Linux on iSeries

2001 Enhancements
ITSO Technical Overview
May 2001

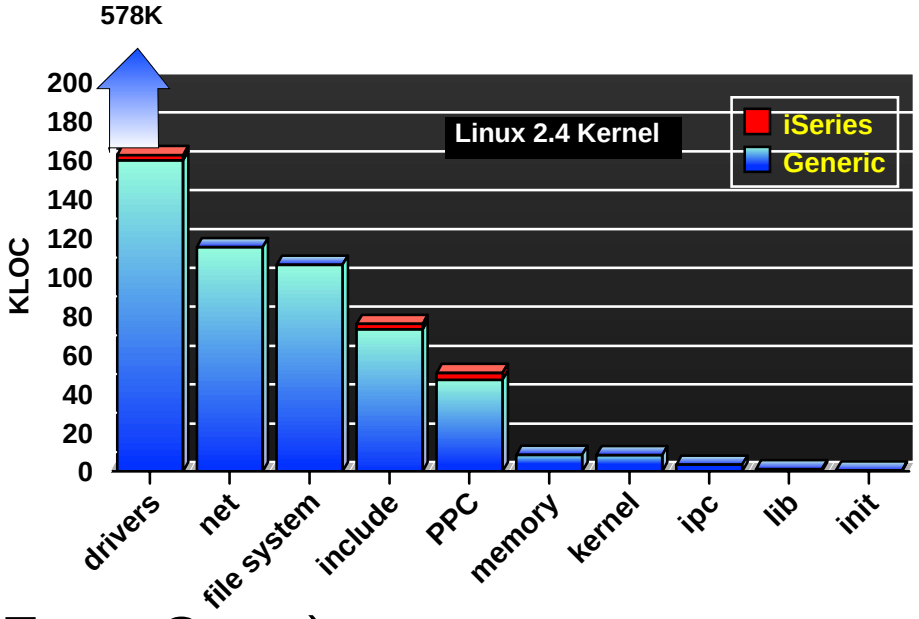
What's Linux ?

UNIX-like operating system

- Pioneered by Linus Torvalds (1991)

Open-source software

- Continuous development/testing by global community
- IBM is a contributing member
- New source of web-based applications



Cross Industry Support:

- Hardware, Software, Services
- Flexibility and choice of environment

Growth/acceptance

- 1000 users in 1992 to 9 million in 2000 (ref Tower Group)
- 166% growth in 2000 (ref IDC)
- 25% of new Server Hardware include Linux (ref IDC)

www.iseries.ibm.com/linux

Notes: What's Linux ?

Linux is a popular UNIX-like operating system originally developed by Linus Torvalds in 1991. It was initially proposed to run on inexpensive Intel hardware. It is continuously developed and tested by an open source community communicating via Internet. IBM is a contributing member of the Open Source community.

Linux has one source tree, which is compiled for a specific hardware platform to generate a Linux 32-bit Kernel (version 2.4). IBM has contributed modifications for the Linux PowerPC kernel. These modifications are Open Source, and will be available on an IBM web site - watch www.iseries.ibm.com/linux

These modifications will eventually be a part of the Linux kernel for PowerPC

- Architecture Independent Code - no changes
- Architecture Dependent Code - some changes

Linux is rapidly becoming the operating system of choice for many of today's critical computing workloads. The number of Linux users grew from about 1,000 in 1992 to about 9 million last year, according to the Tower Group. Linux is the fastest growing server operating system, growing at 166% last year according to IDC.

IDC estimates that Linux ships on at least 25% of new servers operating system ships worldwide today.

LINUX®: IBM continues to invest in supporting Linux across all IBM servers. IBM plans to provide Linux for selected models of the iSeries 400 platform by providing native support of the Linux kernel running in a secondary logical partition of the operating system. This will enable Linux applications to run on such iSeries 400 systems with very few or no changes required.

The Linux kernel will enable a new stream of e-business applications for the iSeries 400 platform that complements its strength as an integrated core business solution. Linux applications will benefit from the iSeries 400 platform's ability to provide resource flexibility, reliability, and connectivity to other applications on a single server.

"Linux represents the next step in this e-business evolution. Linux will do for software what the Internet did for networks. Linux is all about application connectivity." (Sam Palmisano, IBM President and Chief Operating Officer).

Linux on the iSeries?

Implementation Choices:

- Linux libraries in a PASE environment ("Linux within AIX")
- Linux version of the PASE environment ("Linux only")
- Linux OS in an Integrated Netfinity Server
- Linux OS as an LPAR implementation

And the winner is:

Availability

- Linux must be purchased from a Distributor
  - GA plans to be announced shortly
- IBM plans to support Linux running on iSeries in 3Q 2001
- LinuxWorld in New York and Paris - Jan 31 to Feb 2
- PartnerWorld in Atlanta - Feb 25 to 28

Future Directions

- Support for 64-bit kernel
- Additional OS/400 - Linux Integration

Linux OS in an iSeries LPAR ....

