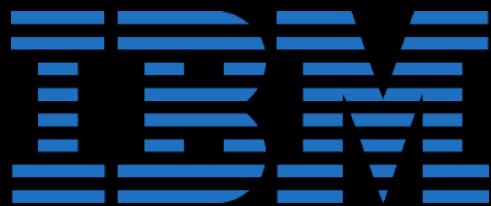


# IBM i

60 things other  
platforms just dreams  
about

# About me

## Torbjörn Appehl



IBM Champion

5 Year Milestone



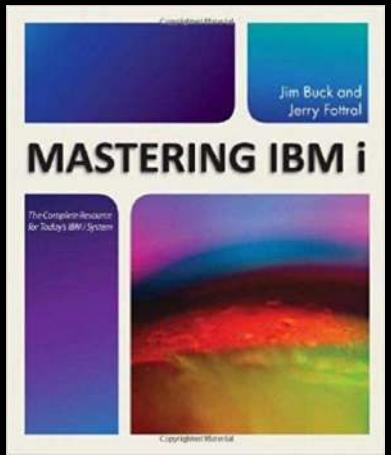
IBM i

Not your grandfathers AS/400, iSeries or System i  
Knowledge is POWER  
It is IBM i since 2008. But you knew that didn't you.

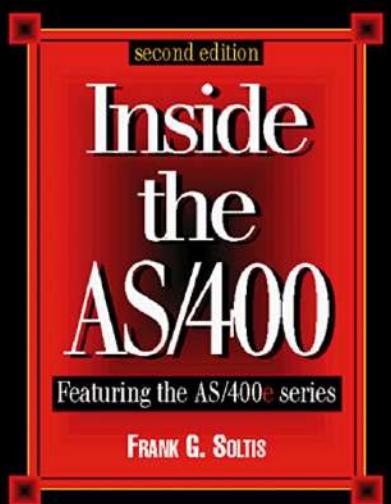
common  
EUROPE

<https://www.ibmicompetence.com/>

# Thank you



# Google



**Observations from Uppsala**  
Computer simulation, programming, software, technology, research, and more (since 2007)

## IBM i – I'm Impressed

Jakob  
2011 August 14  
computer architecture,  
history of computing  
IBM, IBM i, Software  
Engineering Radio, Steve  
Will

From what little I had heard and read, the IBM AS/400 (later known as iSeries, and now known as simply IBM i) sounded like a fascinating system. I knew that it had a rich OS stack that contained most of the services a program needs, and a JVM-style byte code format for applications that let it change from custom processors to Power Architecture without impacting users at all. It was supposedly business-critical and IBM-quality rock solid. But that was about it.

Welcome to PUB400.COM - your public IBM i 7.4 server

What is PUB400.COM?  

- A free and public server running IBM i 7.4 for everyone.
- It has 16Gb RAM, 1Gb disk storage and two power supplies.
- You can program in CL, RPG, COBOL, run your apps and start learning about the cool server system over 100GB of space.
- Or just browse the web, or download some software or other wise be awesome.
- On average of 45 new users per day Great IBM i community!

About PUB400.COM:  
This system has been serving the IBM i community for almost 15 years since starting as a little test system. Serving more than 70 000 Users worldwide as a learning and testing environment to get in touch with the most advanced business operating system "IBM i" (named "AS/400" before). IBM i is the best integrative platform for managing and running business oriented workload combining legacy software with modern open source techniques. It's just up to you - IBM i will handle it.  
Please respect some rules using this system:

- Don't create multiple accounts or try to log on connected environments.
- There will be a hard restriction on number of connections from a single IP.
- There will be a hard limiting on switching other users from a user to another.
- Don't use the system for illegal purposes, or for any other reason than what is written in the rules.
- If you need reliable access, high quality service, and fast R2H2D2, then you're in the wrong place.
- The system is in a development. But it's not for a reason make movements, unless the whole.

[Sign up](#) and start exploring IBM i.  
[Reset password](#) when lost your password and cannot connect.  
[User forum](#) share knowledge in our little forum (members-only).  
[FAQ](#) some useful help pages.  
[Links and docs](#) some useful links and documents.

IBM i is beautiful in it's architecture and design  
and unique in how it all hangs together not at least with  
with IBM Power



THERE IS NO SPECIFIC ORDER  
I AM GOING HIGH AND LOW

A close-up photograph of a bright orange goldfish swimming towards the left. The fish has a slightly translucent body and a full, flowing tail and fin. The background is a clear, gradient blue, suggesting an underwater environment.

"REMEMBER,  
A **DEAD** FISH CAN  
FLOAT  
DOWNSTREAM,  
BUT IT TAKES A **LIVE**  
ONE TO SWIM  
UPSTREAM."

-ANNIE LEIBOVITZ



# IBM Future Systems Project

In the late 1960s and early 1970s, IBM considered a radical redesign of their entire product line to take advantage of the much lower cost of computer circuitry expected in the 1980s

The major objectives of the FS project were consequently stated as follows:

- make obsolete all existing computing equipment, including IBM's, by fully exploiting the newest technologies
- diminish greatly the costs and efforts involved in application development and operation
- provide a technically sound basis for re-bundling as much as possible of IBM's offerings (hardware, software and services)

It was hoped that a new architecture making a heavier use of hardware resources, the cost of which was going down, could significantly simplify software development and reduce costs for both IBM and customers.

# Secondly, what do they have?



**Stable and Flexible Workhorse Operating System**  
Verified User  
Engineer in Information Technology  
Information Technology & Services Company, 201-500 employees

Score 10 out of 10 • Vетted Review • Verified User • Review Source

**Use Cases and Deployment Scope**  
Windows Server is our organization's primary server operating system. It's used to support needs across the entire organization, from authentication, file and print to database, application and web servers.

**Pros and Cons**

- ⊕ Easy to manage
- ⊕ Wide Application Compatibility
- ⊕ Stable operating system environment
- ⊕ Flexible, suitable for a number of different roles
- ⊖ Security, always room for improvement there
- ⊖ UI driven platform makes doing things from the CLI difficult at times.
- ⊖ Patching process can turn into a nightmare with the way security updates are bundled and documented

- ⊖ Windows Server is extremely complex, and while newer versions have eased the initial setup process, setting up a server is still a very time consuming and difficult task.
- ⊖ The complexity of Windows Server also makes troubleshooting any problems that arise extremely difficult, both in tracking down the actual issue and then resolving the issue. Often times a problem can manifest itself in more than one way, making searching for the specific problem also difficult.
- ⊖ Windows Server is also very expensive, with complex and confusing licensing terms. In fact, Microsoft provides a 32-page PDF guide on Windows Server licensing, which is in and of itself dense and confusing to follow. To make matters more complicated, there are multiple different versions of Windows Server itself - Nano, Essentials, Standard and Datacenter edition, and each edition has different licensing terms. Licensing terms include items such as the physical processor's cores of the server, how many users will be accessing the server (called a CAL - client access license), and a plethora of other items.
- ⊖ Microsoft's support for Windows Server can be extremely frustrating at times. While Microsoft hosts a very active user forum, Microsoft employees who frequent those forums often provide only stock answers to questions (without actually reading the details) or no answers at all. For more in-depth phone support can be quite expensive.
- ⊖ Upgrading a Windows Server from one major version to another (i.e. 2012 to 2016) is a frustratingly complex and dangerous procedure, as many things can go wrong during the upgrading, essentially breaking the entire setup. In fact, Microsoft doesn't even suggest doing an in-place upgrade, but to perform a backup of the existing server, doing a clean install of the new version, and migrating the information from the older version to the new version. In general, it is not even recommended to upgrade from one version to another as the risk significantly outweigh the benefits.

**Advantages**

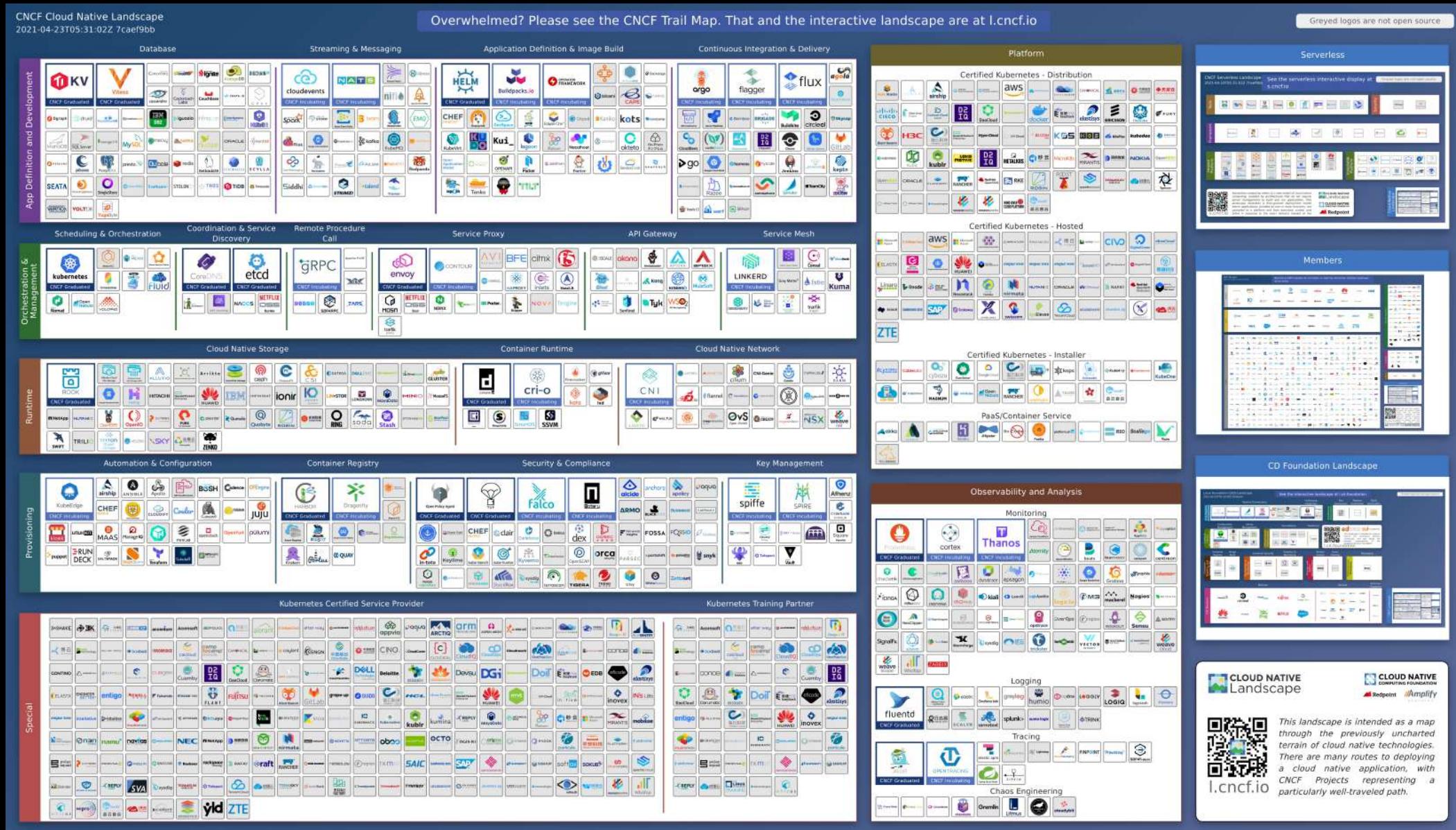
1. Ease of use
2. Available software
3. Backwards compatibility
4. Support for new hardware
5. Plug & Play
6. Games
7. Compatibility with MS driven websites

**Disadvantages**

1. High resource requirements
2. Closed Source
3. Poor security
4. Virus susceptibility
5. Outrageous license agreements
6. Poor technical support
7. Hostile treatment of legitimate users
8. Extortionist prices
9. Additional expenses
10. Poor stability
11. Vendor lock-in
12. Backwards incompatible file formats
13. Poor support for older hardware
14. Poor remote access
15. High Total Cost of Ownership



# The latest hype, Cloud Native





Ok, lets start

# 5250

```
MAIN          IBM i Main Menu
System: Select one of the following:

1. User tasks
2. Office tasks
3. General system tasks
4. Files, libraries, and folders
5. Programming
6. Communications
7. Define or change the system
8. Problem handling
9. Display a menu
10. Information Assistant options
11. IBM i Access tasks

90. Sign off

Selection or command
===>  

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F13=Information Assistant
F23=Set initial menu
(C) COPYRIGHT IBM CORP. 1980, 2009.
ONLINE          M 20,7
```

Have you ever tried command line on Windows or Linux?

