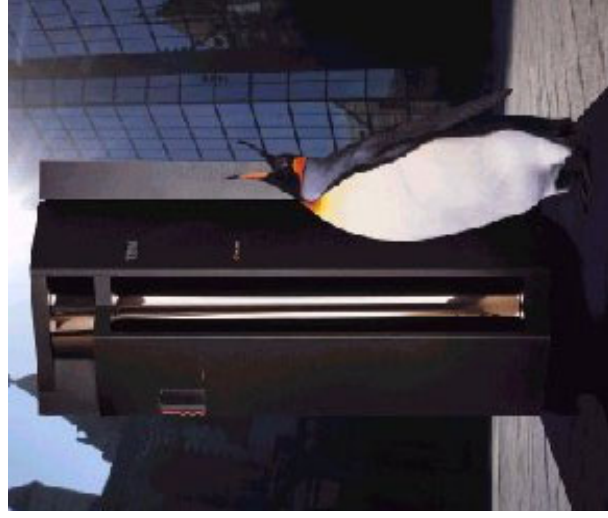


Server Consolidation with Linux with IBM Servers



Bill Reeder
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AIX*	GDPS	Netfinity*	VisualAge
APPN*	Geographically Dispersed Parallel Sysplex	Net.Data	VM/ESA
Capacity Upgrade on Demand	HiperSockets	NetSpool	VSE/ESA
CUoD	IBM*	OS/390*	VTAM
CICS*	IBM logo*	Parallel Sysplex*	WebSphere*
DB2	IMS, IMS/ESA*	Processor Resource/Systems Manager	z/Architecture
DB2 Universal Database	Intelligent Miner	PR/SIM	z/OS
e-business logo	IP PrintWay	RMF	z/OS.e
Enterprise Storage Server	Language Environment*	RS/6000	zSeries
eNetwork	Magstar*	S/390*	zSeries Entry License Charge
ESCON*	MQSeries*	S/390 Parallel Enterprise Server	zVM
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Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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For the next generation of e-business.



IBM  eServer zSeries

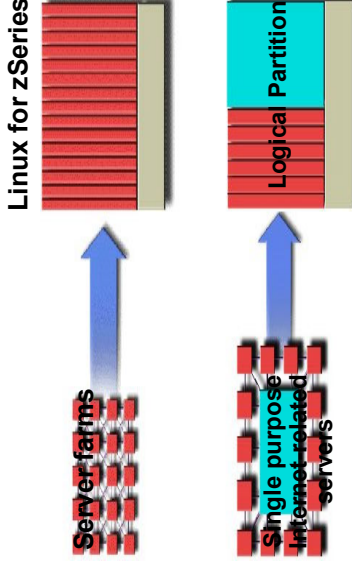
IBM's Commitment to Linux



Game Changing Applications

Distributed

Enterprise: Centrally managed but geographically dispersed replicated servers which are low cost, robust, very reliable



Credit Union Central Alberta

Integration of Webserving to CICS/VSAM

Banco Mercantil

30 NT servers to Linux zSeries

Branch Renewal

Prominent banks integrating Linux servers as part of branch renewal.

Hill House Hammond

Automation at 290 branch.offices.....

BNP Paribas

16 way Intel linux cluster for arbitrage

DKB

80 Node Intel cluster for derivative pricing

Akamai

Content caching server to improve delivery on the web

Workload Consolidation:

- Multiple workloads consolidated on zSeries/iSeries -Reduced cost
- Better resource use & performance
- Speed of deployment

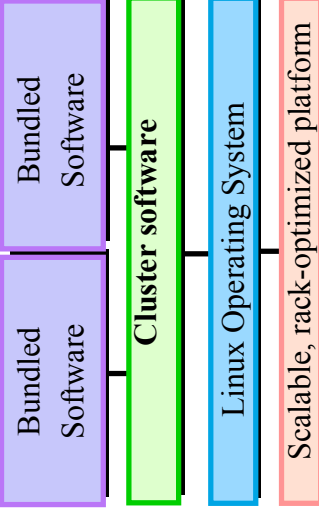


Linux Clusters:

Pre-built / tested / integrated configurations providing scalability, high-availability, rapid setup and installation for parallel environments (web serving, engineering, scientific)

Appliances:

Stable, Reliable, Affordable servers preconfigured with Linux applications -- deployed in minutes

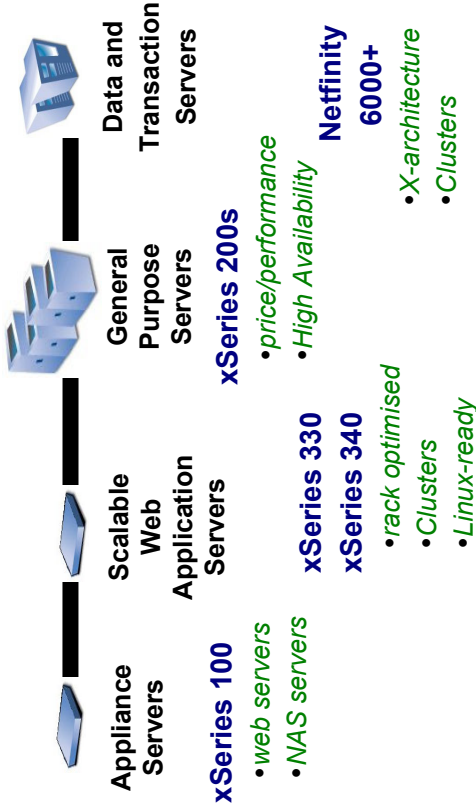


Intel Processor	800MHz
Form Factor/Height	Rack/ 1U



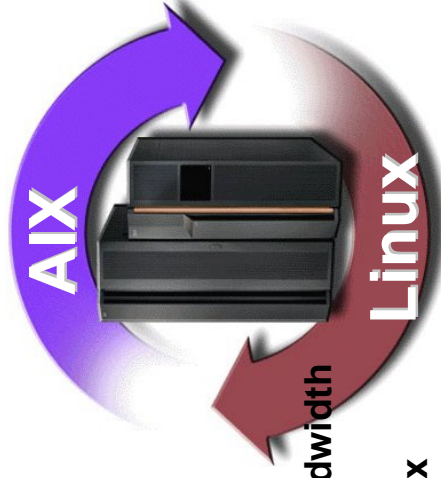
Broadest Linux Server Line

Linux for xSeries and Netfinity The Point of Entry - Where Industry Standards Meet Enterprise Capabilities



Linux for ^ pSeries & RS/6000 The Point of Integration - Where Linux Meets UNIX

- Native Linux for RS/6000 (32-bit)
- Native Linux for pSeries (64-bit)
- Exploit Power3 / Power4 Floating Point, 64-Bit Performance, I/O Bandwidth and RAS
- AIX Toolbox for Linux Applications in AIX 5L



Linux for ^ iSeries

The Point of Coexistence - Where Linux Complements Integrated e-business Solutions

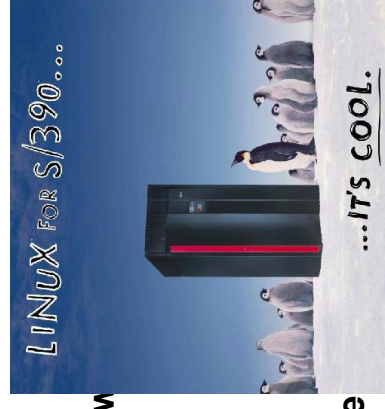


- Linux in a partition
- Integrates new ebusiness applications

Linux for ^ zSeries and S/390

The point of consolidation - Linux Ascends to the Mainframe

- Pure Linux OS
- Exploits zSeries hardware
- Scalable, protected partitions
- Shared infrastructure
- Reduced cost of ownership



IBM Middleware for Linux on zSeries

■ WebSphere

- f* WebSphere Application Server Advanced Edition, Version 4.02
- f* WebSphere MQ, Version 5.2
- f* WebSphere Personalization, Version 3.5
- f* WebSphere Commerce Suite, Version 5.1
- f* WebSphere Host on-Demand, Version 5.0.3
- f* CICS Transaction Gateway, Version 4.0
- f* IMS Connect, Version

■ Data Management

- f* DB2 Universal Database, Version 7.2
- f* DB2 Connect, Version 7.1
- f* DB2 Intelligent Miner Scoring, Version 7.1
- f* DB2 Net Search Extender, Version 7.2

■ Tivoli

- f* Tivoli Storage Manager Client, Version 4.2
- f* Tivoli Enterprise Console, Version 3.7.1
- f* Tivoli Software Distribution, Version 4.0
- f* Tivoli Distributed Monitoring, Version 4.1
- f* Tivoli Workload Scheduler, Version 8.1



Independent Software Vendors supporting Linux on zSeries

- **ERP, Production Planning, Logistics**
 - f* ABAS Software AG
 - f* SAP
- **Database**
 - f* Oracle 9i
 - f* Software AG Tamino (XML Database)
- **Application & e-business Integration**
 - f* Tibco
 - f* Iona
 - f* BEA WebLogic
 - f* Aeonware (B2B/B2C)
- **Systems Management**
 - f* BMC
 - f* Computer Associates
- **Windows migration, ASP**
 - f* Halcyon Software
- **Stock tracking**
 - f* RTS Realtime Systems
- **Core Banking Applications**
 - f* Sanchez
- **Mail & Calendaring**
 - f* Sendmail
 - f* Bynari (Mail & Calendaring)
- **Print server**
 - f* Macro4
- **Development & Testing Tools**
 - f* Logics Software
 - f* Rational Software
 - f* Rogue Wave Software
 - f* Dignus
 - f* Serena
 - f* ACTS (testing)
- **Backup Software**
 - f* Computer Associates
- **Firewall**
 - f* zGuard



ISVs are constantly releasing new applications for Linux on zSeries. Get the most current information from the Developer Products for Linux on zSeries Web page at:

ibm.com/zseries/solutions/s390da/linuxproduct.html

IBM Global Services Support for Linux on zSeries

■ IBM Operational Support Service Offerings

- f* Advanced Support
 - Customized Service Solution
 - Focused Support Team
 - Accelerated Response
 - Customized Reporting
 - Proactive Recommendations/Support
- f* Account Advocate
 - Assigned Technical Specialist/Team
 - Tracks, Reviews & Escalates Problems as Required
 - Available 9X5
 - Reviews Support Activity with Customer Monthly
- f* Support Line
 - Fee Service for How To/Usage Questions
 - 800# and Electronic Access
 - 9X5 or 24X7 Coverage
 - Response Time: 2 Hours Primeshift, 2-4 Hours Offshift