1. A Guest of OS/400 running in a Partition
2. Providing value-add similar to Integrated xSeries Server support

Notes: Linux on the iSeries?

In evaluation how to accommodate the Linux operating system with OS/400, the developers considered four available options, and opted to support Linux in a guest partition of an LPAR'ed iSeries system. This would enable Linux to be closely integrated with OS/400 in a manner parallel to the support provided with the Integrated xSeries Server (previously Integrated Netfinity Server).

IBM has previewed Linux on the iSeries at LinuxWorld in New York and Paris - Jan 31 to Feb 2 as well as at PartnerWorld in Atlanta - Feb 25 to 28, 2001. While IBM plans to support Linux running on iSeries in 3Q 2001, the Linux Distributions must be purchased by Distributors, whose general availability plans have not been announced yet.

Running Linux on the iSeries provides an integrated solution for combining the strengths of Linux and OS/400. Linux delivers excellent open source solutions, while OS/400 is a premier integrated platform for business solutions.

Future Directions include:

- Support for 64-bit kernel
- Additional OS/400 - Linux Integration

Extending the iSeries 400 Solution Base

Application Environments

- Extend core applications with SCM, CRM/BI
- Leverage IBM middleware
- Provide open environment

Interconnected for application enhancement

OS/400 Application Enablers

- Integrate for value and ease of use
- Drive to open and standard interfaces
- Leverage IBM technology

Security
- Certificates
- Virtual Private Networks
- Integrated SSL
- Hardware Cryptography

Database
- UDB
- Net Server
- JDBC interoperability
- ODBC interoperability

Manage-ment
- Single system, multi-workload
- Multi system
- Management Central
- Tivoli

Java
- Java Virtual Machine
- WebSphere
- Just In Time compilation
- Integrated memory management

Notes: Extending the iSeries 400 Solution Base

Linux on iSeries would the recommended when the strength of Linux applications are required to be integrated with the platform strengths of the iSeries, and the other iSeries-based applications.

With the inclusion of Linux support, the iSeries provides the capability to integrate

- iSeries Business Applications including
  - Enterprise Resource Planning (ERP)
  - Customer Relationship Management (CRM)
  - Supply Chain Management (SCM)
  - Business Intelligence (BI)
- Intel-based Applications
  - Running on the Integrated xSeries Server
- Native iSeries implementations of
  - Lotus Domino-based Applications
  - WebSphere-based Applications
- AIX-runtime Applications
- Now ...Linux-based Applications

Scalable

- CPW from 100 to 20,200
- 1-way to 24-way Processors

Business Recovery Protection

- Full OS/400 system backup provides disaster recovery for Linux
- Linux backup saves daily Linux files changes direct to iSeries tape device

Linux and LPAR

Linux runs in a secondary partition of OS/400

- A Guest of a partition running OS/400
- A Linux partition may require dedicated processors
  (refer iSeries Models later in this presentation)
- Resource allocation to Linux partition requires IPL of Linux
- Linux partitions are started and stopped from the primary or hosting partition
- Leverage LPAR and Integrated xSeries Server models

Minimum resources for a Linux Partition

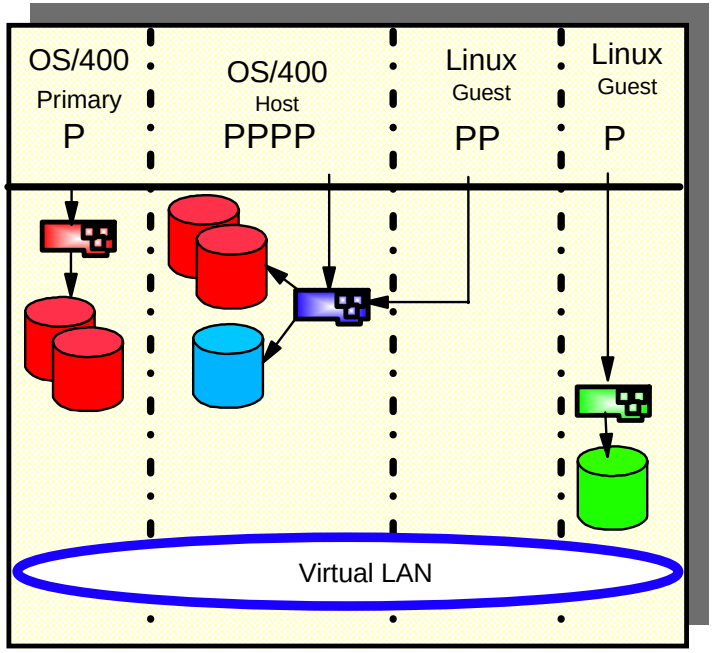
- 1 processor (iStar Processors only)
- 64 MB memory
- Virtual LAN, Console, and Disk
- No dedicated I/O hardware required