# Menu driven interface

```
MAIN                                IBM i Main Menu
                                         System: PUB400
Select one of the following:
1. User tasks
2. Office tasks
3. General system tasks
4. Files, libraries, and folders
5. Programming
6. Communications
7. Define or change the system
8. Problem handling
9. Display a menu
10. Information Assistant options
11. IBM i Access tasks
12. Sign off
Selection or command
==> go backup_
F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F1
F23=Set initial menu
(C) COPYRIGHT IBM CORP. 1980, 2018.
MR  A

                                         BACKUP
                                         Backup Tasks
                                         System: PUB400
To select one of the following, type its number below and press Enter:
1. Run backup
2. Display backup status
10. Set up backup
20. Initialize a tape
21. Initialize a tape set
RUNBACKUP                               Run Backup
                                         System: PUB400
To select one of the following, type its number below and press Enter:
1. Run daily backup
2. Run weekly backup
3. Run monthly backup
10. Back up IBM-supplied libraries
11. Back up the entire system
Type a menu option below
1_
F1=Help   F3=Exit   F9=Command line   F12=Cancel
MR  A

                                         Type a menu option below
                                         -
                                         F1=Help   F3=Exit   F9=Command line   F12=Cancel
MR  A
21/007
```

# Advanced Function Keys and massive help built in

# F1 – Get help

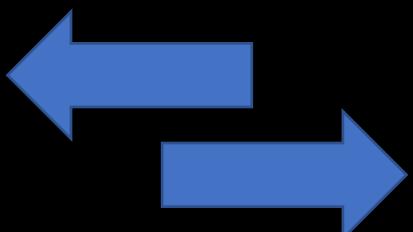
Help

Display Messages - Help

The Display Messages (DSPMSG) command is used by the display station user to show the messages received at the specified message queue. If the message queue is not allocated to the job in which this command is entered or to any other job, it is implicitly allocated by this command for the duration of the command. When the messages are shown, options are also shown that allow the user to either remove one or more messages from the queue or to enter a reply to each inquiry message.

```
.....  
Select Assistance Level  
  
Current assistance level . . : Intermediate  
  
Type choice below, then press Enter.  
  
Assistance level . . . . . 2 1=Basic  
                                2=Intermediate  
  
F1=Help   F12=Cancel
```

F8/F9



## F4 - Prompting

## Display Software Resources (DSPSFWRSC)

Type choices, press Enter.

# System Request

System Request

Select one of the following:

- 1. Display sign on for secondary job
- 2. End previous request
- 3. Display current job
- 4. Display messages
- 5. Send a message
- 6. Display system operator messages
- 7. Display work station user
  
- 80. Disconnect job
  
- 90. Sign off

Selection

—  
F3=Exit F12=Cancel

(C) COPYRIGHT IBM CORP. 1980, 2018.

System: PUB400

Display Job  
System: PUB400  
Job: QPAD090744 User: TAPPEHL Number: 080753

Select one of the following:

- 1. Display job status attributes
- 2. Display job definition attributes
- 3. Display job run attributes, if active
- 4. Display spooled files
  
- 10. Display job log, if active, on job queue, or pending
- 11. Display call stack, if active
- 12. Display locks, if active
- 13. Display library list, if active
- 14. Display open files, if active
- 15. Display file overrides, if active
- 16. Display commitment control status, if active

More...

Selection

—  
F3=Exit F12=Cancel

M A

21/007

M A

20/007

# Commands you understand

ANZPRB – Analyze Problem

DSPJOB – Display Job

DSPLLOG QHST

PWRDWNSYS

```
df -h -x squashfs  
head -n 5 core.c  
ps -e | grep shutter.  
tar -cvjf songs.tar.bz2 Ukulele/
```



Concepts that had  
businesses and  
business  
applications in mind  
from the beginning

# Jobs

All work done on a system is performed through jobs. Each job has a unique name within the system. All jobs, with the exception of system jobs, run within subsystems.

The job accounting function gathers data so that you can determine who is using your system and what system resources they are using. It also assists you in evaluating the overall use of your system.

```
Work with Job
System: PUB400
Job: QPAD073443 User: TAPPEHL Number: 120620

Select one of the following:
1. Display job status attributes
2. Display job definition attributes
3. Display job run attributes, if active
4. Work with spooled files
10. Display job log, if active, on job queue, or pending
11. Display call stack, if active
12. Work with locks, if active
13. Display library list, if active
14. Display open files, if active
15. Display file overrides, if active
16. Display commitment control status, if active
More...
```

```
Work with Active Jobs
PUB400
04/22/21 11:17:23 UTC
CPU %: .0 Elapsed time: 00:00:00 Active jobs: 303

Type options, press Enter.
2=Change 3=Hold 4=End 5=Work with 6=Release 7=Display message
8=Work with spooled files 13=Disconnect ...
Current
```

```
Work with Active Jobs
PUB400
04/22/21 11:17:23 UTC
CPU %: .0 Elapsed time: 00:00:00 Active jobs: 303

Type options, press Enter.
9=Exclude 10=Display call stack 11=Work with locks
12=Work with threads 14=Work with mutexes ...
Current
```

# Subsystems

The subsystem is where work is processed on the system. A subsystem is a single, predefined operating environment through which the system coordinates the work flow and resource use. The system can contain several subsystems, all operating independently of each other.

## System

Subsystem Nordics

Application Sweden

Application Norway

Subsystem EMEA

Application Germany

Application UK

To efficiently use system resources, different types of jobs require different processing instructions and system resources. To meet this need, the operating system creates unique operating environments called *subsystems*. Each subsystem has a set of system resources, especially a memory pool, that determines how quickly it can process jobs.

You can Run an HTTP Server in its own Subsystem. If you have multiple HTTP servers, you can have each HTTP server run in its own subsystem.



# Memory pools

A memory pool is a logical division of main memory or storage that is reserved for processing a job or group of jobs. On your system, all main storage can be divided into logical allocations called memory pools. By default, the system manages the transfer of data and programs into memory pools.

System	Pool	Reserved	Max	
Pool	Size (M)	Size (M)	Active	Pool
1	3131.51	2087.59	+++++	*MACHINE
2	53596.48	5.25	168	*BASE
3	8192.00	.00	244	*INTERACT
4	32.00	.00	5	*SPOOL

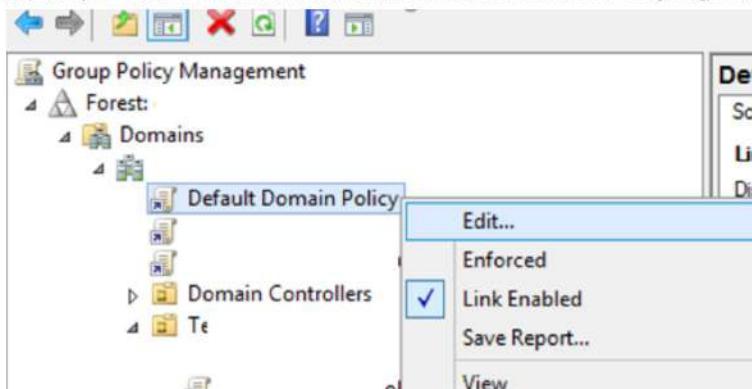
Multiple pools in a subsystem help you to control the jobs' competition for system resources. The advantages of having multiple pools in a subsystem are that you can separate the amount of work done and the response time for these jobs. For example, during the day you may want interactive jobs to run with good response time. For better efficiency you can make the interactive pool larger. At night you might be running many batch jobs, so you make the batch pool larger.

# System values

You can use system values to change the system in order to define the working environment. For example, system date, library list, international characteristics, and certain security features are all set by system values.

1. To configure the AD account password policy, open the **Group Policy Management** console (`gpmc.msc`);

2. Expand your domain and find the GPO named **Default Domain Policy**. Right-click it and select **Edit**;



3. Password policies are located in the following GPO section: **Computer configuration**

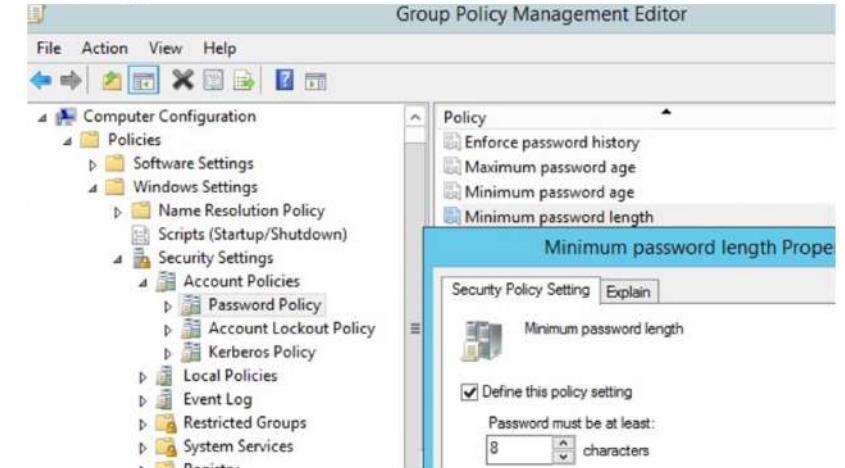
**Settings->Security Settings -> Account Policies -> Password Policy;**

Selection or command  
==> `chgsysval QPWDADMINLEN`

F3=Exit F4=Prompt F9=Retrieve F12=Cancel

4. Double-click a policy setting to edit it. To enable a specific policy setting, check the **Define this policy settings** and specify the necessary value (on the screenshot below, I have set the minimum password length to 8 characters).

Save the changes;



5. The new password policy settings will be applied to all domain computers in the background in some time (90 minutes), during computer boot, or you can [apply the policy immediately](#) by running the `gpupdate /force` command.

# 100% SQL Standard

“Some customers are developing their database model on Db2 first as this is the most standard SQL compliant database they have”



- Db2 for i 7.4 conforms with the following industry standards for SQL:
- ISO/IEC 9075-1:2016, Information technology - Database languages - SQL - Part 1: Framework (SQL/Framework)
  - ISO/IEC 9075-2:2016, Information technology - Database languages - SQL - Part 2: Foundation (SQL/Foundation)
  - ISO/IEC 9075-3:2016, Information technology - Database languages - SQL - Part 3: Call-Level Interface(SQL/CLI)
  - ISO/IEC 9075-4:2016, Information technology - Database languages - SQL - Part 4: Persistent Stored Modules (SQL/PSM)•
  - ISO/IEC 9075-10:2016, Information technology - Database languages - SQL - Part 10: Object Language Bindings (SQL/OLB)
  - ISO/IEC 9075-11:2016, Information technology - Database languages - SQL - Part 11: Information and Definition Schemas (SQL/Schemata)
  - ISO/IEC 9075-14:2016, Information technology - Database languages - SQL - Part 14: XML-Related Specifications (SQL/XML)
- Db2 for i 7.3 conforms with the following industry technical report for SQL:
- ISO/IEC TR 19075-6:2016, Information technology - Database languages - SQL Technical Reports - Part6: SQL support for JavaScript Object Notation (JSON)

# A Secure System

[IBM » I » 7.4 : Vulnerability Statistics](#)

[Vulnerabilities \(1\)](#) [Related Metasploit Modules](#) (Cpe Name:cpe:/o:ibm:i:7.4)

[Vulnerability Feeds & Widgets](#)

**Vulnerability Trends Over Time**

Year	# of Vulnerabilities	DoS	Code Execution	Overflow	Memory Corruption	Sql Injection	XSS	Directory Traversal	Http Response Splitting	Bypass something	Gain Information	Gain Privileges	CSRF	File Inclusion	# of exploits
<a href="#">2019</a>	1														
<b>Total</b>	1														
% Of All		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Warning : Vulnerabilities with publish dates before 1999 are not included in this table and chart. (Because there are not many of them and they make the page look bad; and they may not be actually published in those years.)