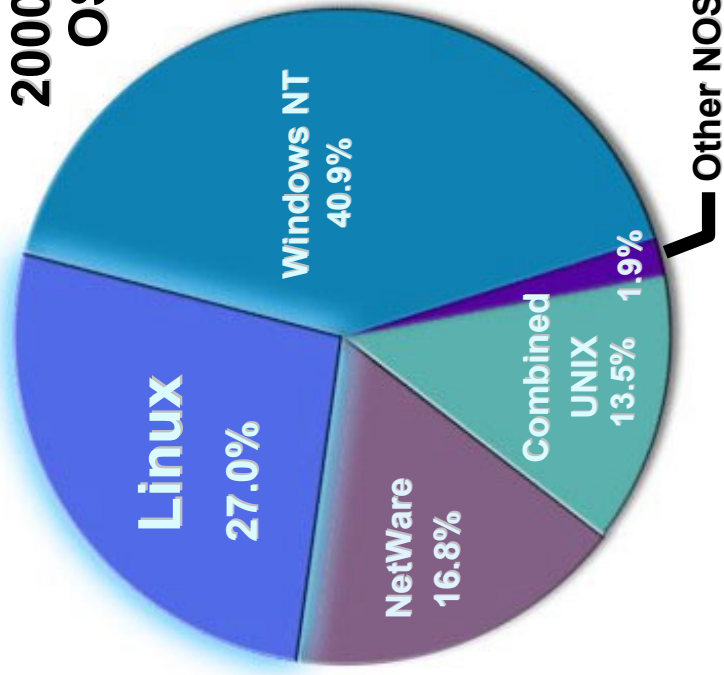
■ IBM Consulting - Implementation Services

- f* Consulting & Education
 - Open Source Consulting
 - Linux Infrastructure Assessment
 - Class room and Web-based courses
 - Redbooks
- f* Application
 - Installation Services for WebSphere
 - Installation Services for MQ Series
 - DB2 Migration
 - Server Consolidation
- f* Implementation
 - System installation and configuration
 - e-business e-server solutions
 - Cluster solutions
 - Platform Migrations



Linux Momentum

2000 New Server OS Shipments



New Server OS License Forecast (00 - 05)

WW Server OS License Share (units)

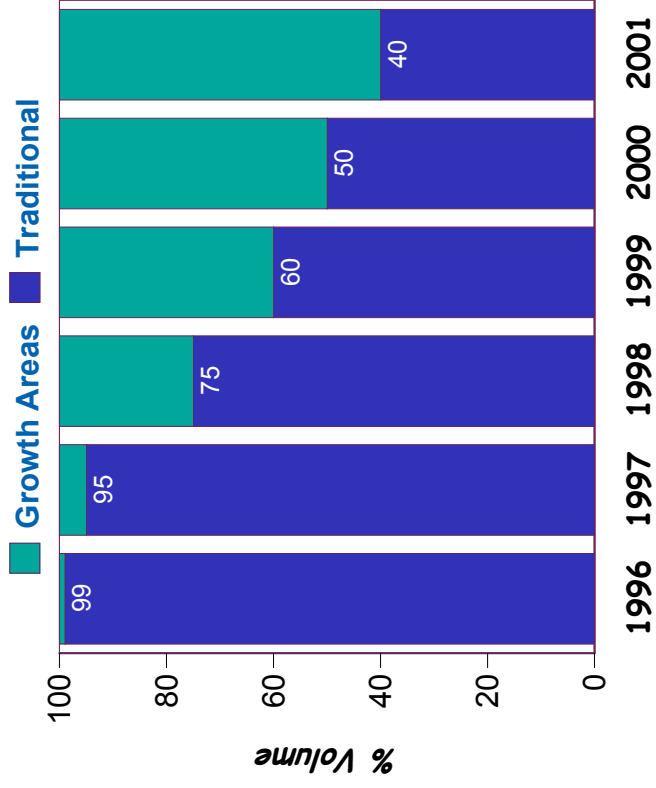
Linux
23.6% Growth



from IDC "WW Client Operating Environments Market Forecast and Analysis" July 2001

Linux Application Environments

IBM zSeries and S/390 Compute Capacity Worldwide



IBM Confidential



IBM **@server zSeries**
For the next generation of e-business.

IBM Market Research

February 2001

How do industry partners benefit from United Linux?



UNITED LINUX



Computer Associates™



Borland



- One Linux version for product verification
- Greater demand for Linux certified products by customers
- Greater access to Linux sales channels - OEM, direct, reseller, wholesale, et. al.
- True standards based Linux
 - LSB compliant
 - Li18nux compliant



zSeries Consolidation "Sweet Spots"

Ideally suited for I/O intensive applications

Enhance existing zSeries investment with Linux applications

Consolidate infrastructure servers on available zSeries logical partitions or virtual servers

Support large numbers of servers with zSeries virtualization technology

Most effective for consolidation of low / moderately loaded servers

Most effective for consolidating servers which peak at different times

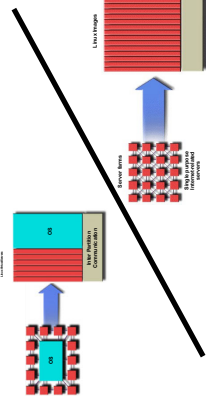
Single server, multiple applications

- Web serving
- e-mail
- Database
- Network Infrastructure (DHCP, LDAP, DNS, DHCP, FTP....)
- File/ Print Serving