Maximum Linux Partition

- 8 processors, 4 GB of memory
- Dictated by Linux

Support on n-way 820, 830, and 840 servers

- With V5R1 Primary Partition
- Hosting Partition with V5R1



P = Processor

Notes: Notes: Linux via LPAR

iSeries Linux LPAR capabilities include:

- Static (requires an IPL to change) partitioning of processors and memory.
- Similar implementation to "Integrated xSeries server (hosted by another OS/400) support for virtual DASD, virtual CD, virtual LAN, and a virtual console.
- Native I/O resources with priority to ethernet and token ring.
- Static partitioning of native I/O resources.
- Support currently for 32-bit Linux kernels.
- Green screen configuration support. The green screen user interface will be an extension to the existing LPAR screens but will only be basic capability.
- Internal LAN for TCP/IP access to AS/400 integrated services
  - Security
  - Install / Backup & recovery
  - Data Base
  - Applications
- LINUX partition is started and stopped from primary partition
- LINUX installs from AS/400 CD-ROM or over network

Support LINUX applications:

- PowerPC based applications run - out of the box
- Intel applications require recompile
- Uses AS/400 MIPS and resources
- Can utilize AS/400 Capacity on Demand with a partition IPL

Linux LPAR capabilities not provided:

- Shared processor support on certain processors
- Dynamic I/O movement
- Interactive workloads

Virtual I/O Devices

Real Devices Owned by OS/400

- Linux partition dependent on OS/400 V5R1 hosting

Disk

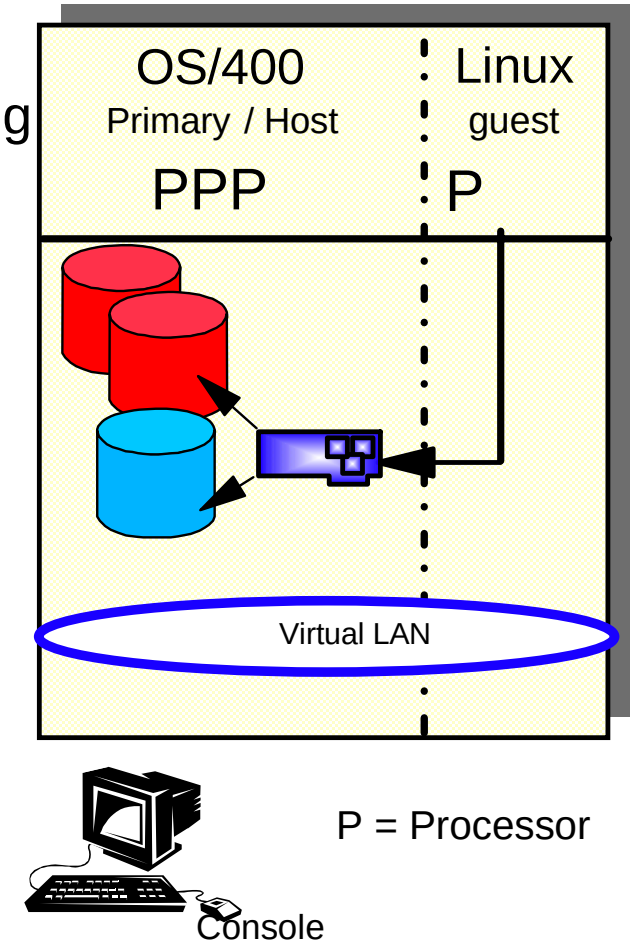
- Space is reserved for use by Linux
- Uses Network Server Device (NWSD) facilities

Tape, CD-ROM and DVD

- Varied on and off between OS/400 and Linux

Virtual LAN

- Uses LPAR Virtual LAN support
  - for partition-to- partition communication
  - between Linux and OS/400



Console
- No console adapter in Linux partition
- PC attached to hosting or primary partition via TCP/IP
- Requires LAN Operations Console and VT100 Emulator
- Used for Installation and Problem Determination

Notes: Virtual I/O Devices

All hardware devices Owned by the Host Partition running OS/400 V5R1
- Linux partition dependent on OS/400 V5R1 hosting partition

Disk space for Linux OS/Applications
- Space is reserved for use by Linux
- Uses Network Server Device (NWSD) facilities

Tape, CD-ROM, DVD
- Shared between OS/400 partitions and Linux partitions
- Varied on and off between OS/400 and Linux

Host OS/400 Partition to Linux partition Communications
- Over LPAR Virtual LAN

Request from Linux client
- In through iSeries LAN adapter
  - routed to Linux via Virtual LAN