[Microsoft » Windows Server 2016 : Vulnerability Statistics](#)

[Vulnerabilities \(889\)](#) [CVSS Scores Report](#) [Browse all versions](#) [Possible matches for this product](#) [Related Metasploit Modules](#)

[Related OVAL Definitions](#) : [Vulnerabilities \(0\)](#) [Patches \(5\)](#) [Inventory Definitions \(0\)](#) [Compliance Definitions \(0\)](#)

[Vulnerability Feeds & Widgets](#)

**Vulnerability Trends Over Time**

Year	# of Vulnerabilities	DoS	Code Execution	Overflow	Memory Corruption	Sql Injection	XSS	Directory Traversal	Http Response Splitting	Bypass something	Gain Information	Gain Privileges	CSRF	File Inclusion	# of exploits
<a href="#">2016</a>	39	1	7	12	2					3	6	23			
<a href="#">2017</a>	251	29	50	13	4		1			17	103	13			
<a href="#">2018</a>	242	18	41	17	1		1			40	68				
<a href="#">2019</a>	357	30	122	102	8		1			11	73	2			
<b>Total</b>	889	78	220	144	15		3			71	250	38			
% Of All		8.8	24.7	16.2	1.7	0.0	0.3	0.0	0.0	8.0	28.1	4.3	0.0	0.0	0.0

Warning : Vulnerabilities with publish dates before 1999 are not included in this table and chart. (Because there are not many of them and they make the page look bad; and they may not be actually published in those years.)

“The IBM i design really shows how to build a secure by design system, where all other OSes seem to try to patch security on as an afterthought”

# Integral Security

Where IBM i really stands out is in the decision to forgo the traditional concept of a file system and instead rely on an object storage concept. This has tremendous advantages for security. Both since access rights are powerful and attached to objects, and by avoiding all the dangers of a typical file system. For example, there is no way to make a document executable. Programs are programs, data objects are data objects, and you cannot make a Windows .exe masquerade as a .jpg. All users are associated with a user profile indicating what they can do and work with.



# A reliable system

# Never-reused address



The use of persistent never-reused object addresses for permanent objects in the system was really surprising – but it does solve many security problems and robustness problems in a neat way.

All programs and data reside in this massive space and are addressable from a single permanent address, which is never reused.



## Top 8 Ways to Fix Attempted Write to Readonly Memory BSOD ...

25 Jan 2021 — The error 0x000000BE (**ATTEMPTED WRITE TO READONLY MEMORY**) occurs when a driver tries to write on a **read-only** segment of your computer's **memory**. If the system manages to identify the driver that caused the error, that driver is going to be mentioned near the STOP message on the **Blue Screen of Death** screen.

<https://jakob.engbloms.se/archives/2111>



# Tags Active Mode

The management of user-space pointers is really amazing. With a little bit of hardware support, the system actually notices if a user-level instruction (in native mode on the processor, obviously, following the MI compilation) changes a pointer. Using a special set of tag bits that associate one bit with each 16 bytes of memory, the OS underneath the MI layer will know if the user has tampered with a pointer. And refuse to use it if this is the case. This creates a situation where a user-level program really cannot do any harm – it cannot address outside of the objects it has access to, and it has no way to forge a pointer as the OS has a way to detect that!

<https://jakob.engbloms.se/archives/2111>



# Tags Active Mode

As perhaps expected for any capability, in order to access an object, a program needs a valid pointer to that object. And in order to get a valid pointer to an object, the executing program needs to show that it has the right to that object. Although the process of simply loading, storing, and copying of pointers can be done very quickly via inlined program code, the process of proving the rights to an object and from there getting a newly created Tagged Pointer is a function of the privileged part of IBM i.

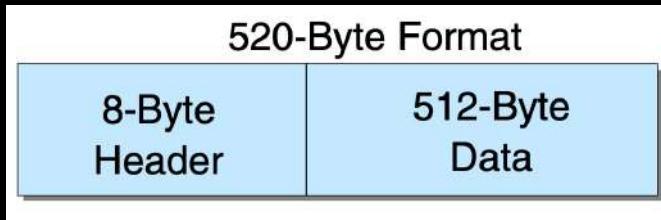
IBM i today runs on a Power-based processor architecture, one enhanced over the typical Power architecture largely in the way that it supports addressing. Along with the process-local addressing used in the base Power architecture, this extended architecture supports Tagged Pointers as well as what IBM i calls Single-Level Store (SLS)

In other words, the hardware is hardcoded to the precise design of IBM i

# 520-byte disks

(512-byte is standard)

When we wanted to move a page from memory to disk, we had another problem. Memory has extra bits for ECC and tags, the disk does not.



Virtual data integrity information

The additional sector bytes are used by IBM i as part of the implementation of its object security.

“520-byte sectors could – and in IBM i do - include the tags for the associated 512 bytes of data”

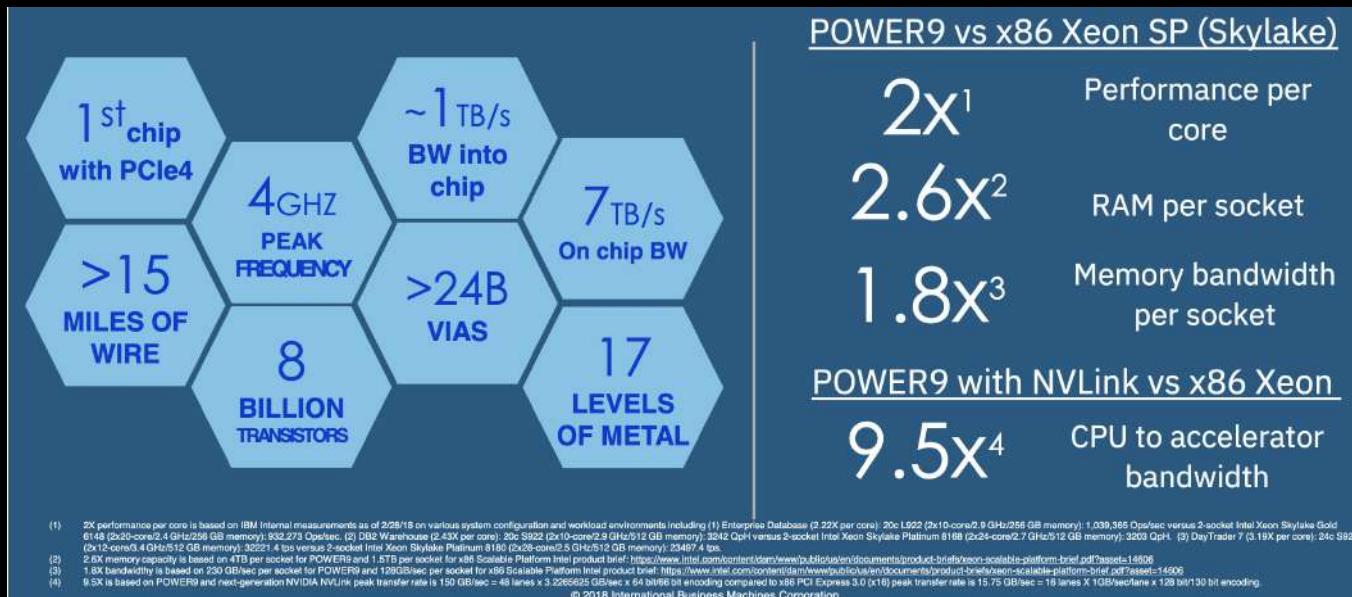


# IBM Power is not x86

For the 12th consecutive year, IBM Power Systems has achieved the highest server reliability rankings when compared to all x86 servers according to ITIC's 2020 Global Server Hardware and Server OS Reliability survey.

Data from IDC has shown that over a 7-year period, IBM Power Systems per-core performance increased by 121% over three generations while Intel's per-core performance only improved by 24% over five generations of systems.

That same ITIC report found that security and data breaches are now the top cause of downtime. As of this writing, the ITIC report did not show any security breaches for PowerVM

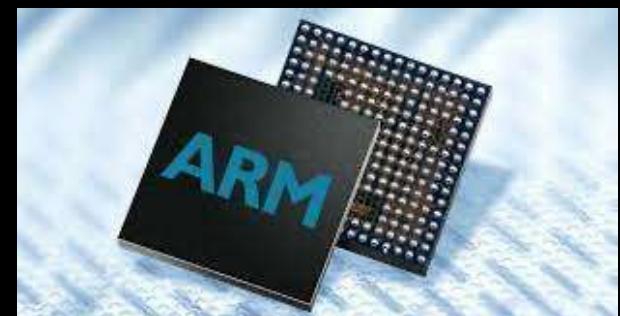


# RISC vs CISC

## Not that they didn't like the idea..

*Dead to Me*

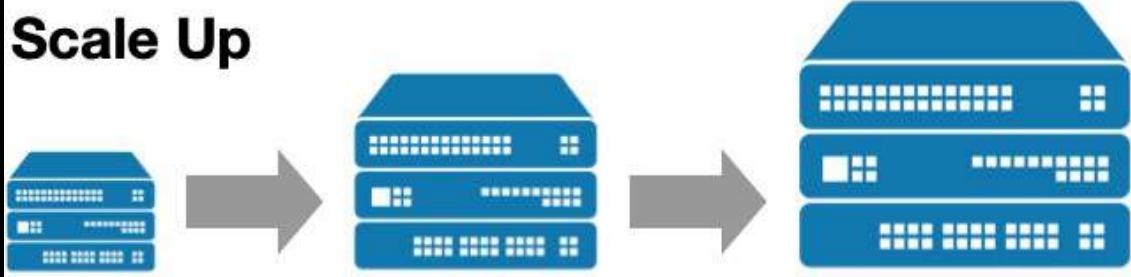
Recognizing that the lack of software could be a serious problem for the future, Intel made thousands of these early systems available to independent software vendors (ISVs) to stimulate development.



**RISC, acronym for Reduced-instruction-set Computing,** information processing using any of a family of microprocessors that are designed to execute computing tasks with the simplest instructions in the shortest amount of time possible. RISC is the opposite of CISC (complex-instruction-set computing).