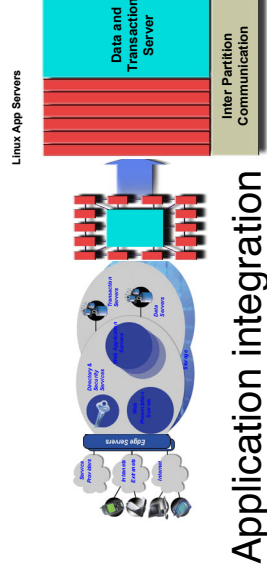
Workload management

- zVM management functions

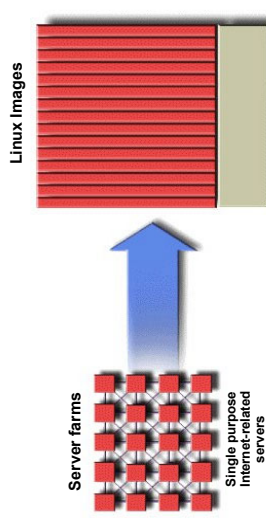
Infrastructure consolidation



Distributed application servers

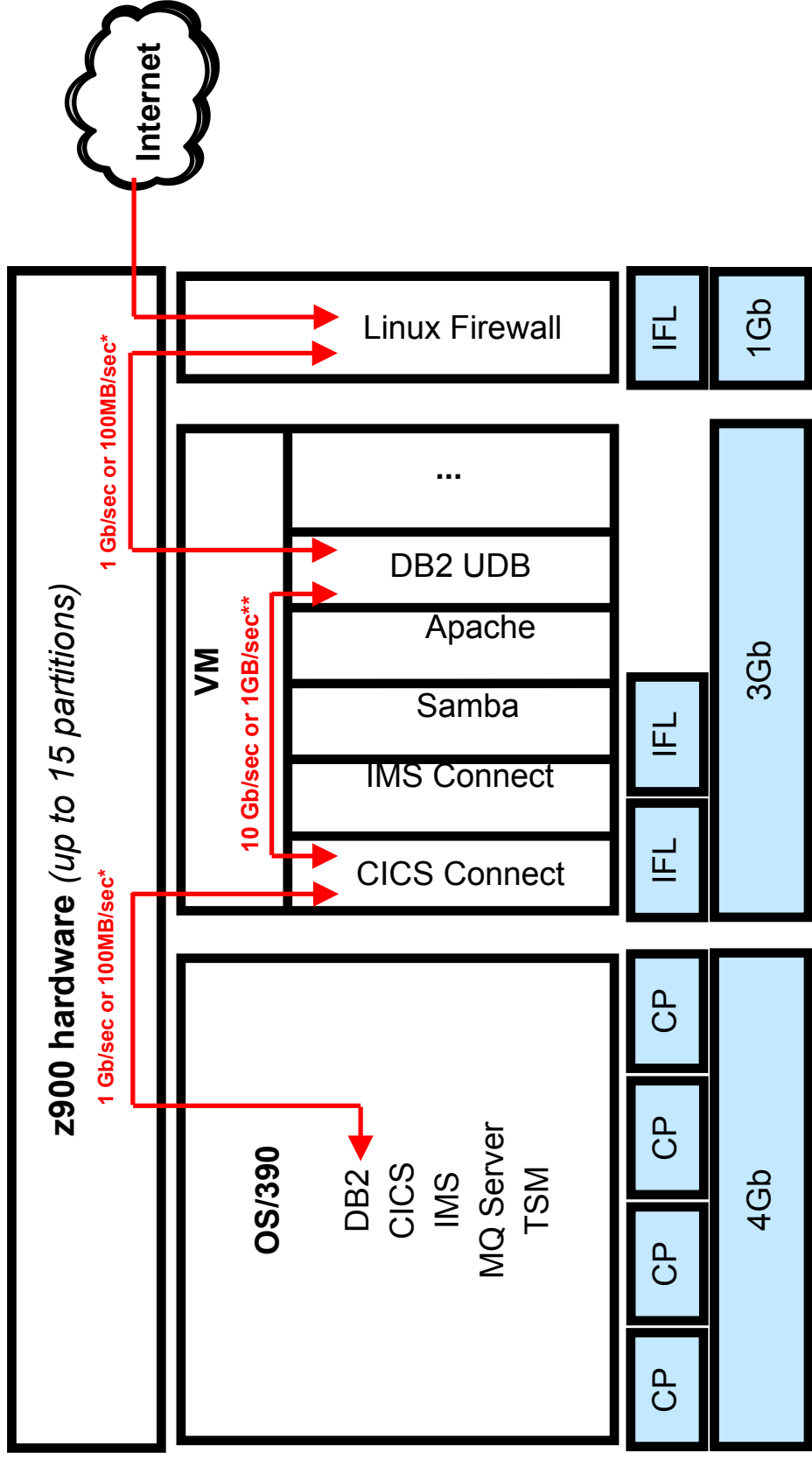


Application integration



Very large scale server hosting

Example of Linux on an established S/390

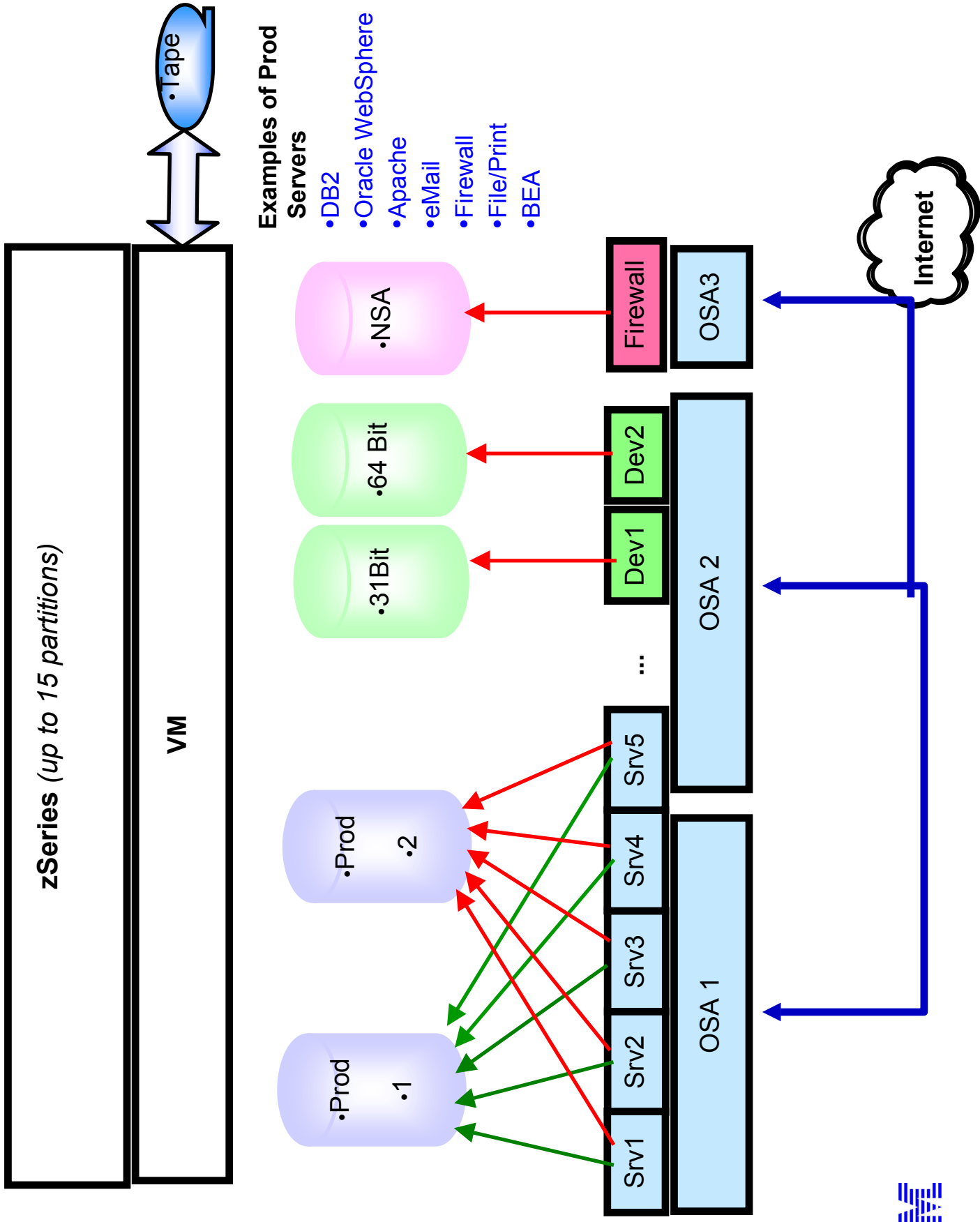


* FICON CTC

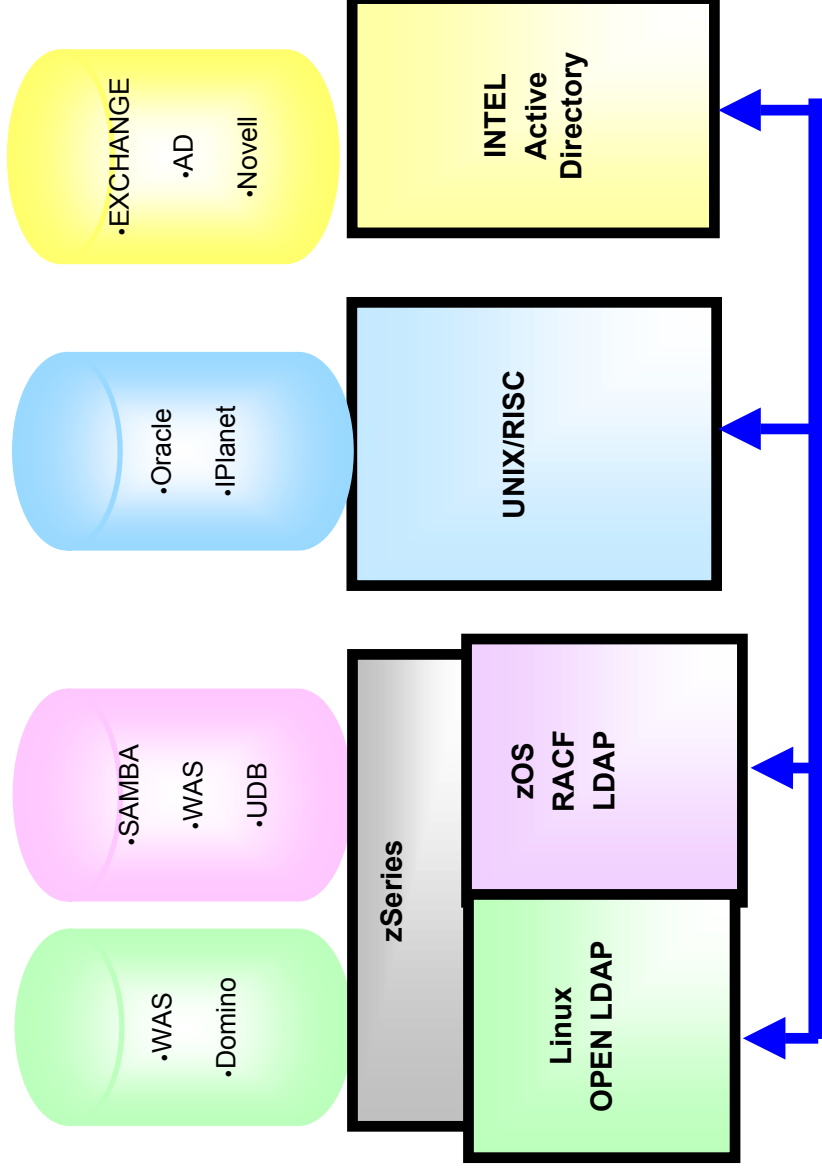
** z900 STI/HiperSocket



Flexible and Robust Linux Installation