Direct I/O Devices

Owned by Linux

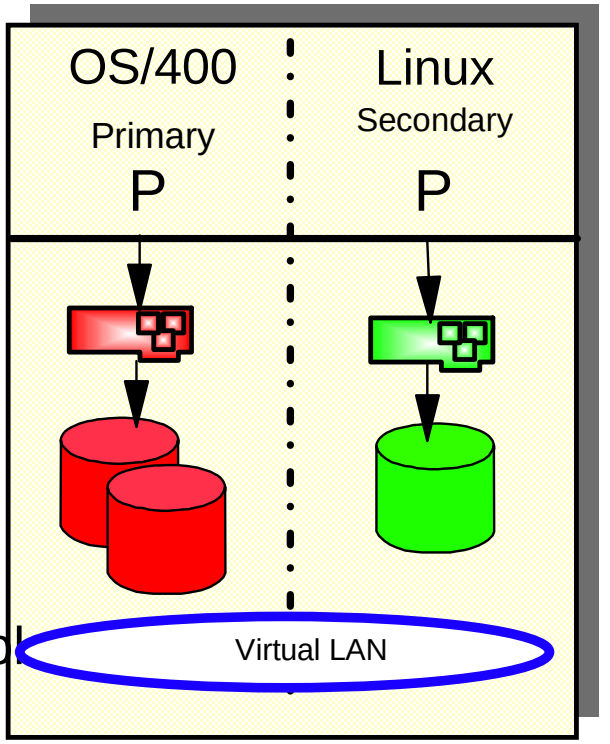
- Managed entirely by Linux
- OS/400 does not "see" them

iSeries I/O Adapters

- Ultra-2 SCSI to connect Disk, Tape, CD-ROM, DVD
  - Feature Codes: 4748, 2763, 4778
  - Hardware RAID and compression are not supported
- LAN: 1 GB Ethernet, 10/100 Mb Ethernet, 100/16/4 Mb To
  - Feature Codes: 2743, 2760, 4838, 2744

IOPs are not used

- Direct attach I/O Adapters
- Configurator will support ordering just IOAs



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Notes: Direct I/O Devices

In this environment, the I/O Adapters and disk drives are "owned" by Linux, and the hosting OS/400 partition is not aware of their existence. The disk is managed entirely by Linux O/S including backup. ISeries Disk hardware RAID and compression are not supported.

You need to order one of these features for each of the I/O Adapters to be directly attached to Linux:

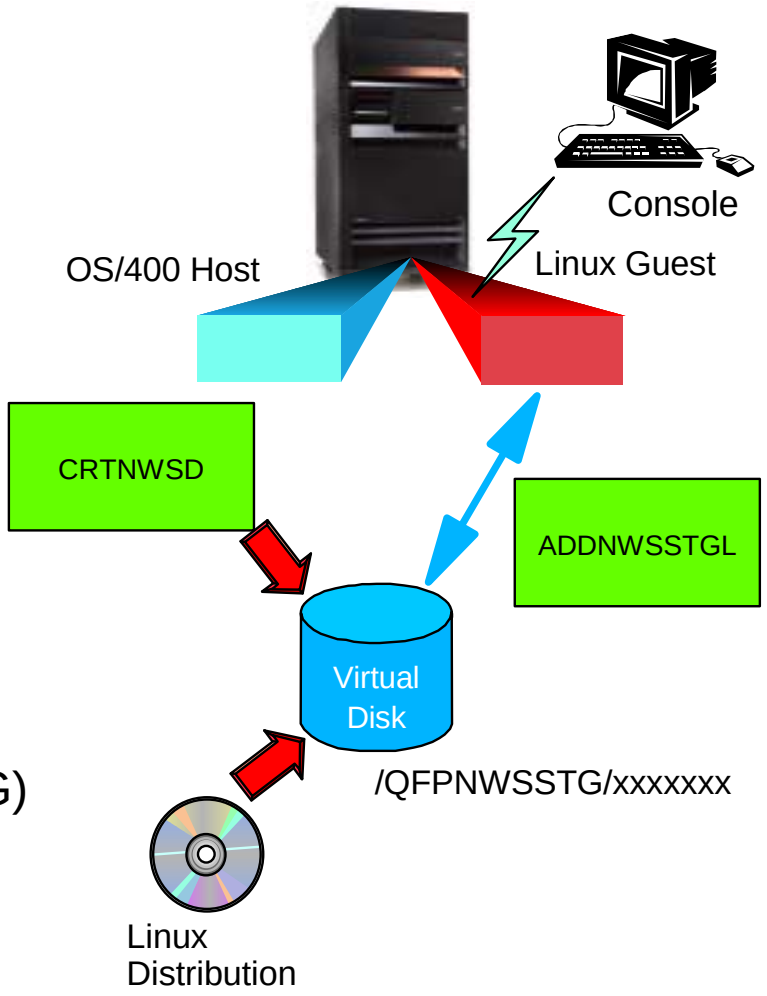
Feature	I/O Adapter
#0601	- #2743
#0602	- #2760
#0603	- #2744
#0604	- #2763
#0605	- #4748
#0605	- #4778
#0607	- #4838

Note: When directly attached to the Linux Partition, the I/O Adapters do not require PCI I/O Processors.

