, support
  - But leverages the open source development model
Leading with the Community

- The strength of Linux is based on having a large, vigorous, development community
  - Not overpowered by a single commercial entity
- Code Contribution Analysis:

  ![Code Commits Pie Chart]

  ![Linecount Pie Chart]

Linux kernel BitKeeper tree analysis, May 2004
Development at Red Hat

- Construction of S/W developed with the community
  - Additional development
  - Integration
  - Hardening
  - QA testing
  - Delivery
  - Benchmarking
  - Certifications
- Risk mitigation through long-term maintenance & support
**Red Hat Product Lineage**

- **Red Hat Linux:** Developed to meet the needs of the Open Source movement and early technology adopters
  - 4-6 month release cycle
  - Latest open source technology
  - ABI/APIs may change
  - Limited support
  - End of life - 1/1/04

- **Fedora Project:** Developed to meet the needs of the Open Source movement
  - Rapid release cycle
  - Latest open source technology
  - ABI/APIs may change
  - No support; free download

- **Red Hat Enterprise Linux:** Developed to meet the needs of enterprise/commercial customers
  - 12-18 month release cycle
  - Stable/mature open source technology
  - ABI/APIs held stable
  - Bundled support – up to 5 years
  - Annual subscription
Operating Platforms

Open Source

Fedora Project

Red Hat Enterprise Linux Code Base

Server

- IBM POWER & zSeries; Intel® x86, EM64T, Itanium® 2; AMD64

Red Hat Enterprise Linux AS

- Intel® x86 servers

Clients/Desktops

- Intel® x86, EM64T, Itanium® 2; AMD64 workstations

Red Hat Enterprise Linux WS

- Intel® x86, EM64T; AMD64 desktops

Red Hat Desktop
Platform Segmentation

- Segmentation is primarily by CPU & Memory limits and support offerings
  - For different markets – offered with different pricing, packaging, support

<table>
<thead>
<tr>
<th>Platform Segment</th>
<th>Max CPUs</th>
<th>Max mem</th>
<th>Target Market</th>
<th>Architectures</th>
</tr>
</thead>
</table>
| Red Hat Enterprise Linux AS  
  “Advanced Server” | -        | -       | Large servers; Database; corporate apps | IBM POWER & zSeries  
  Intel® x86, EM64T, Itanium® 2  
  AMD64 |
| Red Hat Enterprise Linux ES  
  “Entry/Mid Server” | 2        | 8GB     | Entry-mid servers; file/print; web; email | Intel® x86 |
| Red Hat Enterprise Linux WS  
  “Workstation” | 2        | -       | Technical workstation; CAD/CAM apps; HPC; power user | Intel® x86, EM64T, Itanium® 2  
  AMD64 |
| Red Hat Desktop | 1        | 4GB     | Standard corporate productivity desktop; volume deployments | Intel® x86, EM64T; AMD64 |

Hyperthreaded & multi-cored processor chips are counted as a single CPU.
Red Hat Enterprise Linux 3

- Red Hat Enterprise Linux 3 product family shipped in October 2003
  - Over 100 Prior1 features; over 350 general enhancements
  - Back-ported features from the Linux 2.5/2.6 kernel trees
  - Requests from OEM and ISV partners, and customers

- A single source code base is used for all architectures
  - Greatly improves code stability and maintainability
  - 5 new architectures; 64-bit clean implementation
  - Eliminates feature skew; simplifies ISV application support
  - Available in 10 languages

- Key Features for zSeries and S/390
  - Graphical installation
  - Kick Start support
  - Logical Volume Manager
  - LCS and QETH drivers are part of distribution
  - Single code base for all architectures
Red Hat zSeries/390 Development

- **Z990 + Shark Lab in Raleigh, NC**
  - 2 Books, 1TB
  - Z900 just replaced, new Shark to be installed (2 TB)

- **Fedora**
  - z/390 not targets for Fedora Core releases
  - Development Branch Packages are released for z/390
    - Available daily

- **Red Hat Enterprise Linux**
  - Integrated with all architectures:
    - Source
    - Build
    - Maintenance
Red Hat zSeries/390 Development

- Red Hat develops Red Hat Enterprise Linux to be **“architecture blind”**
  - Common source code pool used for all architectures
    - Very minor differences at the lowest hardware level
  - Common feature set and capabilities across all architectures
  - Single development and qualification process
  - Common kernel, toolchain, utilities, libraries, applications, etc.
  - Benefits:
    - Feature compatibility for applications from desktop to mainframe
    - Single management skillset required (common tools, etc)
    - Enhancements/fixes aggregate across the entire architecture set
      - Provides service-level consistency
- Red Hat Enterprise Linux solutions span the complete IT infrastructure
  - Single source for sales & services
Red Hat Enterprise Linux & z/390