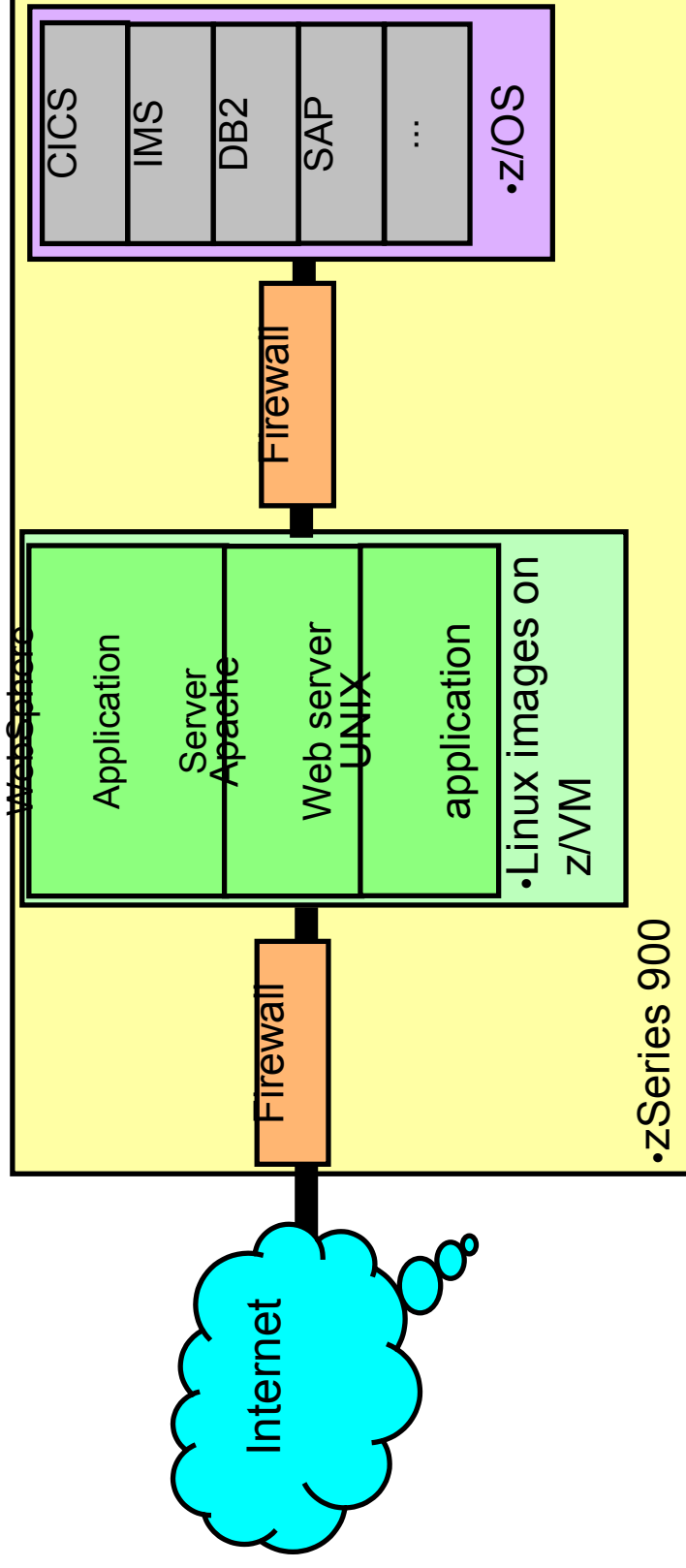


LDAP Security Methods

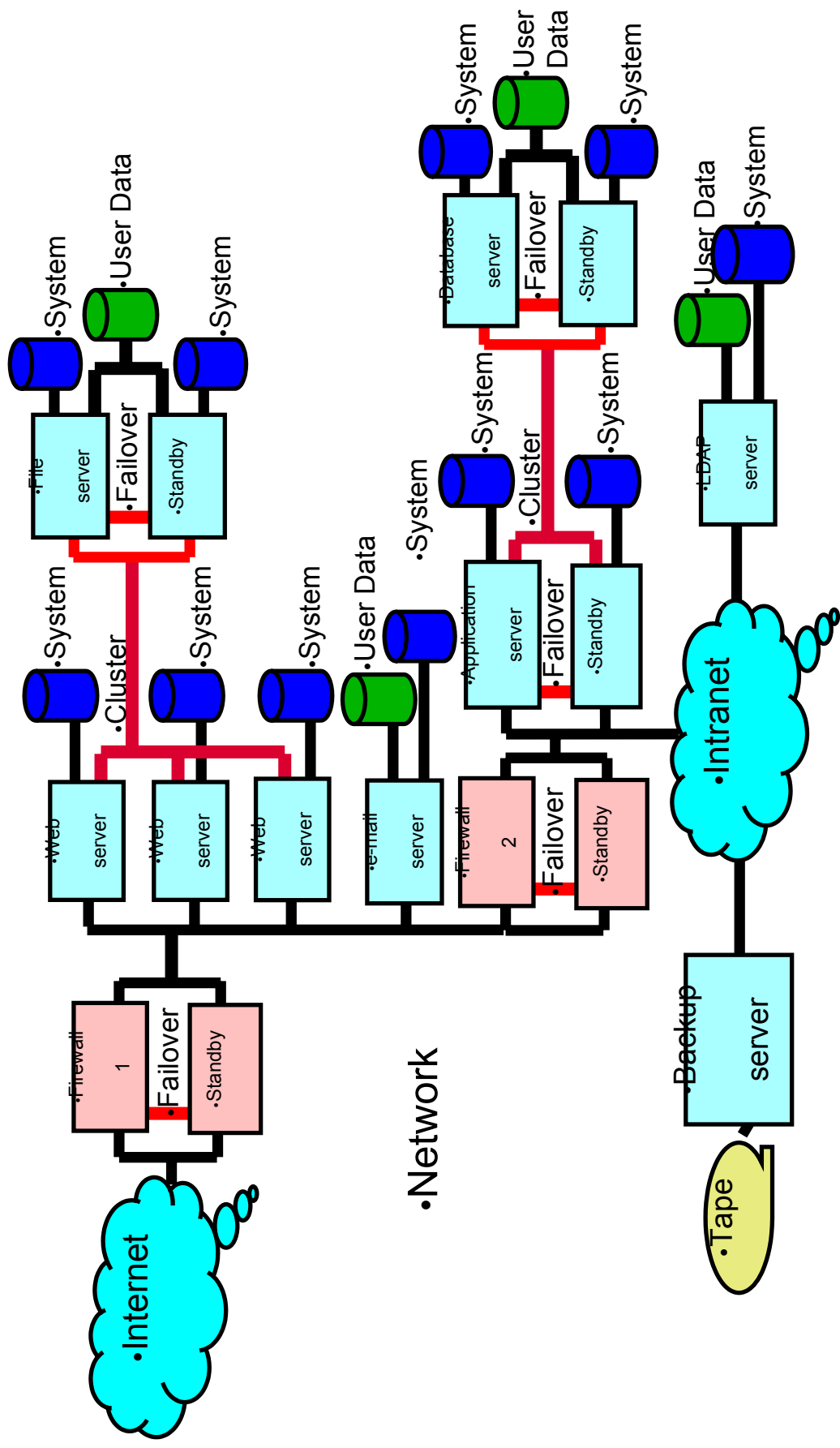


- Java Connectors (MetaMerge)
- C Connectors
- MQ Series
- TCO of Security Administration
- Security Management, Source Authority

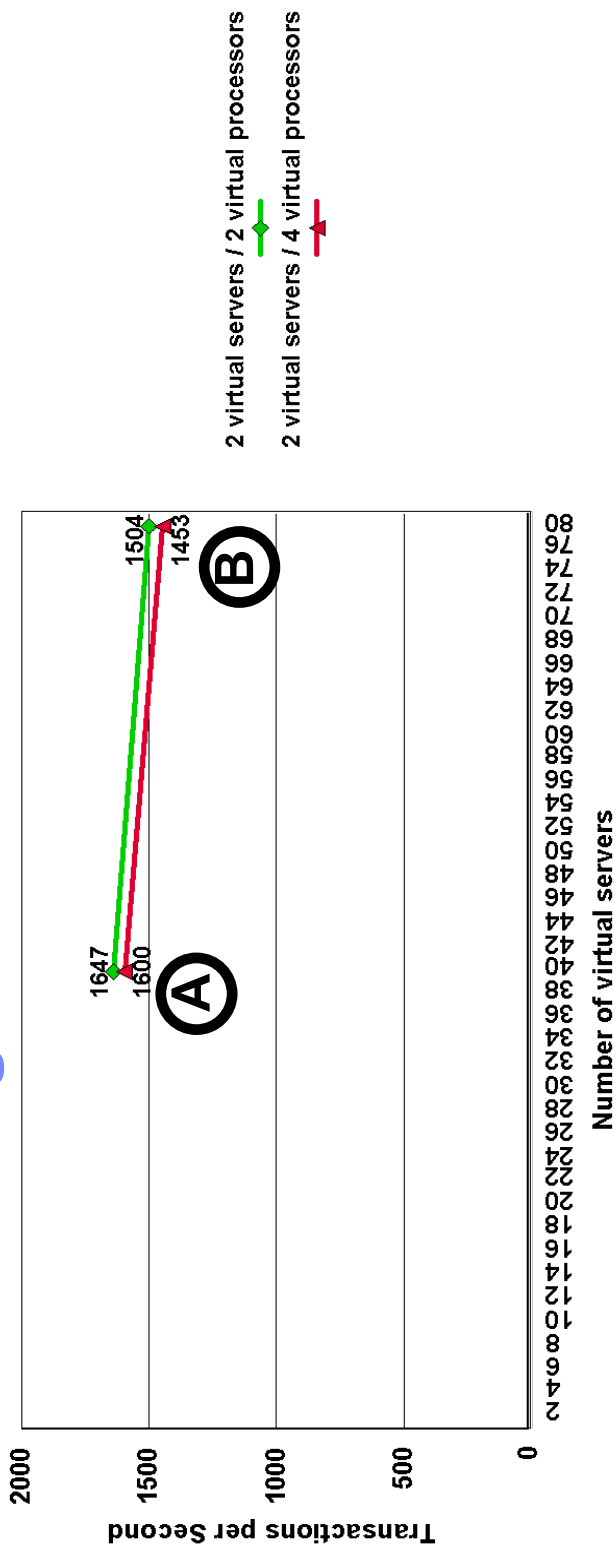
Back-end integration with Linux ...



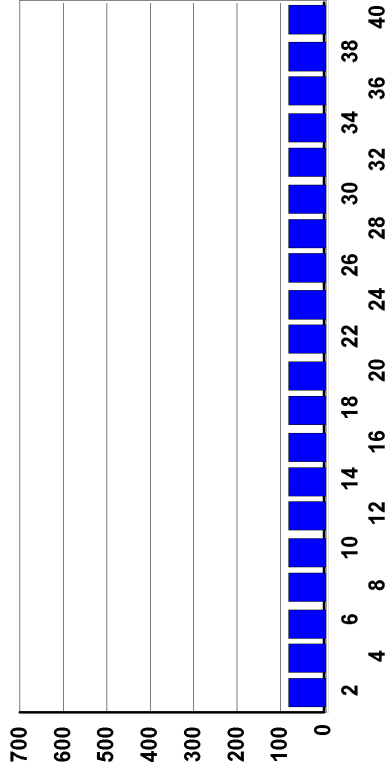
Application Serving - Classic Scenario



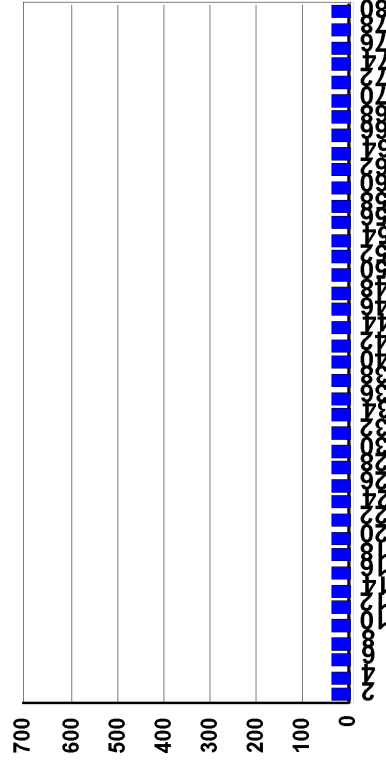
Typical stress testing scenario - The effect of using multiple identical workloads