Installation Overview

Installation Overview

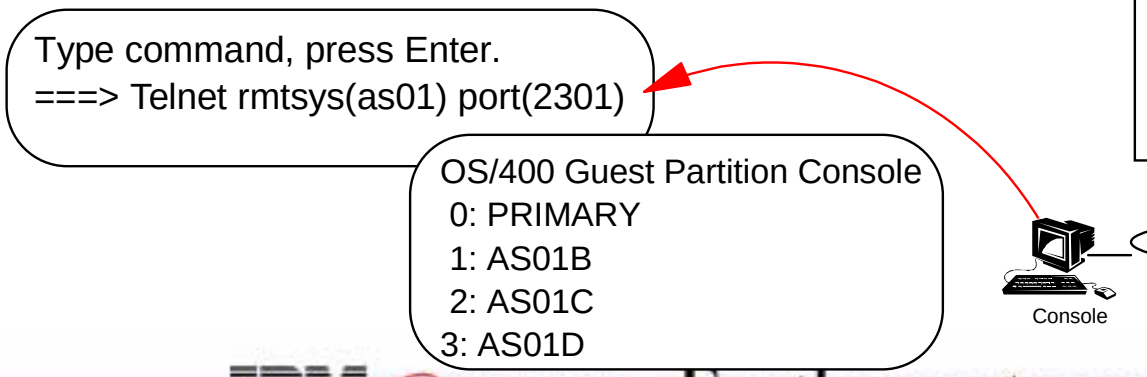
- Define Guest Partition for Linux
  - Partition Identifier/Name
  - Number of Processors
    - Up to 8 processors (Linux Maximum)
    - No "interactive" CPW required
  - Main Memory Size
    - 64 MB to 4 GB Memory (Linux Maximum)
  - Enable Virtual LAN for Communications
  - Identify Host OS/400 Partition for Linux "guest"
- Create Network Server Description (CRTNWSD)
  - Define Storage Space or "Virtual Disk" (CRTNWSSTG)
  - Add Link to Network Server Device (ADDNWSSTGL)
- Configure Console
  - Telnet - port 2301
- Vary on NWSD
- Install of Linux based on distributors install instructions
- Start Linux (VRYCFG or WRKCFGSTS *NWS)