- Red Hat Enterprise Linux v.3 supports all currently shipping, and several previously available, mainframe systems, including:
  - z990, z900, z800, G5/G6
  - Including all I/O infrastructure (storage, LAN)
    - Drivers open sourced by IBM
    - Red Hat distributes the drivers as part of the core Enterprise Linux distribution
- 31-bit kernel for G5/G6, 64-bit kernel for z990, z900 & z800
  - Support for 31-bit OS on 64-bit platforms (consistent with other platforms)
- 64-bit OS runs on the z900, z990, z800
- Application Support:
  - Core Utilities/Applications provided with Red Hat Enterprise Linux
    - Apache, Samba, NFS, FTP, sendmail
  - WebSphere
  - DB2
  - Working with Oracle/IBM for certification
Sys_events() will be provided in Red Hat Enterprise Linux 4

- Stability requirement for RHEL 4 - defined interface to kernel (ABI) – changing sys_events without modifying our interface was too difficult
- Sys_events() (David Libenzi) provides a mechanism identifying changes to (numerous)network connections/file descriptors
  - Specific applicability to threaded Domino implementation
    - File description means a network connection to Domino logical connection
- Investigation into earlier delivery is currently underway
Partnerships Create Solutions

- Red Hat has the strongest partnership links in the Linux market:
  - Partnerships with all the leading OEMs has resulted in over 400 certified hardware systems
    - Servers, workstations, desktops, laptops, peripherals
  - More than 300 ISV partners have certified over 1000 applications
  - Global Distributor Partners allow Red Hat Enterprise technology to be procured world-wide
  - Developer Connection
  - Training partners
  - Hosting partners
  - Runtime partners
  - Business partners

Over 400 certified systems

Over 1000 certified applications
Red Hat Enterprise Linux is supported for a full 5 years from product release.

Support delivered by Red Hat selected partners
- IBM (and others)

Three phases of support:
- Full support: Includes hardware updates, bug fixes, security
- Deployment: Includes security & bug fixes
- Maintenance: Includes security & selected bug fixes
Red Hat Enterprise Linux Kernel Features

Red Hat Enterprise Linux is based on a Linux 2.4.21 kernel, with numerous enterprise-focused Linux 2.6 kernel features included:

- Provides a solid combination of stability and performance

<table>
<thead>
<tr>
<th>Feature</th>
<th>Included in Linux 2.6 kernel</th>
<th>Included in Enterprise Linux 3 products</th>
<th>Provides:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Posix Thread Library (NPTL)</td>
<td>Yes</td>
<td>Yes</td>
<td>High performance POSIX compliant multi-threading</td>
</tr>
<tr>
<td>Kernel IPSec</td>
<td>Yes</td>
<td>Yes</td>
<td>IPSec layer for use by kernel modules</td>
</tr>
<tr>
<td>Asynchronous I/O (AIO)</td>
<td>Yes</td>
<td>Yes</td>
<td>Improved application performance</td>
</tr>
<tr>
<td>O(1) Scheduler</td>
<td>Yes</td>
<td>Yes</td>
<td>Highly scalable SMP scheduler</td>
</tr>
<tr>
<td>Oprofile</td>
<td>Yes</td>
<td>Yes</td>
<td>CPU-hardware-based performance monitoring</td>
</tr>
<tr>
<td>Ksymoops</td>
<td>Yes</td>
<td>Yes</td>
<td>Improved kernel bug reporting</td>
</tr>
<tr>
<td>Reverse Map Virtual Memory (rmap VM)</td>
<td>Yes</td>
<td>Yes</td>
<td>Performance improvement in memory constrained systems</td>
</tr>
<tr>
<td>HugeTLBFS</td>
<td>Yes</td>
<td>Yes</td>
<td>Performance improvement for large virtual memory applications (e.g. Databases)</td>
</tr>
<tr>
<td>Remap file_pages</td>
<td>Yes</td>
<td>Yes</td>
<td>Kernel memory optimization for shared memory applications</td>
</tr>
<tr>
<td>2.6 network stack features (IGMPv3, Ipv6...)</td>
<td>Yes</td>
<td>Yes</td>
<td>Improved network capabilities (performance, messaging, standards)</td>
</tr>
<tr>
<td>Ipvs</td>
<td>Yes</td>
<td>Yes</td>
<td>Network load balancing</td>
</tr>
<tr>
<td>Access Control Lists (ACLs)</td>
<td>Yes</td>
<td>Yes</td>
<td>Improved file system security management</td>
</tr>
<tr>
<td>4GB-4GB memory split</td>
<td>No</td>
<td>Yes</td>
<td>Greatly increased x86 physical memory support and larger application address space</td>
</tr>
<tr>
<td>Scheduler support for hyperthreaded CPUs</td>
<td>No</td>
<td>Yes</td>
<td>Improved hyperthreaded CPU performance (2.6 implementation not yet comparable)</td>
</tr>
<tr>
<td>Block I/O (BIO) layer</td>
<td>Yes</td>
<td>No</td>
<td>Major rewrite of the I/O subsystem (stabilization and driver support in progress)</td>
</tr>
<tr>
<td>Support for &gt;2 TB file system</td>
<td>Yes</td>
<td>No</td>
<td>Support for very large volumes. Red Hat Enterprise Linux 3 supports up to 1 TB</td>
</tr>
<tr>
<td>New I/O elevators</td>
<td>Yes</td>
<td>No</td>
<td>Fine tuning for I/O subsystem performance (stabilization in progress)</td>
</tr>
<tr>
<td>XFS filesystem</td>
<td>Yes</td>
<td>No</td>
<td>High performance file system</td>
</tr>
<tr>
<td>Interactive scheduler response tuning</td>
<td>Yes</td>
<td>No</td>
<td>Scheduler improvements for interactive tasks (stabilization in progress)</td>
</tr>
</tbody>
</table>
Red Hat Enterprise Linux Benchmarks