Stress 20 Trade2 Workloads



Stress 40 Trade2 Workloads

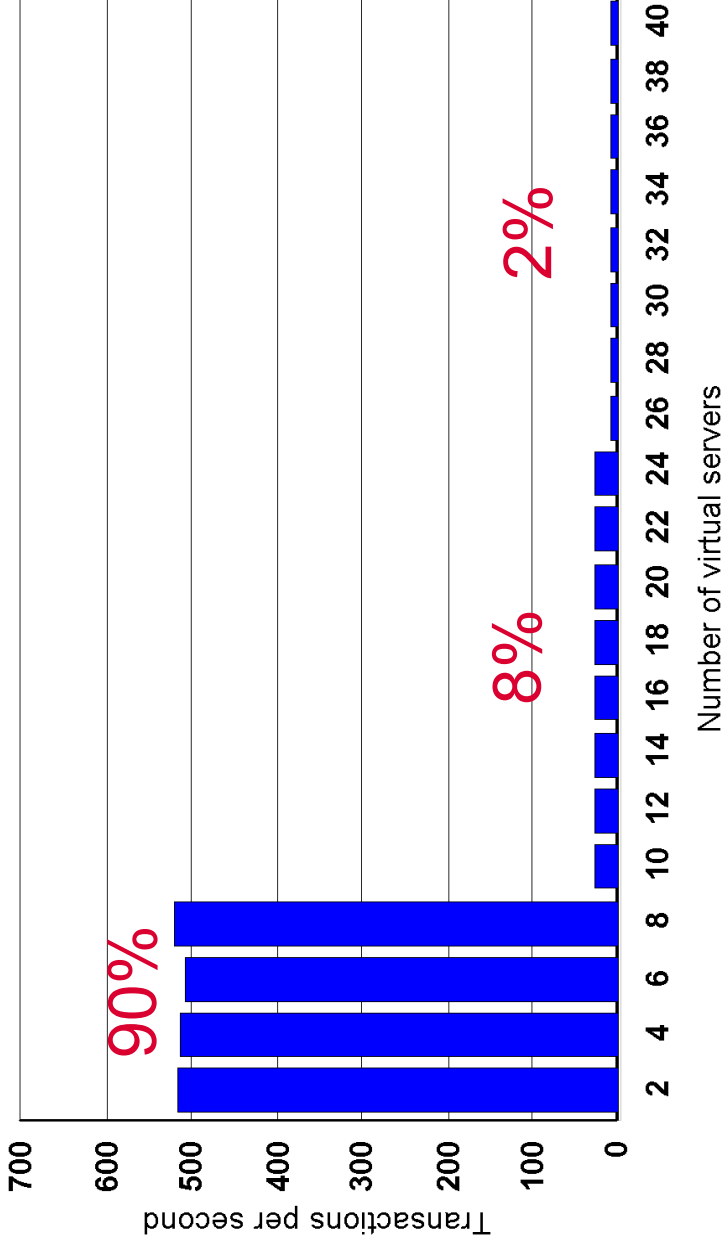


Http/WAS guest to DB2/UDB guest

Trade2 Workload



Workload distribution scenario - Non uniform workload distribution



■ A more realistic way of simulating the behavior of a server farm

f 8 servers provide 90% of the workload

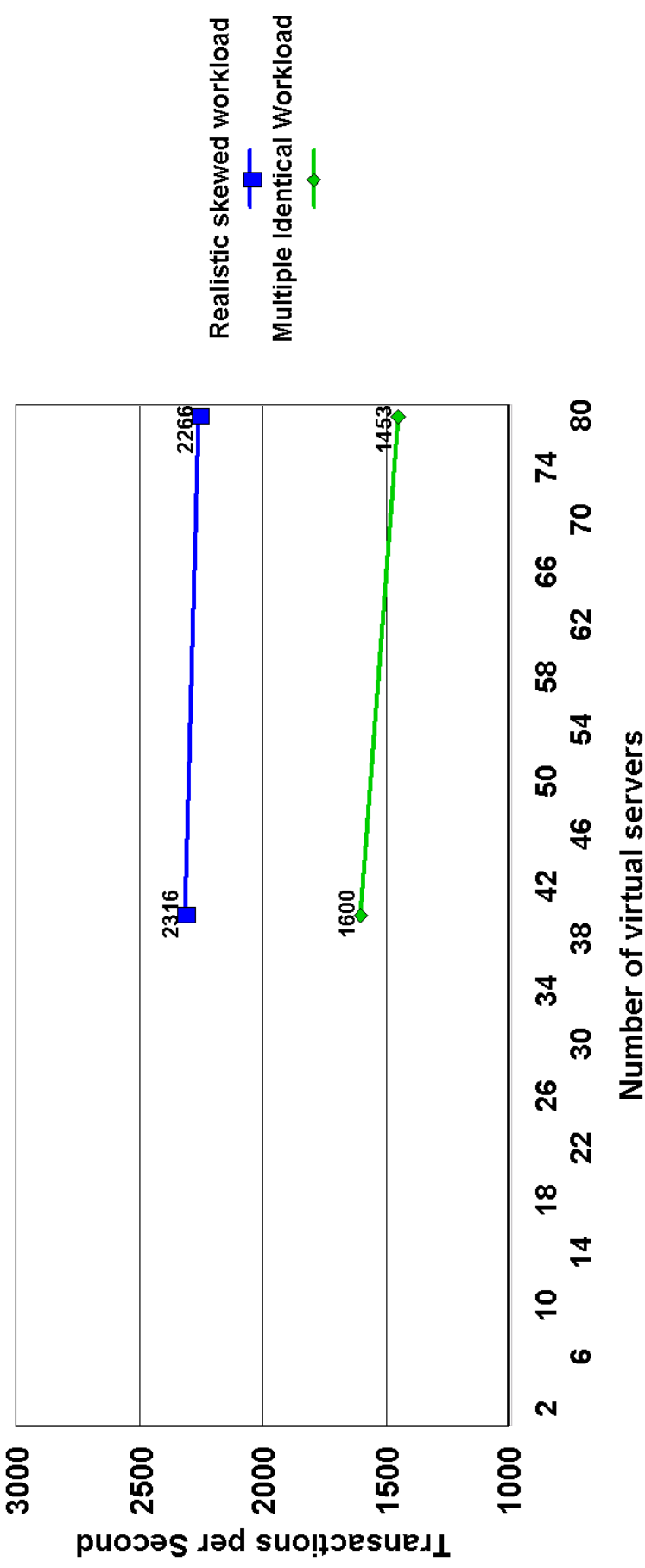
f 16 servers provide 8% of the workload

f 16 servers provide 2% of the workload



Non uniform workload distribution scenario

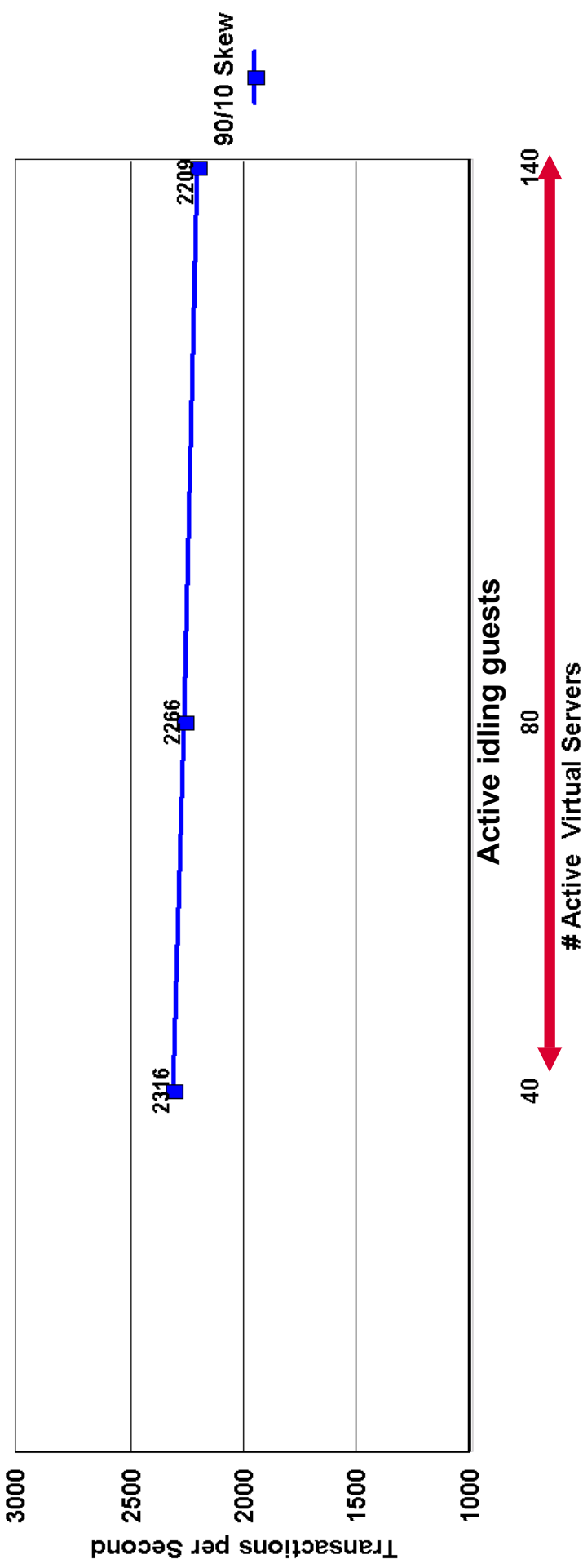
- Example of difference in capacity with non-uniform workload distribution



- 45% increase in performance with realistic skew
- With 80 guests - 240 virtual cpus on 16 physical cpus - 15:1 ratio
- Flat skew on 100% busy system drives cache miss rate
- z/VM with robust cache hierarchy manages realistic skew very well

Non uniform workload distribution scenario

The effect of adding additional virtual servers idling

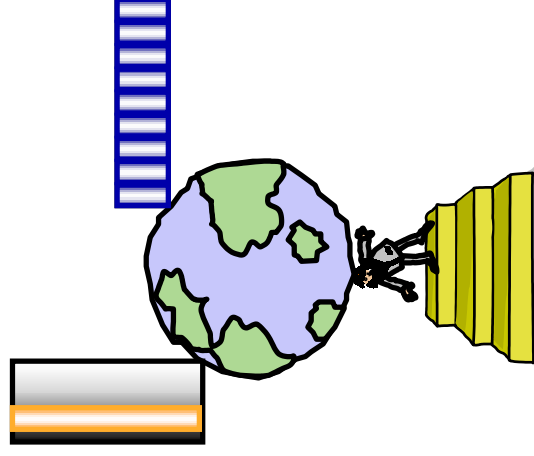


- Idling guests consume little resource
- Possible to consolidate very lightly utilized servers with higher utilized servers

Idle virtual servers respond quickly if system is not fully utilized

Cross Brand Linux Solutions

Architecting and Optimizing the
Consolidation Model



Bill Reeder

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Why a Hybrid x, p, i & z Solution

- Fulfill customer requirement for a complete solution
- Create optimized solution for performance with world class performance and scaling
- Create horizontally scalable test and development environments
- Quickest path to production
- 24x7 real world computing
- Safe, secure, and functional disaster recovery

Architected e Server/Linux Solutions

- Grid Solution Hybrids
- Classic Sun Solutions Oracle RYO applications
- IBM Middleware Hybrids
- BEA Weblogic Applications
- Hybrid e-mail Solutions
- Migrating Novell and Microsoft File and Print Customers
- [Next Steps](#), Search for Java Applications