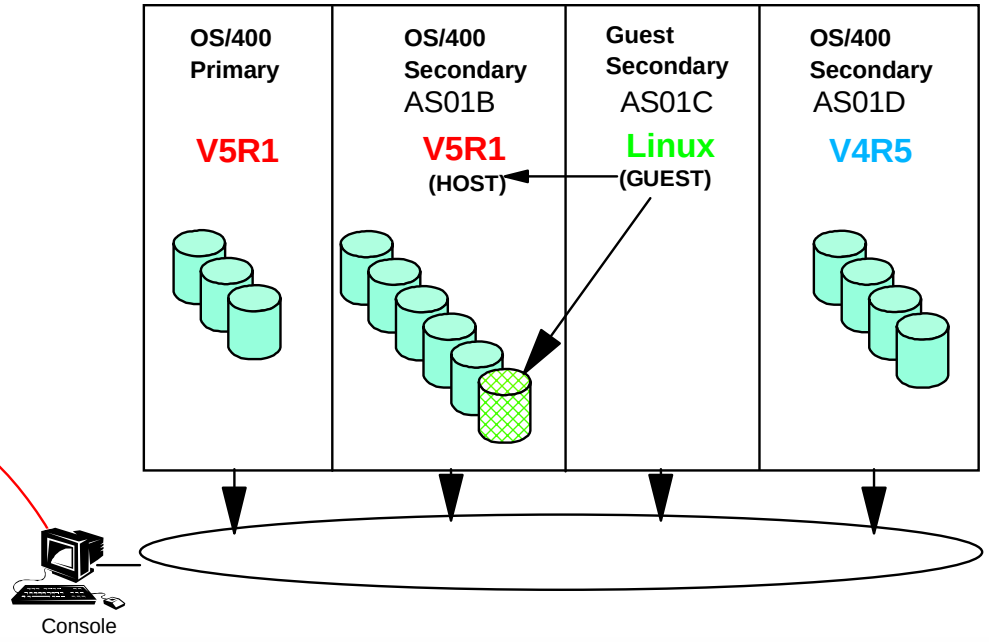


Notes: Installation Overview

Define Partition for Linux

- Guest partition (requires V5R1 on Primary).
- Enable the Virtual LAN for Communications between the OS/400 host partition and the Linux guest. This is the route used for communication between the two partitions.
  - Identify OS/400 Partition "hosting" the Linux "guest".
  - "guest" is a new partition parameter in V5R1 when you Create a new partition
- Create Network Server Description using the following command:
  - CRTNWSD NWSD(<device-name>) **RSRCNAME(*NONE) TYPE(*GUEST)** ONLINE(*NO) PARTITION() CODEPAGE(437)
- Define Storage Space or "Virtual Disk" and link to the Network Server Device
  - CRTNWSSTG NWSSTG() NWSSIZE(<size>) ASP(<value>)
  - ADDNWSSTGL NWSSTG(<storage-name>) NWSD(device-name)
- Configure Console
  - TELNET RMTSYS(<partition-name>) **PORT(2031)**
- Vary on NWSD from media
- Install of Linux based on distributors install instructions
- Start Linux (VRYCFG or WRKCFGSTS *NWS)





iSeries Models for Linux

Mdl	Ftr	Tech	MHz	CPW	n-way	LPAR	Linux	Shr Prc
270	2431	Sstar	540	465	1	Y	Y	Y
	2432	Sstar	540	1070	1	Y	Y	Y
	2434	Sstar	600	2350	2	Y	Y	Y
	2452*	Sstar	540	100*	1	Y	Y	Y
	2454*	Sstar	600	250*	2	Y	Y	Y
	2248	Pulsar	400	150	1	N	N	N
	2250	Pulsar	400	370	1	N	N	N
	2252	Pulsar	450	950	1	N	N	N
	2253	Pulsar	450	2000	2	N	N	N
	2422*	Pulsar	400	50*	1	N	N	N
	2423*	Pulsar	450	100*	1	N	N	N
	2424*	Pulsar	450	200*	2	N	N	N
820	0150	Sstar	600	1100	1	Y	Y	Y
	0151	Sstar	600	2350	2	Y	Y	Y
	0152	Sstar	600	3700	4	Y	Y	Y
	2435	Sstar	600	600	1	Y	Y	Y
	2436	Sstar	600	1100	1	Y	Y	Y
	2437	Sstar	600	2350	2	Y	Y	Y
	2438	Sstar	600	3700	4	Y	Y	Y
	2456*	Sstar	600	100*	1	Y	Y	Y
	2457*	Sstar	600	250*	2	Y	Y	Y
	2458*	Sstar	600	400*	4	Y	Y	Y

Mdl	Ftr	Tech	mhz	CPW	n-way	LPAR	Linux	Shr Prc
820	2395	Pulsar	400	370	1	Y	N	N
	2396	Pulsar	450	950	1	Y	N	N
	2397	IStar	500	2000	2	Y	Y	N
	2398	IStar	500	3200	4	Y	Y	N
	2425*	Pulsar	450	100*	1	Y	N	N
	2426*	IStar	500	200*	2	Y	Y	N
	2427*	IStar	500	300*	4	Y	Y	N
830	2400	IStar	400	1850	4	Y	Y	N
	2402	IStar	540	4200	8	Y	Y	N
	2403	IStar	540	7350	8	Y	Y	N
	2351	IStar	540	7350	4/8	Y	Y	N
840	2461	Sstar	600	20200	24	Y	Y	Y
	2352	Sstar	600	12000	8/12	Y	Y	Y
	2353	Sstar	600	16100	12/18	Y	Y	Y
	2354	Sstar	600	20200	18/24	Y	Y	Y
	2418	IStar	500	10000	12	Y	Y	N
	2420	IStar	500	16500	24	Y	Y	N
	2416	IStar	500	10000	8/12	Y	Y	N
	2417	IStar	500	13200	12/18	Y	Y	N
	2419	IStar	500	16500	18/24	Y	Y	N

No Linux Support

No Shared Processor Support for Linux

* Domino Server-Dedicated

Notes: iSeries Models for Linux

For **non-SStar models only**, set QPRCMLTTSK=0 - Disable processor multitasking by changing the System Value(QPRCMLTTSK=0) Processor multitasking. This system value allows you to turn on and turn off Processor multitasking capability. If enabled, more than one set of task data will be resident in each CPU. Some workloads may experience increased performance due to caching implications. On a partitioned system, this system value is changed from the primary partition only. A change to this system, value takes effect at the next IPL. The shipped value is 1. This system value effects all partitions of the iSeries system.