# Scale up AND Scale Out

## Scale Up



## Scale Out



- ✓ Modular, Scalable POWER9 server
  - 1 to 4 x 5U CEC drawers + 2U Control Unit
- ✓ POWER9 Enterprise processor
- ✓ Up to 192 cores in a single system
- ✓ Up to 64 TB DDR4 memory
- ✓ Up to 32 PCIe Gen4 slots
- ✓ PowerAXON 25Gb/s ports
  - Used for SMP cabling between nodes - 4x bandwidth improvement
  - Enabled for OpenCAPI accelerators



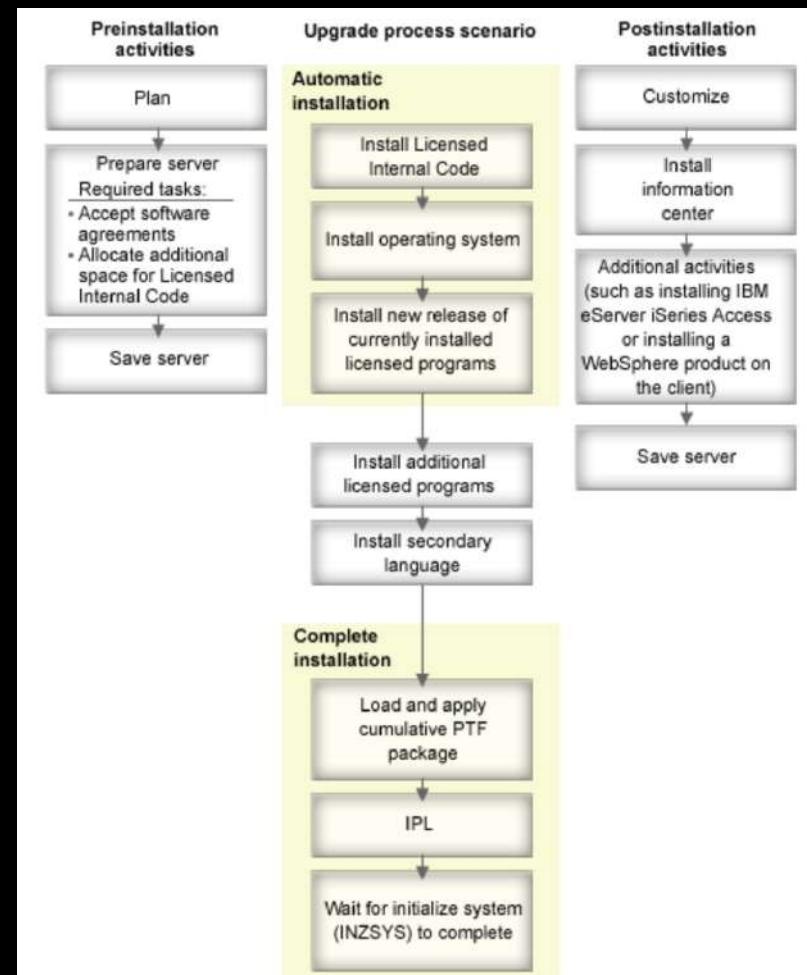
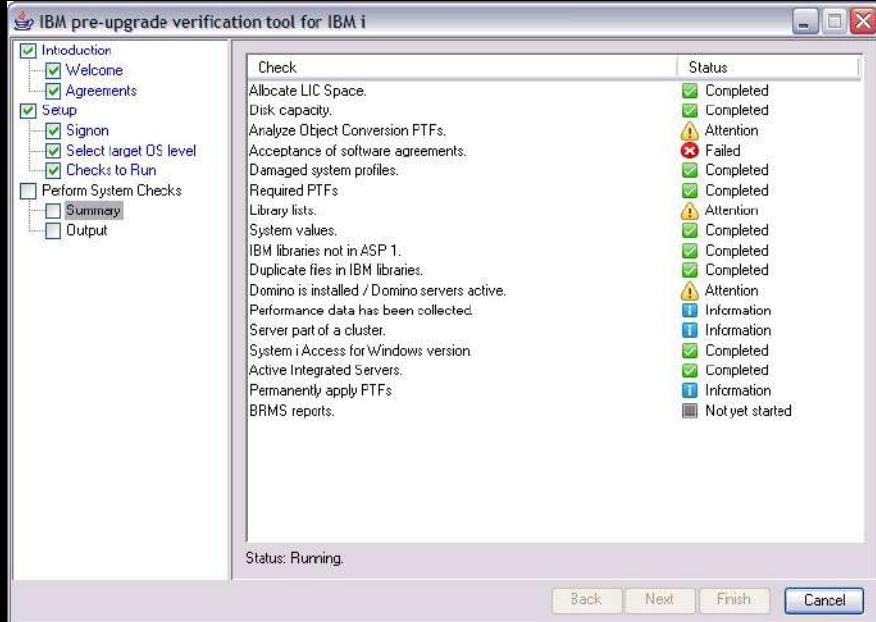
Severin Romanov @Sever\_i · Nov 22, 2019

Largest in the world #IBMi LPAR

96 cores, 16TB RAM, 800TB SSD mirrored protection, POWER9 SMT8

...

# Reliable upgrade process



Fresh install is always the preferred method. This was debated not too long ago on r/sysadmin. Unless there's a very specific reason to, I'm not sure why you would even consider an in-place upgrade.

A clean install is a great way for a fresh start, especially if you've been running the same system version for quite a long time.

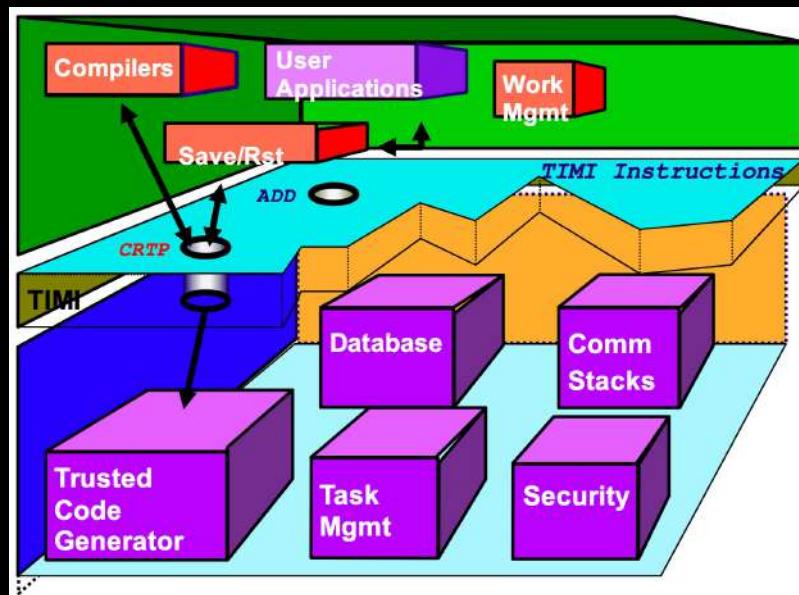
With In-Place upgrade, elements of the previous system remain, causing performance issues of the new system

# Holistic architecture

# TIMI

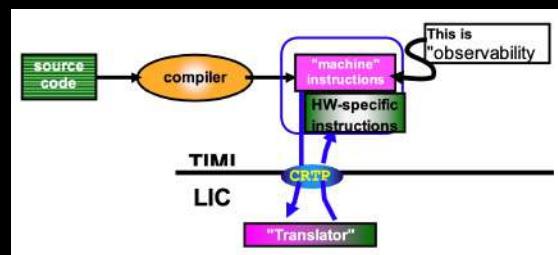
## Technology Independent Machine Interface

The IBM i Architecture depicted below only allows predefined MI Instructions to go to the lower level of microcode. All user code, including the compilers as well as the operating system itself, is independent from the microcode and hardware layer below. All compiled code will have to get translated in order to get machine level instructions specific to the hardware being run on.



# TIMI

While ARM has launched a series of encodings over time and implemented various subsets in various particular cores, the true renovation of the mainstream ARM instruction set had to leverage the move to 64-bit to force their ecosystem to come along. In the IBM i, such an update could have happened at any point in time, and users would not have noticed. Impressive.



“Compare this to how we are today moving from 32bit to 64-bit on the x86 platform. Even though most 32 bit applications will run on 64-bit hardware, the applications will still have to be rewritten to fully employ the 64 bit design. The same story happened when Intel moved from 16-bit to 32bit”

IBM i uses a byte code format for application programs. This byte code (known as technology-independent machine interface, or TIMI) is quite unlike what we have in the JVM or CLR. First of all, it predates the JVM by about 15 years. The first generation of systems, the IBM Series 38, came out in 1980. Second, the TIMI code contains many higher-level operations like database accesses, making it possible to generate far better executable code than if it was just plain API calls. Third, it is compiled before execution, and not just-in-time.

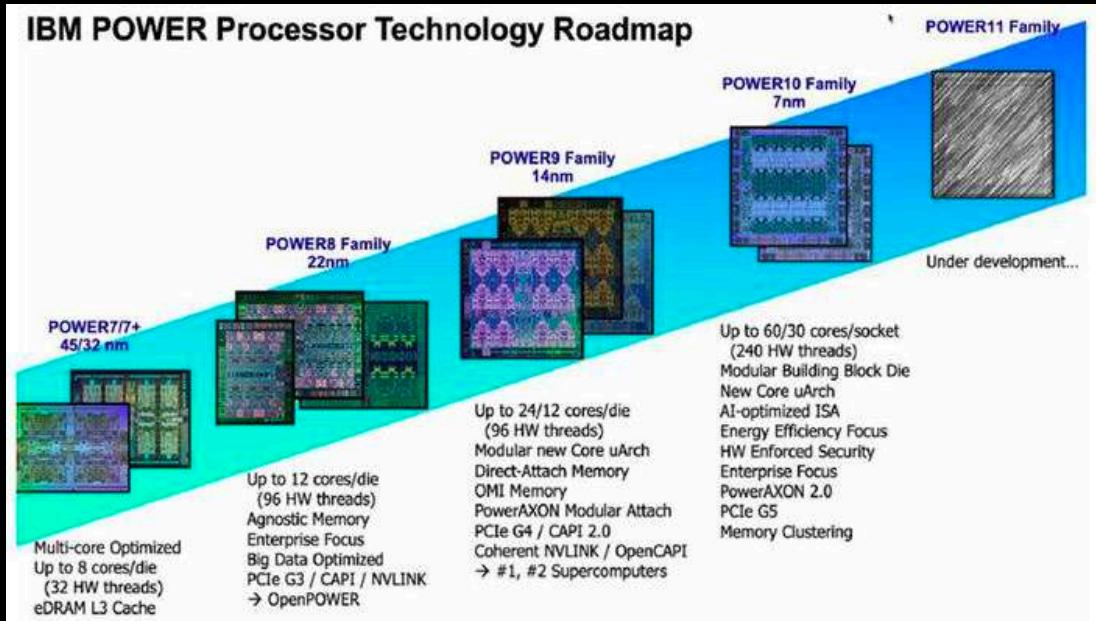
“IBM i behaves more like a traditional single-memory-space real-time OS (RTOS) like VxWorks 5”

# Future compatibility



Thanks to TIMI

# Power10... Power11..



## And your programs will run on it..

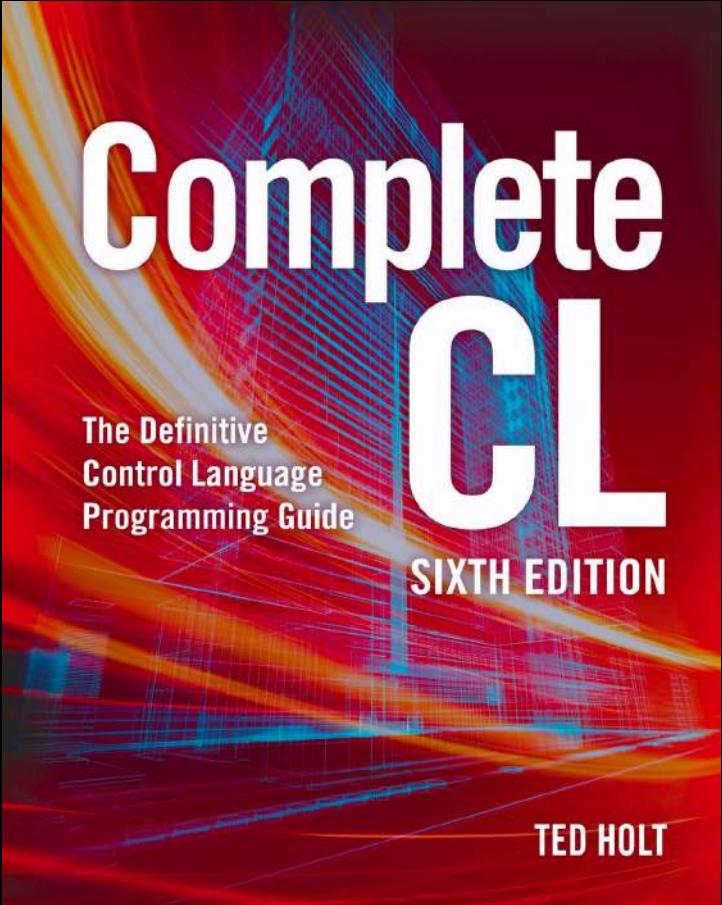
Maybe: The **Start Object Conversion (STROJCVN)** command either converts user objects or checks which objects will require conversion. Objects are converted from the format used in a previous version, release, and modification level of the operating system to the format required for use in the current version, release, and modification level of the operating system.