Hybrid Linux on x Series and z Series

- **Which application services on x Series**
 - f Applications requiring a distributed architecture
 - f Code compiled to Intel only
 - f Compute intense workload
- **Which application services on z Series**
 - f Those needing rapid scaling
 - f Development Environments
 - f Those needing 24x7 such as **DNS, DHCP, Databases, MQ Series**

■ **Why Hybrid Solutions**

Total Cost

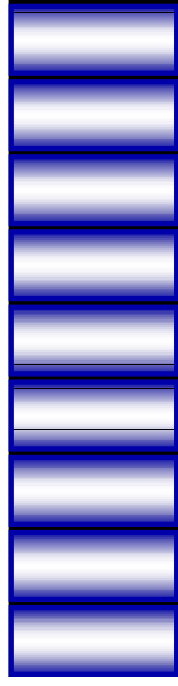
Performance

Balance



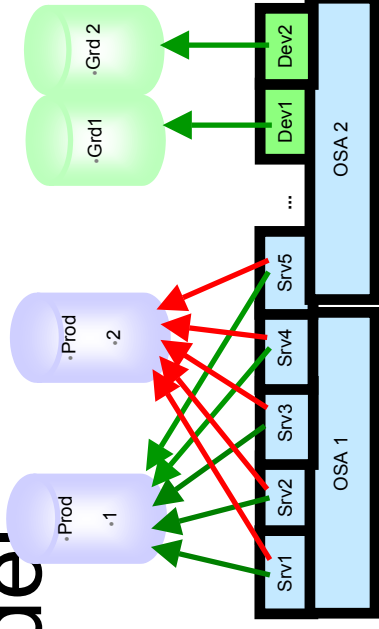
Grid Hybrid Solutions

- Hybrids allow for overflow workload
- With hybrids create instances for dynamic upgrade, bug patching and testing
- 24x7 Grid Control
- On Demand Utility Model



Intel Bases Grid

- Grid Control Program
- Grid Machines



z Series Grid

- Grid Control Program
- Overflow Grid
- Grid Update
- Grid Test

Targeting Sun Servers Using Oracle Solutions

- Customers concerned with SUN remaining viable
- Customers with RYO Oracle Applications
- Customers with Oracle eBusiness Suite, Applications Server, and Collaboration Suite Server

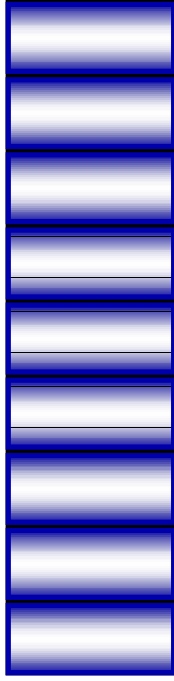
Oracle Advantages on

Linux z Series

- Horizontal and vertical scaling of the database environment
- Shorten backup windows
- Shorten disaster recovery time
- Can leave application workload on existing architecture by splitting database and application workload
- Take advantage of z Series offloading IO processing

Oracle Solutions on Linux Available Today!!!

xSeries Linux Servers



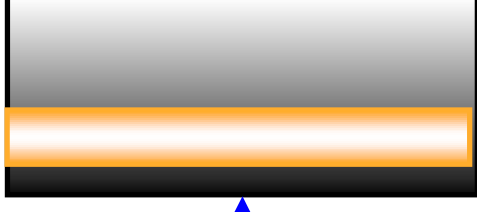
Deploy Customer written Applications

- C
- C++
- Perl
- Java
- Apache
- Tomcat

Oracle Applications Server



z Series Linux Server



*Oracle 9i r2
Develop and Test
Customer written
Applications*

- C
- C++
- Perl
- Java
- Apache
- Tomcat



z Linux Oracle DB Solutions (Oracle Based Applications)

- Current Solution
 - Coming Solutions
- f* Oracle 9i on z
- f* Oracle Application Server on x with DB on z Supported Server x
- f* eBusiness Suite on x with DB on z **looking for customer demand**
- f* Collaboration Suite on x with DB on z **looking for customer demand**



IBM Middleware

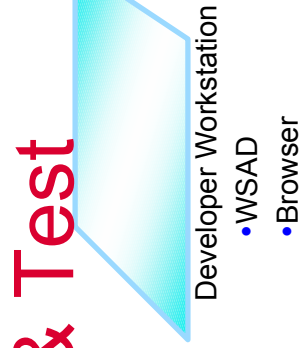
- Customers looking at complete end to end solutions with IBM middleware products
- Customers optimizing development and deployment costs



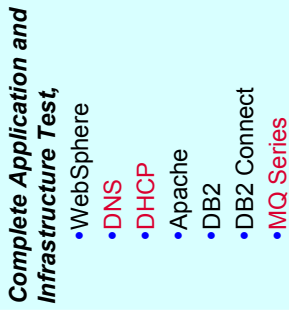
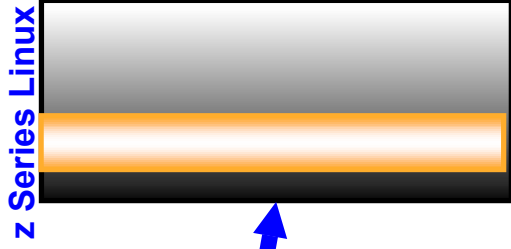
IBM Middleware, an end to end