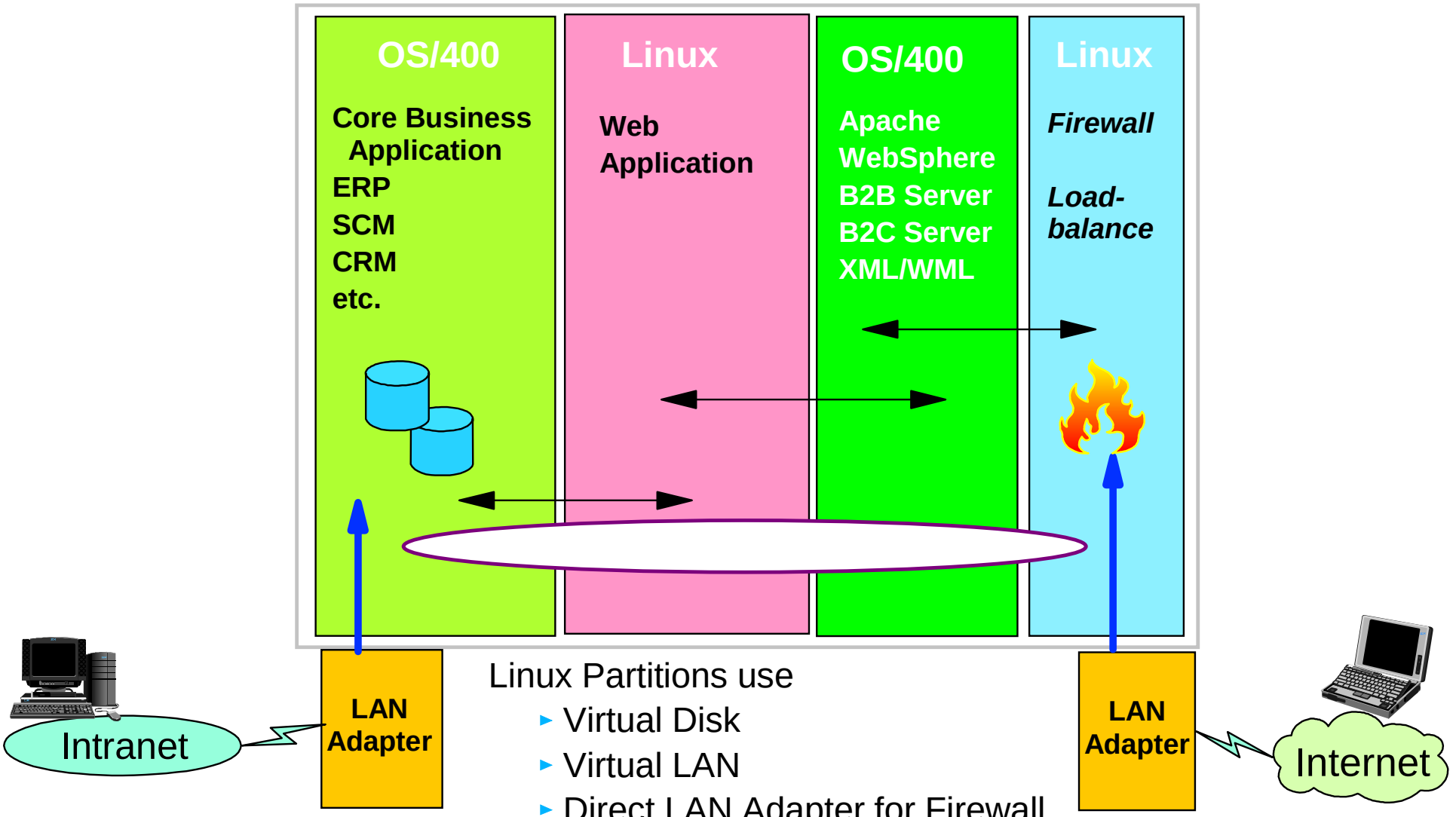
Partitioning:

- Partition the iSeries system to support a host OS/400 partition and a guest Linux partition. The number of processors allocated to a Linux partition must be no more than 8 processors. The main memory allocation should be between 64MB and 4GB. The maximum values are limitation set by Linux capabilities. **Note: Because the Linux Partition has to be defined as a GUEST, V5R1 support is required for the Primary partition.**

Shared Processors

- When configuring LPAR for Linux, a partition can either allocate a number of "whole" physical processors, or a partition can "share" a fraction of a physical processor with another partition. **Only certain iSeries models support a "Shared Processor" configuration.**

iSeries - Linux Example



Linux Partitions use

- Virtual Disk
- Virtual LAN
- Direct LAN Adapter for Firewall

Notes: iSeries - Linux Example

The **primary partition must run OS/400 V5R1** and can support up to 31 Linux partitions depending on the Series model. Selected new processor features for iSeries Model 270, 820, and 840 servers (Sstar), will allow Linux to run in a shared processor pool, where one processor can be shared between four OS/400 and Linux partitions. On existing n-way processor features for iSeries Model 820, 830 and 840 servers, Linux requires a minimum of one processor per Linux environment.

iSeries logical partition capability provides the flexibility to move processor and memory resources between Linux partitions. This movement requires a restart of the affected Linux partitions.