# User profiles built for a multi user system

- The user profile is an IBM i object and an MI system object
- Belongs to a user class - developers, system admins, operators etc.
- Different authority groups
- Library lists
- Authorization lists
- Group profiles
- Program adoption of authority
- Menu access limitations
- Command line limitations
- Public \*EXCLUDE



# CL – Control Language



CL is based on commands. All program statements are nothing more than commands. Many of the commands are the same ones you would use manually, from the keyboard, to operate the computer

With CL you can do any of the following:

- Control system power up and power down
- Change the configuration of the system through changes in system values or line, controller, and device description
- Manage work
- Start other jobs
- Control system security
- Control all forms of communications
- Manage objects in libraries (Create, change, delete, organize, rename..)

# RPG

Optimized language for the integrating system... system resources..  
Database is there no, no software needed (No need for ODBC or JDBC)

Totally integrated and using the OS to max.

It exists in the secure ILE environment

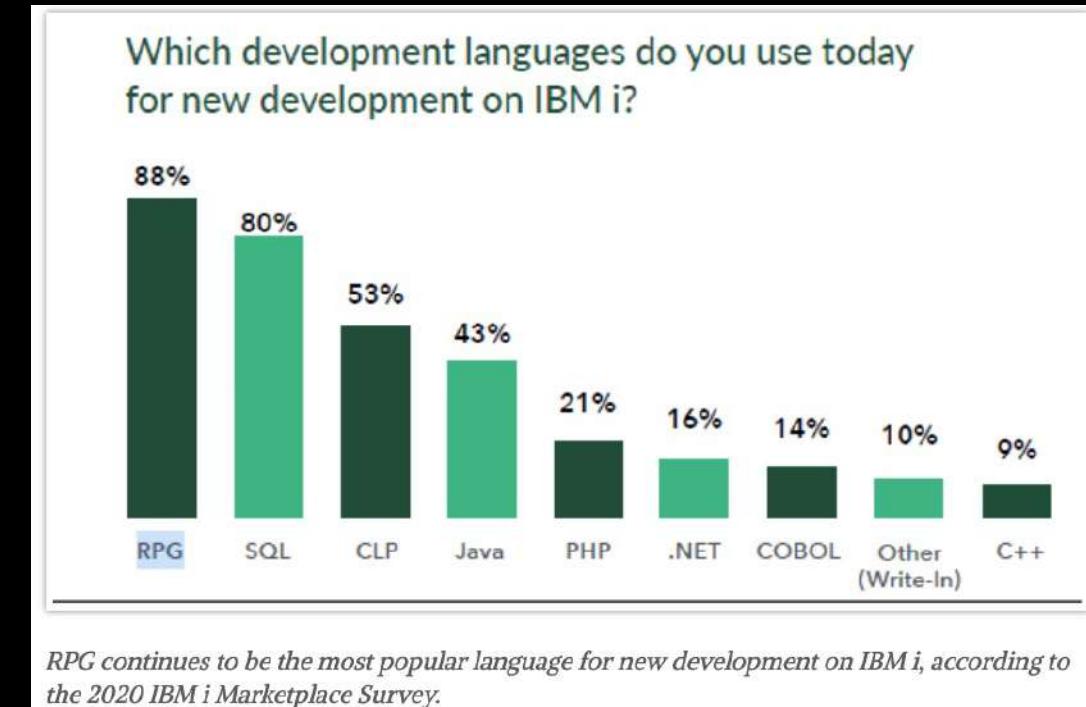
No virtual machine needed

No garbage collection

No storage management needed

No configuration needed

"RPG's native numeric data type is decimal numbers in packed or zoned decimal format. You can store more than 60 digit numbers with no loss of precision, and no special fancy coding is needed to do decimal math in RPG – it's the native built-in way of doing math. In most other languages, if you want to use true decimal numbers, you need to call a special set of APIs. RPG does it natively. RPG rocks for sales figures!"



- Scott Klement at [www.common.org](http://www.common.org)

# Security Levels

**Level 10** — Physical Security. No password required. User profiles are created for any user who attempts to sign on. IBM no longer supports level 10.

**Level 20** — Password Security. Every user must have a valid profile and password. Every user with a valid profile and password assumes root-level authority (\*ALLOBJ) by default.

**Level 30** — Resource Security. Object-level authority is enforced as users do not assume root-level authority by default. A moderately knowledgeable programmer or operator can bypass resource-level security and assume root-level authority.

**Level 40** — Operating System Integrity. Level 30 protection plus additional operating system integrity. It is possible for an extremely knowledgeable programmer with access to your system to elevate his or her level of authority, possibly as high as root-level authority.

**Level 50** — Enhanced Operating System Security. Level 40 protection plus enhanced operating system integrity. A properly secured system at security level 50 is the best defense. However, even at level 50, other system configuration issues must be addressed.

Security on your system is arranged in a series of levels, with each level offering a greater degree of security and protection of your data than the previous level.

You can choose how much security you want the system to enforce by setting the security level (QSECURITY) system value.

# Authority Collection

Trying to remove \*ALLOBJ from a service account, developer, or other profile but don't want to break something in the process? Want to determine where someone is getting authority from? Baffled on how to resolve an authority failure? Anxious to determine who is using a file containing confidential information?

Authority Collection is the answer! Introduced in version 7.3 and enhanced significantly in 7.4, Authority Collection takes the guesswork out of securing your system by documenting exactly what authority is required by the operating system to perform a task or to access a specific object.

The screenshot shows a SQL script editor window with the following content:

```
File Edit View Run VisualExplain Monitor Options Connection Tools Help
C:\Users\cwoodbury\Documents\My Presentations\Authority Collection.sql - Run SQL Scripts - R2D2(H02d0cbr)
-- Authority to IFS objects
SELECT path_name, system_object_type, detailed_required_authority
FROM qsys2.authority_collection
WHERE authorization_name = 'SERVICE1';

-- Removing *ALLOBJ
SELECT authorization_name, system_object_name, system_object_schema,
system_object_type, required_authority, detailed_required_authority, current_authority,
authority_source
```

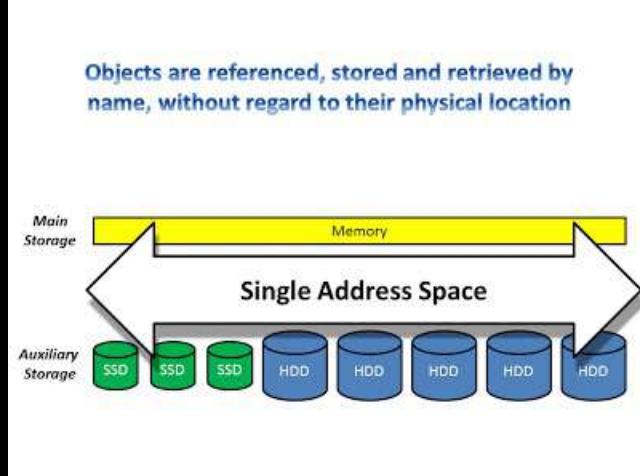
Below the code, a table displays the results of the query:

PATH_NAME	SYSTEM_OBJECT_TYPE	DETAILED_REQUIRED_AUTHORITY
/home/service1	*DIR	*OBJOPR *EXECUTE
/home	*DIR	*OBJOPR *EXECUTE
/home	*DIR	*OBJOPR *READ *EXECUTE
/	*DIR	*OBJOPR *EXECUTE
/payroll	*DIR	*OBJOPR *EXECUTE
/payroll	*DIR	*OBJOPR *ADD *DLT *UPD *EXECUTE
/payroll/newfile	*STMF	*OWNER *OBJEXIST *OBJMGT *OBJOPR *READ *ADD *DLT *UPD



# Sophisticated Storage Management

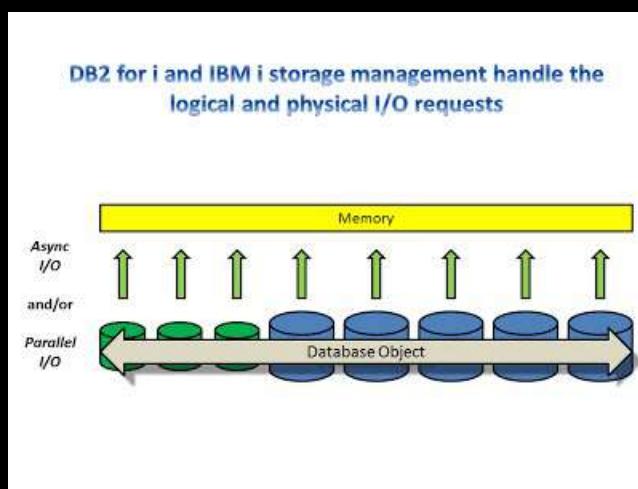
## One of the Crown Jewels: Single Level Storage



Given that all systems have both disk and memory, DB2 for i teams up with IBM i storage management to move data between main storage and auxiliary storage (aka memory and disk) in a way only an integrated database could.

DB2 for i objects share the same memory as the application, optimally balanced by storage management, to simplify operations and gain performance advantage with adjacent memory usage.

The supervisory nature of IBM i coupled with the concept of referencing only “one copy of data” via unique virtual address (VA) allows for some very clever I/O capabilities. I/O can be scheduled and performed asynchronously (i.e., no waiting) allowing for just-in-time arrival of information. Data can be cached in memory and transparently accessed given the fact that it’s always referenced by VA.



There are no buffer pools or database subsystems to define, configure or manage. If the table and/or index are brought into memory ahead of the query, the application does not have to wait on the relatively slower physical I/O mechanism.

When doing physical I/O, the query optimizer can request parallel I/O be used to get data into memory faster. Remember, this is all accomplished without database administration or configuring the data space for parallelism.

# Sophisticated Storage Management

There are known performance and efficiency benefits from having a single memory space, and the IBM i manages to provide that while still being entirely secure and enforcing protection around all data and code. The reason is that protection is part of the system object model and supported by the hardware with a little bit of extra functionality not found in any other system.

The “single-level store” is the most interesting property of the IBM i. User-level programs only see a vast uniform address space and use pointers to objects to manage code and data. Disks and RAM are handled by the OS completely transparently. Pointers are also global, and any program can share data with any other program in a very efficient way. Data protection is handled by objects, which means that there is no need for traditional MMU-based data protection. Which in turns makes task switching amazingly quick

<https://jakob.engbloms.se/archives/2111>

# Sophisticated Storage Management

With a single-level storage the entire storage of a computer is thought of as a single two-dimensional plane of addresses, pointing to pages. Pages may be in primary storage (RAM) or in secondary storage (disk); however, the current location of an address is unimportant to a process. The operating system takes on the responsibility of locating pages and making them available for processing. If a page is in primary storage, it is immediately available. If a page is on disk, a page fault occurs and the operating system brings the page into primary storage. No explicit I/O to secondary storage is done by processes: instead, reads from secondary storage are done as the result of page faults; writes to secondary storage are done when pages that have been modified since being read from secondary storage into primary storage are written back to their location in secondary storage.