Solution

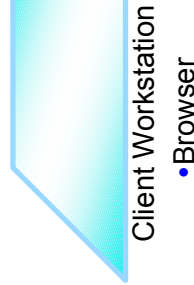
Development & Test



x Series Linux



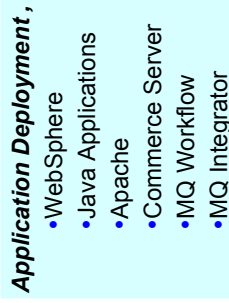
Production



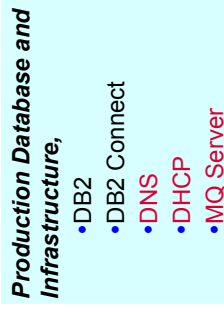
x Series Linux



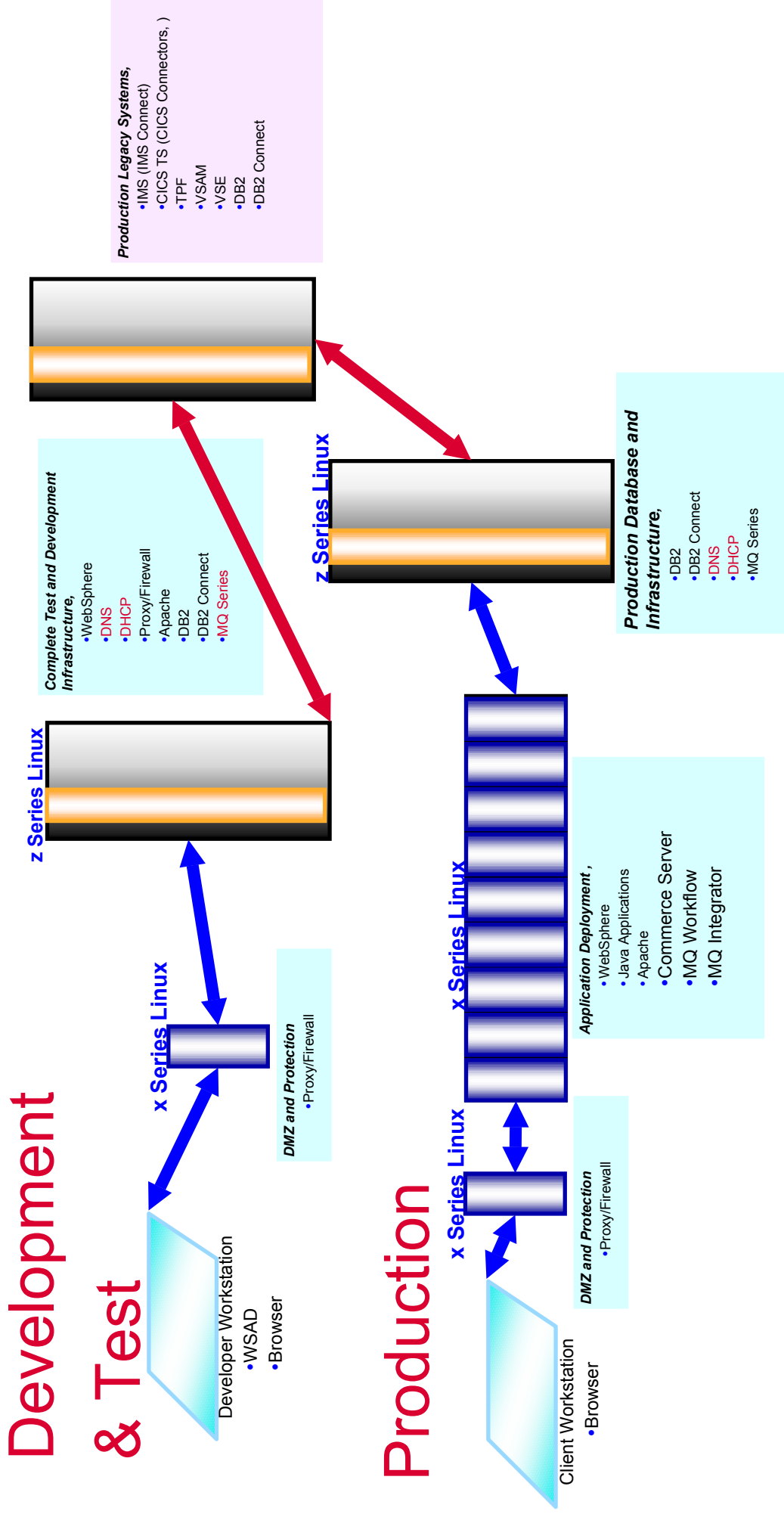
x Series Linux



z Series Linux



IBM Middleware, an end to end Solution with Legacy Connectors



IBM Middleware

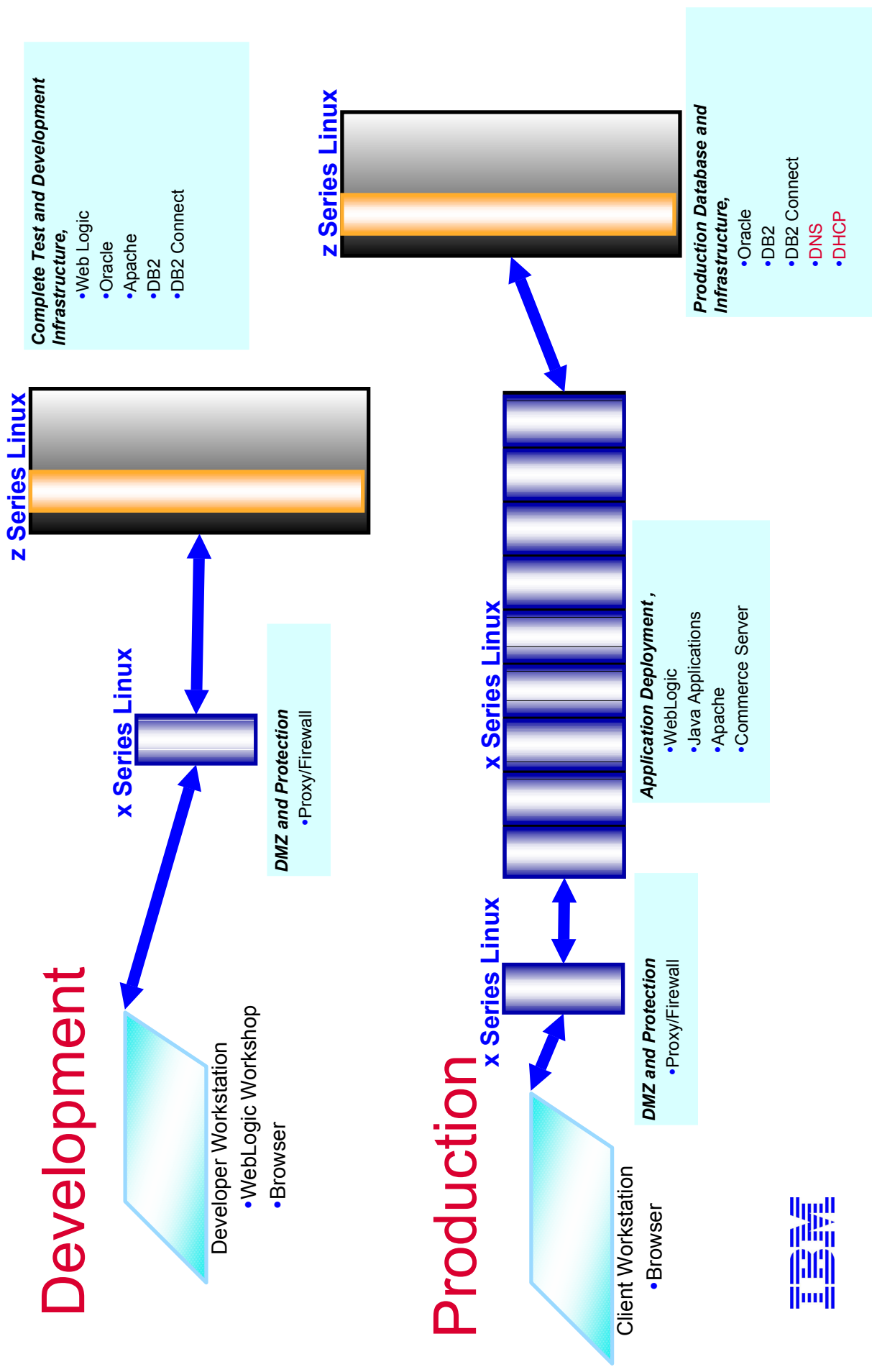
- Current Solution
 - f MQ Series on z MQ Integrator and MQ Workflow on x Series
 - Coming Solutions
 - f Domino e-mail on z, Application serving and Fax Serving from x Series 1Q 03
 - f IBM Tivoli System Automation for Linux 1H 03

Hot ISV Application Solutions

- Current Solution
 - f e-mail Hosting, Bynari, Samsung, Stalker on z Series, Paging and Fax Services on x Series
 - f Legato
 - f StoneGate
- Coming Solutions
 - f Veritas Family of products leveraged on both x and z Series
 - f e-mail Hosting, Novell Net Mail on z Series, Paging and Fax Services on x Series



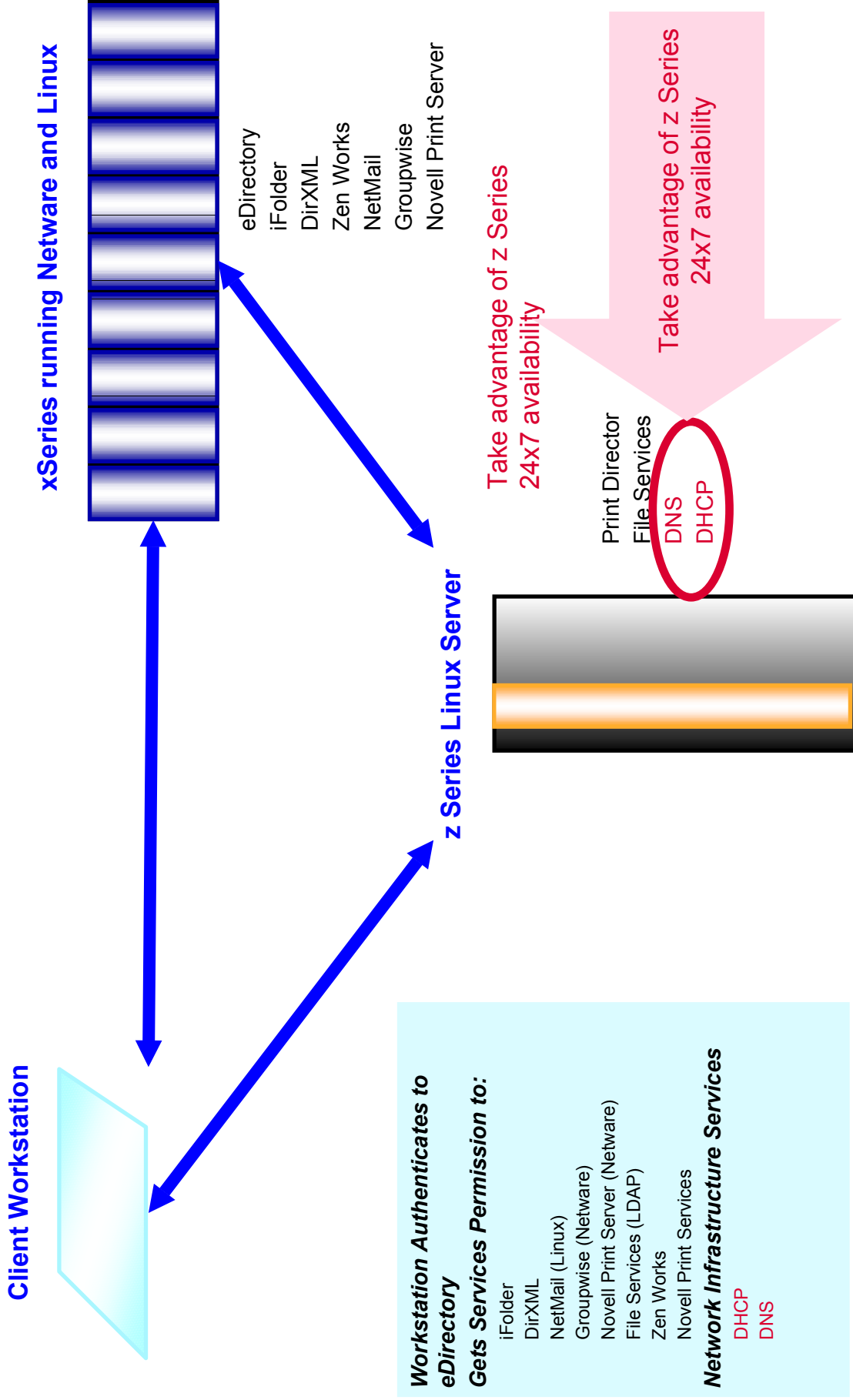
BEA WebLogic



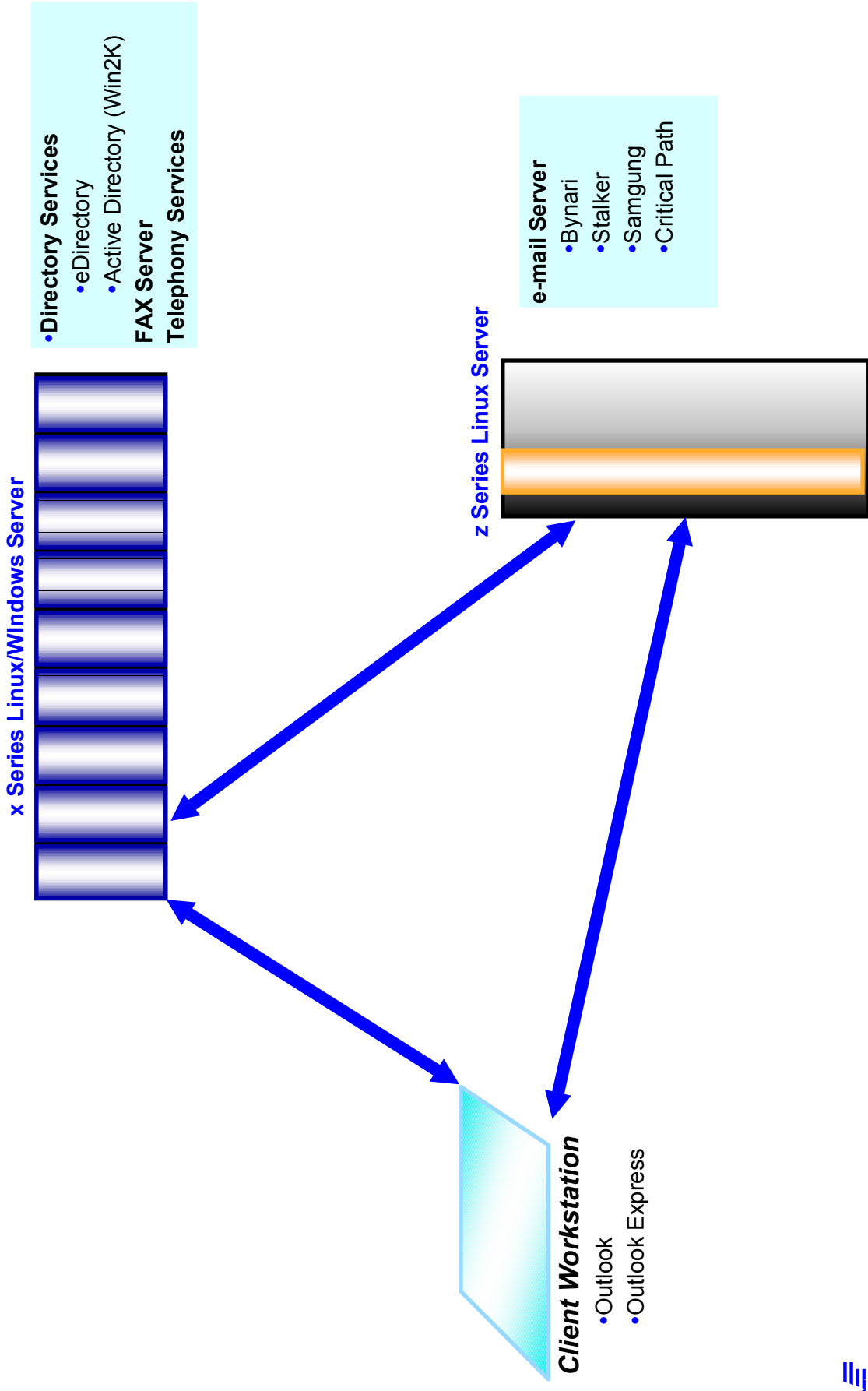
Targeting Microsoft Customers with Hybrid Solutions