- Red Hat Enterprise Linux performance & scalability is demonstrated by multiple world record benchmark results
  - **Performance**:
    - #1 – TPC/C, overall world record, cluster configuration
    - #1 – SPECjAppServer2002, dual-node world record
  - **Price/performance**
    - #1 – TPC/H, first under $100/QpH @ 3000 GB
Red Hat Enterprise Linux v.3 Update 3

- Support for the new IBM POWER5 series systems
- Security: Position Independent Executables (PIE) support
  - Application section load addresses are randomly assigned every time an application is started, making address-based exploits much harder
- For non-S/390/z architectures
  - Inclusion of Evolution Exchange Connector
  - Support for local disk kernel crash dumps (extension of network dump feature)
  - Security: Exec Shield and No eXecute (NX) support
  - Extensive new driver support (esp. SATA, Fibre Channel, RAID, Network)
  - Misc. security updates & bug fixes; service call auditing; additional 32-bit libraries for 64-bit systems
    - Intel/AMD hardware architecture capability

Note: Features are subject to change prior to release
The Future: Red Hat Enterprise Linux v.4

- Red Hat Enterprise Linux v.4 will be a large release with many new features
  - Red Hat partners have had Alphas for several months
  - Betas Q3/Q4 CY04 – Final release target Q1 CY05

- Primary features include:
  - Linux 2.6 kernel base; GCC 3.4 toolchain
  - Enhanced Security with SELinux
  - Development focus on performance and scalability
  - Forward compatibility for applications (via compatibility libraries)
  - Enhanced storage and device-support subsystems
    - Improved Global File System, Virtualization & Storage Management
    - Device Mapper features – cluster-wide, snapshot, multi-path
  - Distributed Management and Provisioning enhancements (via RHN)
  - Also:
    - Improved Desktop Capabilities
    - Extensive partner hardware support (more laptops, etc.)

Note: Features are subject to change prior to product release

Due Q1 2005!
Red Hat Layered Products & Mainframes

- Red Hat has been rolling out a family of layered products for the Red Hat Enterprise Linux platform:
  - Red Hat Global File System (June 2004)
    - Provides cluster file system with shared, concurrent, read-write access
    - Announced June 2004
    - zSeries GFS support being evaluated (announced prior to acquisition)
  - Red Hat Application Server (July 2004)
    - Standards complaint Web and EJB container environment, based on Apache, Tomcat, JOnAS, Struts
    - Announced August 2004
  - Red Hat Developer Suite
    - IDE based on Eclipse
    - Announced late 2003

- These products are currently not available for mainframe systems
  - We are soliciting feedback from the mainframe community on the need for these products.
Red Hat Network

- Red Hat's modular, Web-based Linux management platform
  - Built for distributed systems
  - Integrates with existing platforms
- Simple value proposition
  - Save time and money
  - Increase productivity
  - Enhance security
- Modular approach
  - Updates
  - Management
  - Provisioning

Runs entirely on local network (hosted version available)
Red Hat Global Support

- 24x7 Production Support
  - Support centers on 4 continents
  - 100% RHCE staffed
  - Services in 8 languages

- Technical Account Management
  - Single point of contact, liaison to RH
  - 2x/year on-site implementation review
  - Includes technology roadmap briefings

- Developer support services
  - Service optimization for implementation
  - Performance tuning
  - Application porting and migration
Red Hat Solution Summary

Management & Support Infrastructure

- http://rhn.redhat.com
- Red Hat Network Server Modules
- Red Hat Global Support Services
- Red Hat Global Professional Services
- Red Hat Global Learning Services

Development & Deployment Infrastructure

- Development & Deployment
- Infrastructure
- Applications – Browsers
- Middle Tier
- Servers – Web – J2EE
- EIS Tier
- Database – SAN

- Red Hat Developer Suite
- Red Hat Enterprise Linux WS
  Red Hat Desktop
- Red Hat Application Server
  EJB container
  Web container
- Red Hat Enterprise Linux AS/ES
- Red Hat Global File System
  Red Hat Cluster Suite
- Red Hat Enterprise Linux AS/ES
Questions?