# Sophisticated Storage Management

The system also does stuff like automatically extending files that are full etc

To increase the size of the pool, simply add disk drives to IBM i and they automatically become part of the system ASP

“The disk drive box was disconnected and the system hang.  
When cable was inserted again the system continued like nothing happened... ”

There is no need to be concerned about particular disk drives filling up or moving data from one disk to another to improve performance because all data management is taken care of by the licensed internal code. Therefore, IBM i does not require a Database Administrator. Licensed internal code also ensures that there is no disk fragmentation.

CICS Storage violations can seem to be one of the most difficult problems to deal with when debugging. Storage Violations can in the worst cases bring down CICS and can sometimes go undetected by CICS which could lead to problems in the future. S

Instead of an object being stored on a single physical disk drive, single-level storage scatters objects across all physical drives, transparently to the user

IBM i disk management supports fully parallel disk I/O, which provides outstanding disk I/O performance because each object on the system is accessible by multiple disk arms concurrently.

# Branching

"The memory system had to be more adaptable and better able to deal with multiple users and multiple tasks. In the mainframe's virtual memory approach, it took a thousand instructions to switch from one user to another. "Now, a thousand instructions is an awful lot. But they had to do a lot," Soltis said. "In IBM i, it takes one instruction. You simply branch to location within that huge storage and begin to execute instructions. It's a branch. It's the fastest in the industry."

The single level store is about sharing. There is no need to create a separate address space when executing a new task. Programs don't copy objects into a user's address space. Also, task switching is very fast because it's simple as saving the processor's registers and performing a branch instruction to the location where the task resides



# SLS – NOT THAT THEY DIDN'T LIKE THE IDEA

List of SASOS projects [ edit ]

- Amiga family – [AmigaOS](#), [AROS](#) and [MorphOS](#)
- [Angel](#)
- [BareMetal](#)
- [BMX](#)[citation needed]
- [Br1X](#)
- [Genera](#) by Symbolics
- [IBM i](#) (formerly called OS/400)
- [Iguana](#) at [NICTA](#), Australia
- [JX](#) a research Java OS<sup>[1]</sup>
- [IncludeOS](#)
- [Mungi](#) at [NICTA](#), Australia
- [Nemesis](#)
- [Opal](#)
- [Phantom OS](#)
- [Scout](#)
- **Singularity**
- [SonicOS](#)
- [TempleOS](#)
- [Texas](#)[citation needed]
- [Torsion](#)
- [Zephyr](#)

**Singularity** is an experimental operating system (OS) which was built by Microsoft Research between 2003 and 2010

Singularity Project	
	
Singularity after boot-up	
<b>Developer</b>	Microsoft Corporation
<b>Written in</b>	Assembly language, C, C++, C#, Sing#
<b>OS family</b>	Language-based systems
<b>Working state</b>	Discontinued
<b>Source model</b>	Source-available (through Shared Source Initiative)
<b>Initial release</b>	2007; 14 years ago
<b>Final release</b>	2.0 / November 14, 2008; 12 years ago
<b>Available in</b>	English
<b>Platforms</b>	x86
<b>Kernel type</b>	Microkernel language-based
<b>Default user interface</b>	Command-line interface
<b>License</b>	Microsoft Research License
<b>Official website</b>	<a href="http://research.microsoft.com/en-us/projects/singularity">research.microsoft.com/en-us/projects/singularity</a>

# Object Oriented Operating System



[http://mrfunk.info/?page\\_id=5](http://mrfunk.info/?page_id=5)

Different object types have different operational characteristics. These differences make each object type unique. For example, because a file is an object that contains data, its operational characteristics differ from those of a program, which contains instruction

"For each object type, there are only a well-defined set of functions that can be executed against these objects. Many of these functions are supported only by the privileged kernel of IBM i. In order to execute these functions, the programmer provides a Tagged Pointer – often called a System Pointer – referencing an object's segment and requests execution of that function. If the program does not have an object's System Pointer, the program also does not have access to that object."

# Relational database as native file system

DREAM ON



WinFS (short for Windows Future Storage)[1] was the code name for a canceled[2] data storage and management system project based on relational databases, developed by Microsoft and first demonstrated in 2003 as an advanced storage subsystem for the Microsoft Windows operating system, designed for persistence and management of structured, semi-structured and unstructured data. WinFS includes a relational database for storage of information, and allows any type of information to be stored in it, provided there is a well defined schema for the type.

Q: What one Microsoft program or product that was never fully developed or released do you wish had made it to market?

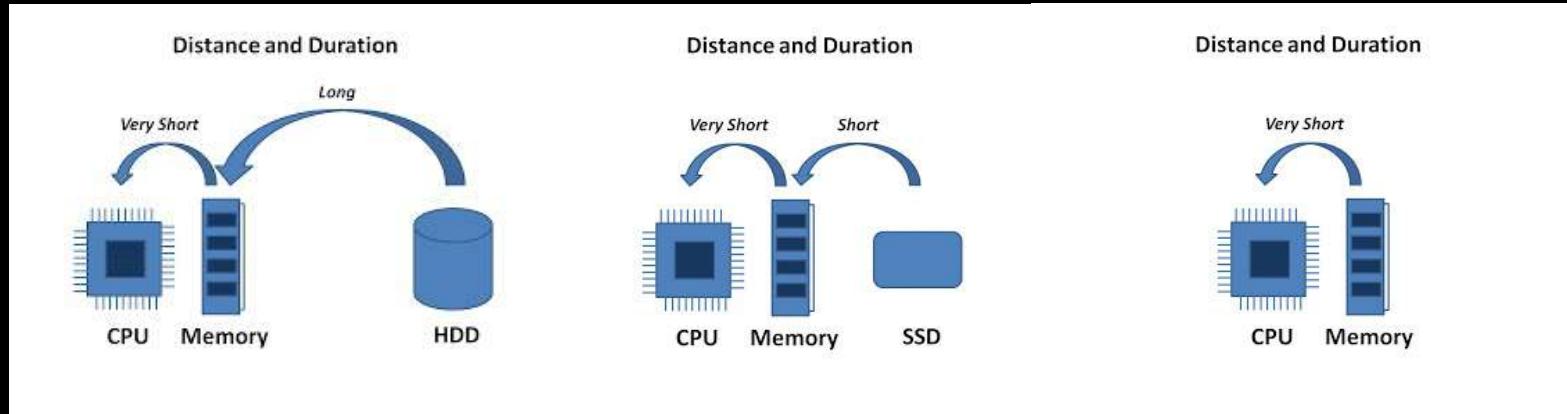
Gates: We had a rich database as the client/cloud store that was part of a Windows release that was before its time. This is an idea that will remerge since your cloud store will be rich with schema rather than just a bunch of files and the client will be a partial replica of it with rich schema understanding.

For those who may not know, Gates was referencing [WinFS](#), or [Windows Future Storage](#). The idea behind WinFS was to integrate some relational database technologies with the Windows File System. In its early (codename "Cairo") days, WinFS was key to Microsoft's plans to create a true, object-oriented file store.



# In memory Database

From day one, the capability of putting and keeping objects in memory has been part of IBM i and DB2 for i. The entire system was build from the ground up to support ALL objects in memory.



A screenshot of the DB2 Control Center interface. The top navigation bar includes "Table", "columns", "Key Constraints", "Foreign Key Constraints", "Check Constraints", "Materialized Query", and "Partitioning". The main area shows a table named "PS\_RB\_EOD\_BAL\_TBL" under the schema "RSA". A dropdown menu for "System name" is set to "PS\_RB00010". In the middle section, there are several checkboxes:  
 Preferred storage media is solid-state drive  
 Keep in memory  
 Volatile data  
 Row access control  
 Column access control  
A text input field labeled "Text:" is present below these checkboxes.  
At the bottom right, a button labeled "Show SQL" is highlighted with a red box.

- **KEEP IN MEMORY <NO/YES>** is available on the following SQL statements:
- **ALTER TABLE**
- **CREATE INDEX**
- **CREATE TABLE**
- **DECLARE GLOBAL TEMPORARY TABLE**

# NVMe

		RAID-5 vs. Mirrored				Mirrored vs. Mirrored			
Protection	Parameter	Units	SAS	NVMe	Difference	SAS	NVMe	Difference	
		0,1,5,6,10	RAID 5	OS Mirror		RAID 10	OS Mirror		
Application Speed	Random 255B Reads	Trans/s	273,000	390,000	42.0%	276,185	387,284	40.2%	
	Random 255B Writes	Trans/s	2,898,000	5,824,000	101.0%	6,674,419	5,785,859	-13.3%	
	Sequential 32KB Reads	GB/s	3.51	8.22	134.2%	3.33	8.22	146.8%	
	Sequential 32KB Writes	GB/s	1.01	2.46	143.6%	1.79	2.48	38.5%	
	Random 4KB Reads	io/s	218,000	368,000	68.8%	217,629	385,410	77.1%	
Storage Subsystem	Random 4KB Writes	io/s	167,000	690,000	313.2%	385,088	666,441	73.1%	
	Sequential 32KB Reads	GB/s	3.48	8.05	131.3%	3.22	7.588	135.4%	
	Sequential 32KB Writes	GB/s	1.00	4.56	356.0%	1.80	4.969	175.4%	
	Random 4KB Reads	us/io	123	99	-19.5%	133	99	-25.6%	
	Random 4KB Writes	us/io	59	24	-59.3%	34	28	-17.6%	

- Conclusions: Lots of green for NVMe indicates consistent better performance
- Random 255B Writes see a slower NVMe performance because the Mirror code is offloaded to the CPUs instead of the SAS Controllers

Color Key	Meaning
Green	Advantage NVMe
Yellow	Within +/-10%
Red	Advantage SAS



# Combine with Single Level Storage

## AI next?

# IBM i Services

## Application Services

These procedures, functions, and views provide interface information that can be used by applications.

## Backup, Recovery, and Media Services (BRMS) Services

These table functions and views provide information about BRMS.

## Communication Services

These services provide communication information.

## IFS Services

These services provide information about the integrated file system.

## Java Services

This view and procedure provide Java information and JVM management options.

## Journal Services

These services provide information about audit journals and data journals.

## Librarian Services

These services provide object and library list information.

## Message Handling Services

These views and functions provide system message information.

## PowerHA Services

These table functions and views provide information about PowerHA®.

## Product Services

These services provide information about licensed products.

## PTF Services

These views provide PTF information.

## Security Services

These views, procedures, and functions provide security information.

## Spool Services

These views and functions provide information about spooled files.

## Storage Services

These views provide information about storage and storage devices.

## System Health Services

For the most important system resources, the IBM i operating system automatically tracks the highest consumption and consumers.

## Work Management Services

These views and functions provide system value and job information.

The GROUP\_PTF\_CURRENCY is a view containing a query which implements a live comparison of the PTF Groups installed on the partition against the service levels listed on the IBM Preventive Service Planning website.