- Customers with mixed Novell and Microsoft file services
- Customers disturbed by Microsoft License practices and changes who want alternatives
- Existing Novell Customers
- Microsoft Exchange customers looking for savings

Novell Solutions with x and z Series Linux Servers Available NOW!!!



e-mail Solutions on Linux

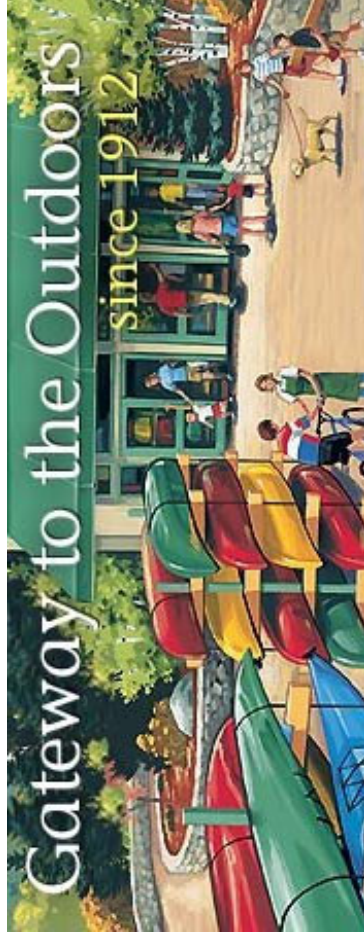


L.L. Bean

Linux for zSeries - Infrastructure servers consolidation

- Direct merchant - over \$1 billion yearly sales
- Replaced e-mail system for high priority applications with Sendmail / SuSE solution on zSeries
- 5X performance improvement over older system
- Sendmail is easier to use and more flexible than older system
- Mainframe reliability and scalability come to high priority e-mail application
- Software costs for traditional software running on same system unaffected due to use of IFL
- "We've seen a dramatic increase in the volume of Internet e-mail as well as an increase in the criticality of that e-mail. Sendmail running on Linux for S/390 provided the increased performance and reliability we needed to meet the ever increasing importance of Internet e-mail."

f Donna Lamberth,
Senior Manager for IS,
LL Bean





French ISP specializing in hosting services for professional Internet users

Selected IBM ^ zSeries and ESS as an alternative to a traditional server farm

Uses z/VM Virtualization Technology to support multiple, secure Linux instances operating concurrently

Key attributes for zSeries win

- Legendary reliability
- Virtual network replaces complex and costly physical network
- Time to bring a server on line is measured in minutes - not days

"Combining zSeries with Linux allows us to benefit from the most reliable infrastructure available today and also lets us offer customers the most cost effective services on the market."

- Mathieu Chambon-Cartier, Chairman, Aleos



Ford Werke AG

Linux for zSeries - Distributed application server

- German Auto Maker
- Runs SuSE Linux on 9672 R76 IFL
- Hosts new Ford Credit and Human Resource



Linux applications

- DB2 Connect provides access to DB2 database running on OS/390
- WebSphere Application Server (WAS) Advanced Edition V3.5 for Linux on S/390 supports the Web enablement of the new applications

"With Linux for S/390 and z/VM on the mainframe, we can consolidate (workload) cost effectively. Our users benefit from the performance and scalability of the solution, that also reduces the TCO." - Egon Terwedow, Technical Specialist Ford Werke AG Cologne.



Linux for zSeries - Distributed application server

- German Financial Institution
- Intranet Application
 - Application designed for expense claims between banks for international payments
 - Provides browser interface to existing CICS / DB2 application running on OS/390
 - Websphere is used as HTTP and Java application server
 - JMS with MQ Client Connect for OS/390 forwards requests to CICS on OS/390
- Extranet Application
 - Security Trading application for Deutsche Bank & their customers
 - Web based front end
 - SSL enablement of HTTP server

Linux for zSeries - Server hosting

- Italian Telecom
- Pilot program uses S/390, z/VM, and Linux
 - VPAM application - written in C
 - Authorizes Internet users
 - Provides Internet access to cache data
 - Filters unauthorized websites
 - Result:
 - Satisfactory performance in broadband speed of access
 - Very happy with portability of Linux code
 - Impressed with IBM teams ability to solve problems
 - Netsiel is now signing a formal contract to implement a Linux/mainframe solution for its business critical

IDC infrastructure.

"Linux is 100 percent source compatible on zSeries, and IBM (using support people in Europe and the US) is able to rapidly solve any matter on the Linux code for zSeries."

-- Umberto Rampa, Netsiel IDC Manager.

Linux for zSeries - distributed application server

Recreational Vehicle Manufacturer

Replaced Microsoft Mail and Novell servers with Bynari Insight Server

Users can still use Microsoft Outlook e-mail client

Runs on Multiprise 3000



"Upgrading to Microsoft Exchange or Novell GroupWise would cost Winnebago about \$100,000. We expect Bynari Insight Server to cost a third or even a quarter of that, because Winnebago will be able to make use of excess capacity on the company's IBM Multiprise 3000 mainframe. The mainframe is our industrial-strength system that stays up, and that's where our expertise is."

- Dave Ennen, Technical Support Manager, Winnebago Industries

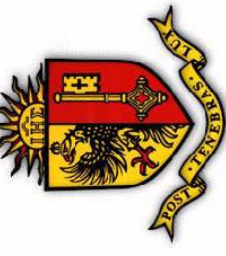


Linux for zSeries - Server hosting

- German solution provider
- Wanted higher availability for Perl based applications than Sun server farm could offer
- Backup and failover plan for multiple physical servers was cumbersome and required manual intervention
- Implementation of new applications was difficult because of interdependencies
- IBM zSeries / SuSE Linux based solution
 - improved overall system availability and reduced staffing requirements by 25 percent
 - new environment requires 40 percent less space
 - Consumes approximately half as much energy
 - Network complexity and vulnerability in terms of adapters, cabling and monitoring has been reduced significantly

University of Geneva

Linux on zSeries - Infrastructure servers consolidation



- Expanded UNIX/Linux computer science capabilities
- Linux virtual machines are potentially accessible to all students
- Runs on Multiprise 3000
- The University of Geneva is one of the largest university campuses in Switzerland, with more than 12,000 students of all disciplines. It is one of the oldest universities in Europe, founded in 1559. Computing resources required for teaching and learning activities are distributed among all faculties. Computing Sciences are

grouped into the Centre

Universitaire d'Informatique

(CUI), which belongs to the

Faculty of Sciences and the

Faculty of Economics.



Boscov's Department Stores

Linux for zSeries - Infrastructure servers consolidation

- Thirty-seven department store chain - eastern U.S.A.
- Runs file/print servers on Linux for zSeries
- Currently working toward Websphere Commerce Suite on Linux for zSeries to improve Web site capabilities
- Boscov's can consolidate up to 44 servers in their server farm without increasing z900 capacity or increasing z/OS and ISV software costs
- Uses SuSE distribution
- "Boscov's Department Stores chose to move ahead with the z900 processor because it provided the business with a robust platform that could meet our expected growth in S/390 transactions, as well as an unparalleled platform for consolidation of our server farm on Linux virtual servers."

f Harry Roberts, Chief Information Officer, Boscov's Department Stores LLC



Boscov's

The Country's Largest Family Owned

DEPARTMENT STORE!

Serving Customers for over 75 Years!

Securities Industry Automation Corp. (SIAC)

Linux for zSeries - distributed application server

- Technology partner of the New York Stock Exchange (NYSE) and the American Stock Exchange
- Moved ARTMAIL application to Linux for S/390

f Delivers daily activity reports to brokers and member firms

- Application was moved from SUN servers

- SIAC is evaluating moving other

applications to Linux on zSeries

- "All US stock exchanges and markets

depend on SIAC to process their

trades, which total approximately

4 to 5 billion shares per day,

resulting in 15 to 20 million buy/sell

side transactions that have to be

processed, examined and reported."

f Steve Romano, Senior Vice President, SIAC



Korean Air

Linux for zSeries - distributed application server

- South Korean airline
 - f* Serves 77 cities in 29 countries
 - f* 111 airplane fleet
- Flight crew scheduling application in production now
- Under development:
 - f* Accounting system
 - f* Daily revenue Accounting System using WebSphere and Java
- Runs on z900 server
- "A single IBM ^ z900 running Linux

can do the work of an entire server farm.

Multiple copies of Linux can run side by

side on a server allowing for highly

scalable and manageable environments

that can handle unpredictable spikes in

Internet activity"

f Yong-Seung Hwang,

Chief Information Officer, Korean Air



Sonera Entrum

Linux for zSeries - server hosting

- Sonera Entrum is the leading broadband Internet provider in Finland
- Provides high-speed Internet access for 500,000 private and 70,000 corporate subscribers
- Uses zSeries and Linux to run 500 virtual servers on a single zSeries server
- Uses IBM Enterprise Storage Server
- Uses Red Hat and SuSE Linux
- "By consolidating all of our services onto one high availability zSeries server running Linux we are saving energy. It also makes systems management and maintenance significantly easier"

f Jukka Kämäri, Managing Director,
Sonera Entrum