Series Linux partitions also support a wide selection of I/O options. A Linux partition can utilize the new Virtual LAN capability to establish multiple high speed TCP/IP connections between logical partitions without additional communication hardware. iSeries disk and removable media devices can be configured for Linux partitions using the OS/400 Network Server Description (NWSD) OS/400 commands to provide a simple, flexible, and integrated storage solution. Additionally, Linux can utilize selected iSeries I/O adapters (IOAs) and devices directly. These configuration options enable a wide selection of iSeries solutions.

Linux Distributions

Distributions - prepackaged

- Use PowerPC Linux kernel with iSeries modifications
  - Add Operating System
  - Add Middleware
  - Add Application components

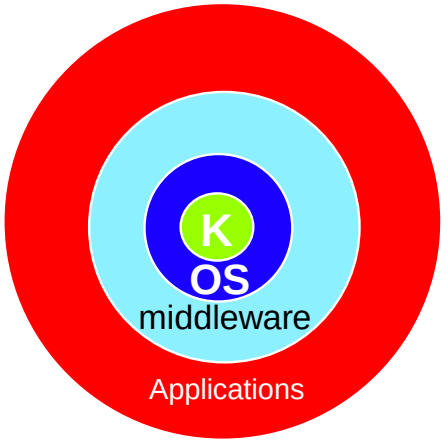
Linux applications

- PowerPC Linux (iSeries/pSeries)
  - Run out of "box"
- Intel Linux
  - Need to be compiled for PowerPC

Development Options

- Linux on iSeries
- PowerPC workstation or server
- Cross Compilers from Intel systems to PowerPC

Distribution



Linux Kernel +
Operating System +
Middleware +
Applications
=
Distribution

Notes: Linux Distributions

IBM will not distribute Linux software itself, but will provide support in OS/400 for the Linux applications.

Commercial "Distributions" will provide prepackaged low-cost version of Linux. It is important to note that any program built for PowerPC Linux will run on all PowerPC Linux platforms. Applications and programs that run on Linux on the pSeries platform will also run on the iSeries platform. Even prior to a formal distribution supporting iSeries, all the packages on the SuSE PowerPC CD run today on the iSeries system. in other words, any standard Linux PowerPC distribution should work on the iSeries (however, initially, only a few selected distributions will be supported through IBM Support).

The Apache Webserver product supported on the iSeries also supports Linux.

Distribution Example: Red Hat 7.0 Server for Intel Includes

MW + Apps	Red Hat 7.0 Professional Server
Web Server	Apache, Tux, thttpd, Zope
Mail Server	sendmail, postfix, exim, WU IMAP
Print Server	lprng, cups
File Server	samba, NFS
News Server	INN
FTP Server	w-ftpd
Firewall	IPchains, TCP wrappers
DHCP	dhcpd
DNS	bind

Source: http://www.redhat.com/products/software/linux/rhl7_server.html on 12/21/00

Linux for iSeries

Possible Distributors for iSeries

- Red Hat
- SuSE
- TurboLinux

Availability Dependent on

- IBM for enablement
- Distributors for product

Support

- Integration - iSeries OS/400 SupportLine
- Linux - separate option
- IBM
- Distributors etc.

Notes: Linux for iSeries

Linux is an open-source product. Therefore an individual or organization can obtain the source format and build a Linux environment. However, to overcome some of the complexities platform specific implementations, and the integration of multiple application solutions, a number of standard Linux Distributions have been developed by leading Linux Distributors.

A Linux Distribution is a coherent collection of software products built around a Linux Kernel for a specific platform architecture. It would include a methodology for ordering, receiving, installing and implementing a application product.

Currently IBM is working with the following Distribution Partners for Linux on iSeries:

- Red Hat
- SuSE
- TurboLinux

The availability of distributions on iSeries is dependent on

- IBM for enablement - GA in 3Q2001
  To enable Linux to run on the iSeries, IBM has contributed to the open source 32-bit kernel version 2.4 for PowerPC. IBM is currently working with the Linux community to create Linux distributions for iSeries. IBM plans to support selected Linux distributions running on iSeries in the second half of 2001.
- Distributors for product Support
- Integration - iSeries OS/400 SupportLine
- Linux - separate option
- IBM
- Distributors etc.

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PowerPC	PowerPC AS	SanFrancisco
Host on Demand	Screen Publisher	Host Publisher
PCOM	WebSphere Commerce Suite	Payment Manager
WebSphere	WebSphere Standard Edition	WebSphere Advanced Edition
MQSeries	MQSeries Integrator	Host Integration Series
WebSphere Development Tools for AS/400	VisualAge for Java	VisualAga for RPG
CODE/400	DB2 UDB for AS/400	HTTP Server for AS/400
iSeries		

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