GRPCUR	GRP_ID	NAME	PTF Group Level	GRP_LVL	GRP_IBMLVL	GRP_LSTUPD	GRP_RLS	PTF Group Status
UPDATE AVAILABLE	SF99740	Current Cumulative P	20303	21091	04/15/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99739	SF99739 740 Group Hi	44		48 04/20/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99738	SF99738 740 Group Se	17		19 04/20/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99652	SF99652 740 Content	3		4 04/19/2021	R740	RELATED GROUP	
UPDATE AVAILABLE	SF99662	SF99662 740 IBM HTTP	9		10 04/17/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99663	SF99663 740 Performa	6		7 03/24/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99665	SF99665 740 Java	9		10 03/23/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99666	SF99666 740 High Ava	5		6 04/09/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99704	SF99704 740 DB2 for	11		12 03/15/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99737	SF99737 740 Technolo	3		4 04/15/2021	R740	INSTALLED	
UPDATE AVAILABLE	SF99741	SF99741 740 All PTF	7		8 03/19/2021	R740	INSTALLED	
-	SF99653	SF99653 740 Db2 Web	9		9 06/22/2020	R740	RELATED GROUP	
INSTALLED LEVEL IS CURRENT	SF99661	SF99661 740 WebSphere	5		5 02/12/2021	R740	INSTALLED	
INSTALLED LEVEL IS CURRENT	SF99664	SF99664 740 Backup R	19		19 01/27/2021	R740	INSTALLED	
INSTALLED LEVEL IS CURRENT	SF99667	SF99667 740 740 TCP/	2		2 12/29/2020	R740	INSTALLED	
INSTALLED LEVEL IS CURRENT	SF99668	SF99668 740 IBM Db2	9		9 01/29/2021	R740	INSTALLED	
INSTALLED LEVEL IS CURRENT	SF99675	SF99675 740 Hardware	2		2 01/16/2020	R740	INSTALLED	

# Db2 for i Services

## **Application Services**

These procedures provide interfaces that are useful for application development.

## **Performance Services**

These services include procedures that provide interfaces to work with indexes and a view to see information about database monitors.

## **Plan Cache Services**

These services include procedures to assist you in performing database administration (DBA) and database engineering (DBE) tasks.

## **Utility Services**

These procedures provide interfaces to monitor and work with SQL in jobs on the current system or to compare constraint and routine information across systems.

### **Example**

For schema PRODLIB, find all instances of index advice where a maintained temporary index was used more than 1000 times and create permanent SQL indexes.

```
CALL SYSTOOLS.ACT_ON_INDEX_ADVICE('PRODLIB',NULL,NULL,1000,NULL)
```

# CPW

# Commercial Processing Workload



The CPW rating of a system is generated using the measurements of a specific workload that is maintained internally within the IBM i Systems Performance group. This workload is rigidly defined for functionality, performance metrics, and price/performance metrics.

As experts in benchmarking and measurement, IDEAS believes that IBM's use of CPW provides a greater opportunity to accurately reflect relative performance than can be found in public benchmark results.

A public benchmark's goal is to demonstrate the absolute highest system performance possible, whereas the primary goal with CPW is to show the relative performance between systems.

# ACS

IBM i Access Client Solutions

File Edit Actions Tools Help

Welcome

System: pub400.com

General

- Data Transfer
- 5250 Emulator
- Integrated File System
- Navigator for i
- SSH Terminal
- Printer Output

Database

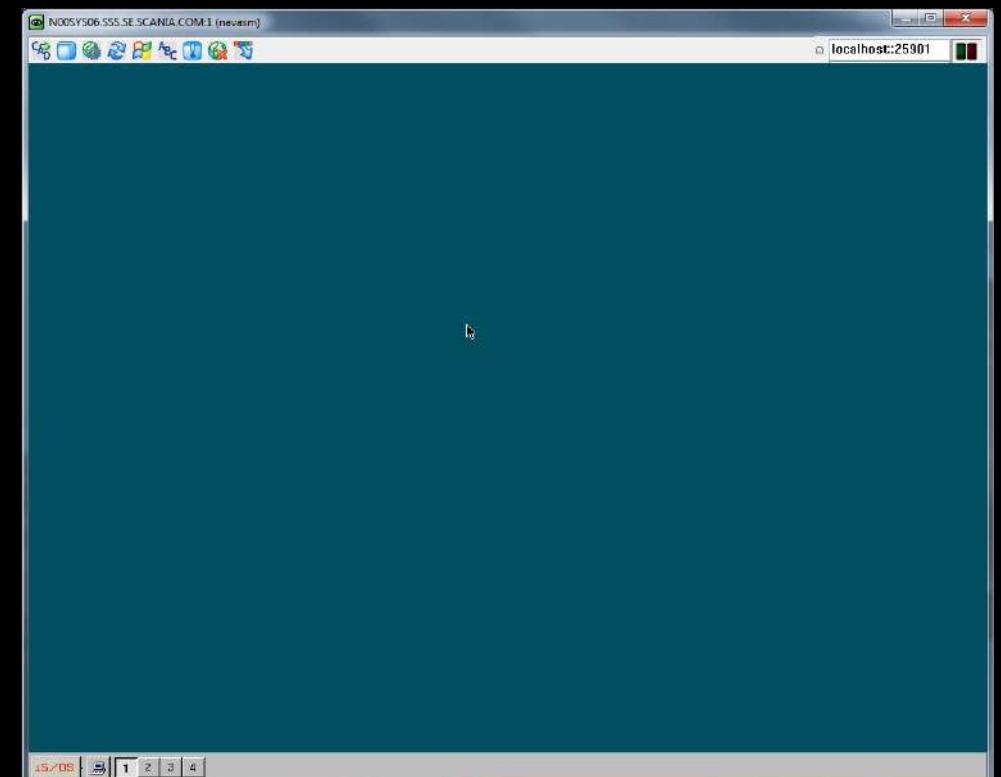
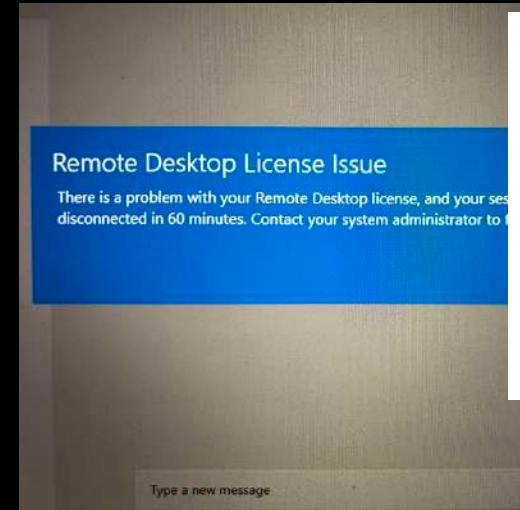
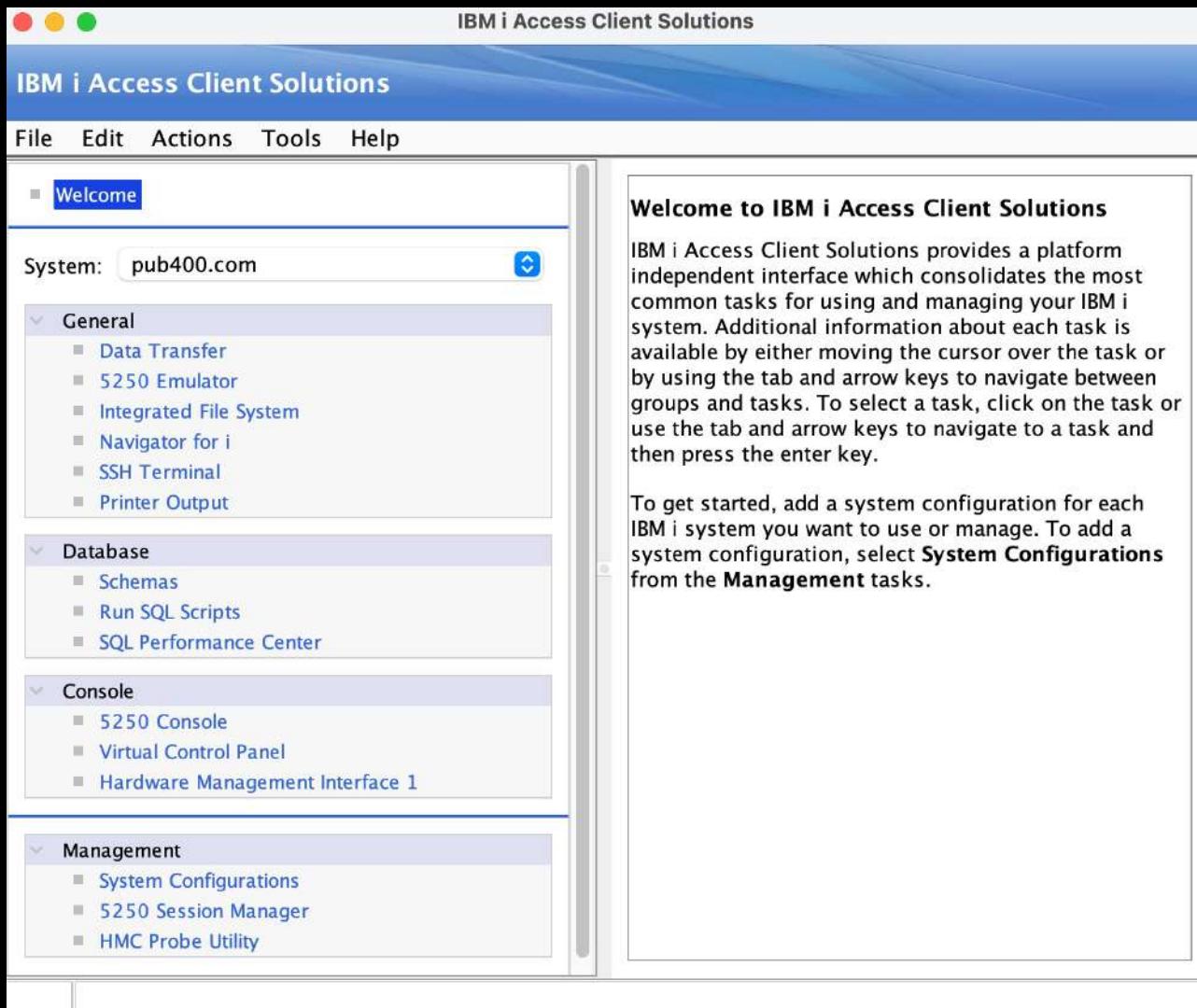
- Schemas
- Run SQL Scripts
- SQL Performance Center

Console

- 5250 Console
- Virtual Control Panel
- Hardware Management Interface 1

Management

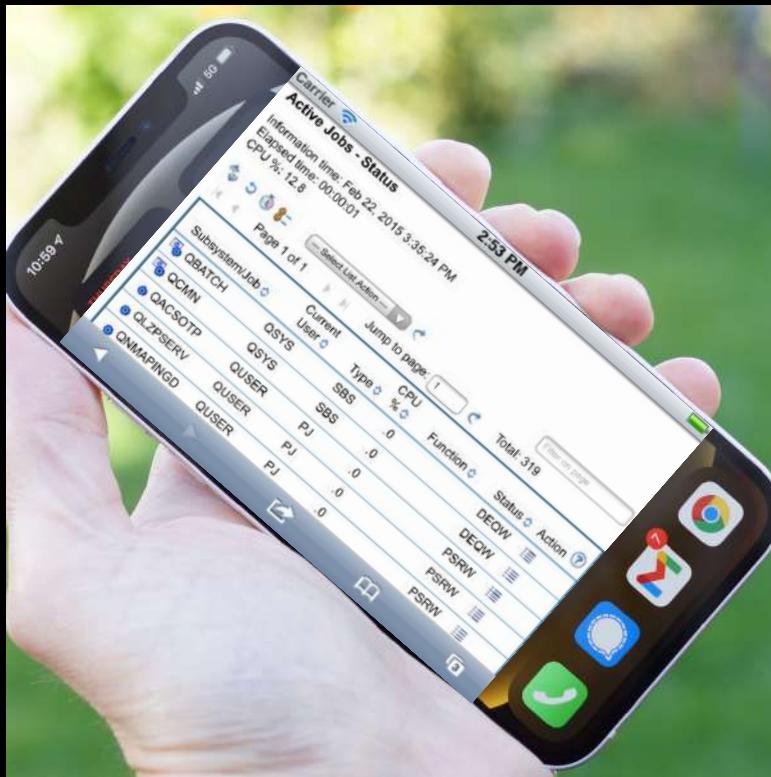
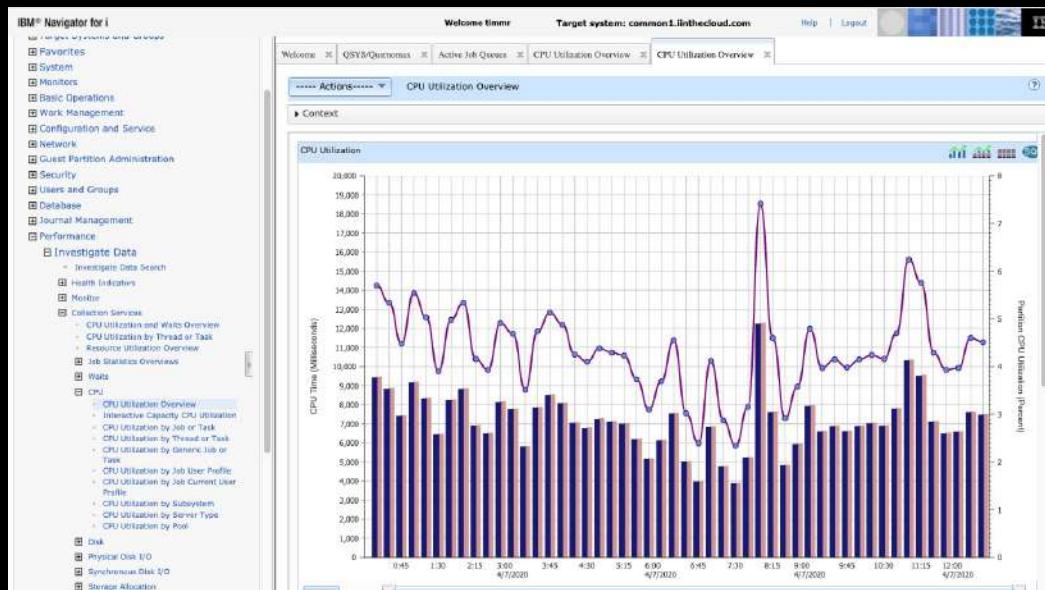
- System Configurations
- 5250 Session Manager
- HMC Probe Utility



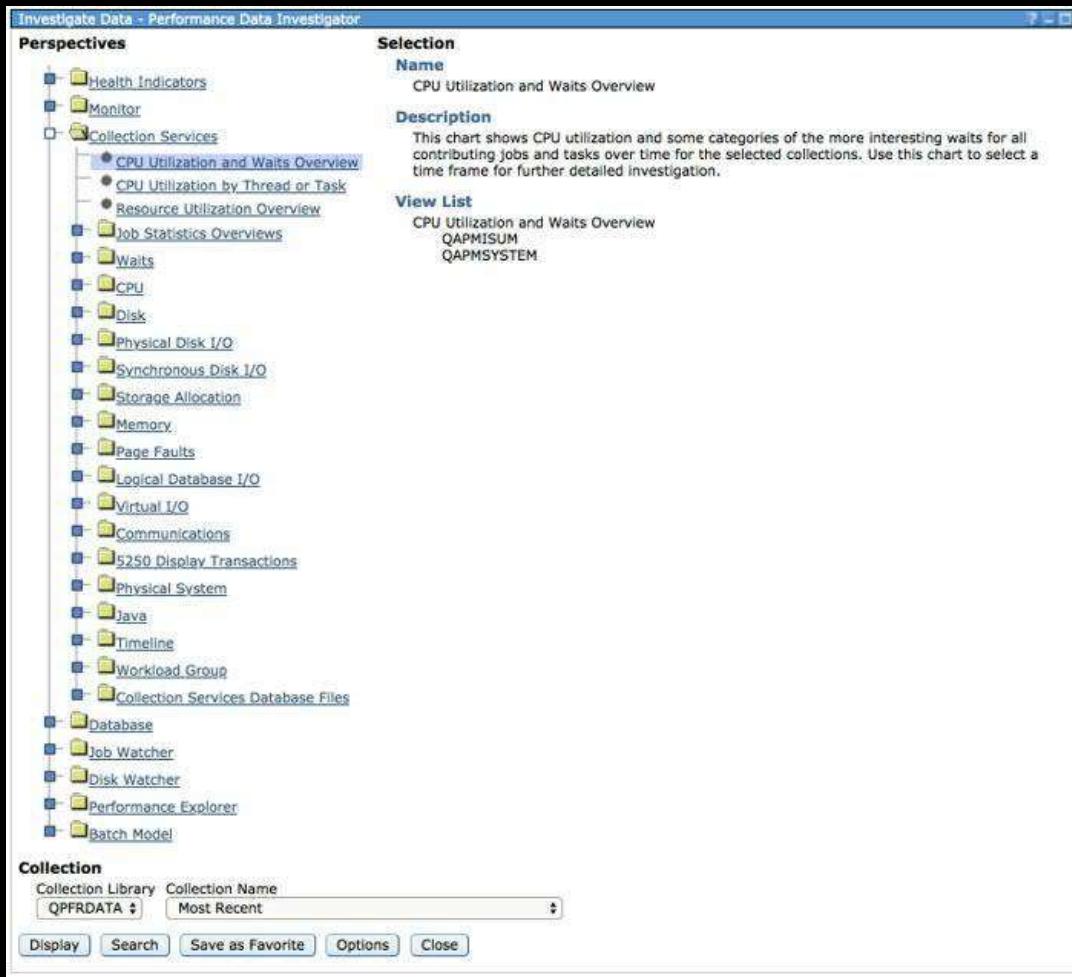
# Web interface

## (including /mobile)

IBM® Navigator for i is a Web console interface where you can perform the key tasks to administer your IBM i. Nothing needs to be installed on your workstation to use IBM Navigator for i. This Web application is part of the base IBM i operating system and be easily accessed by simply pointing your browser to <http://systemName:2001>.



# Holistic approach to performance



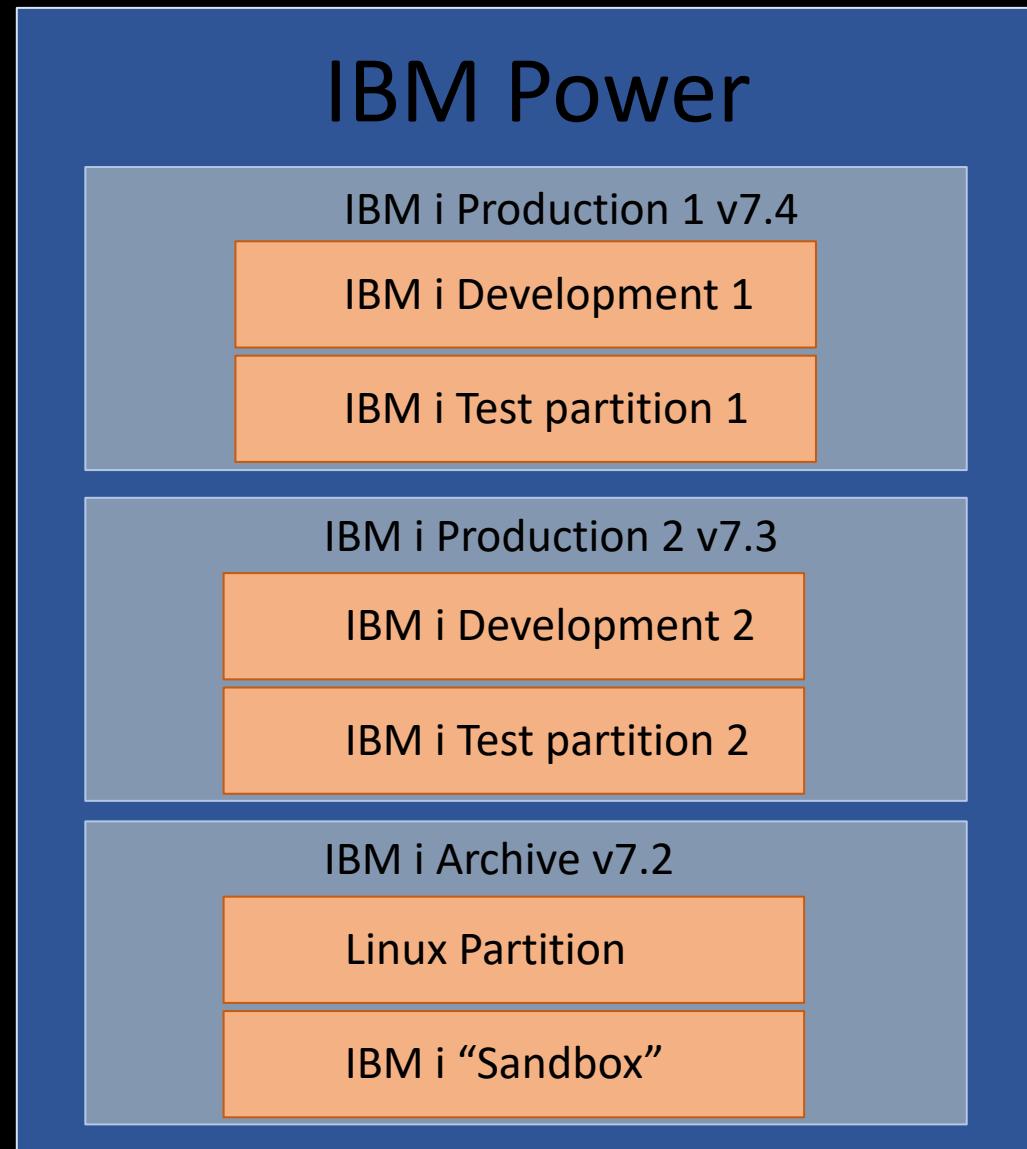
**Index advisor:** If the optimizer determines that a permanent index might be beneficial, it returns the key columns necessary to create the suggested index.

**Plan cache:** The SQL Plan Cache contains a wealth of information about the SQE queries being run through the database.

**EVI**s are a complementary alternative to existing index objects and are a variation on bitmap indexing. Because of their compact size and relative simplicity, EVI<sup>s</sup> provide for faster scans of a table that can also be processed in parallel.

**Symmetrical multiprocessing** is a form of parallelism achieved on a single system where multiple CPU and I/O processors sharing memory and disk work simultaneously toward a single result.

# Client partitions



# RLA – Record Level Access



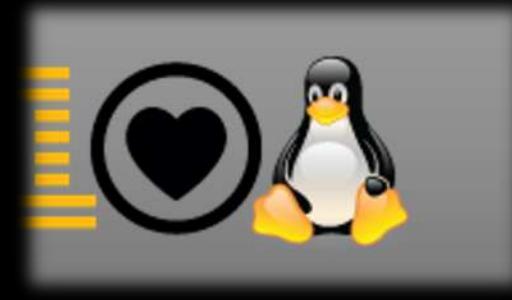
Because sometimes this is still the best way...

# PASE

PASE for i provides an integrated runtime environment that allows you to run selected applications without the complexity of managing operating systems, such as AIX or Linux®.

Applications running in PASE for i are integrated with the IBM i integrated file system and Db2® for i. They can call (and be called by) Java and ILE applications. In general, they can take advantage of all aspects of the IBM i operating environment, such as security, message handling, communication, and backup and recovery.

AIX



But Windows Subsystem for Linux?

"Microsoft envisages WSL as "primarily a tool for developers – especially web developers and those who work on or with open source projects".



KEEP  
CALM  
BECAUSE  
SHIT  
HAPPENS

# Plan A –Avoid it to happen in the first place



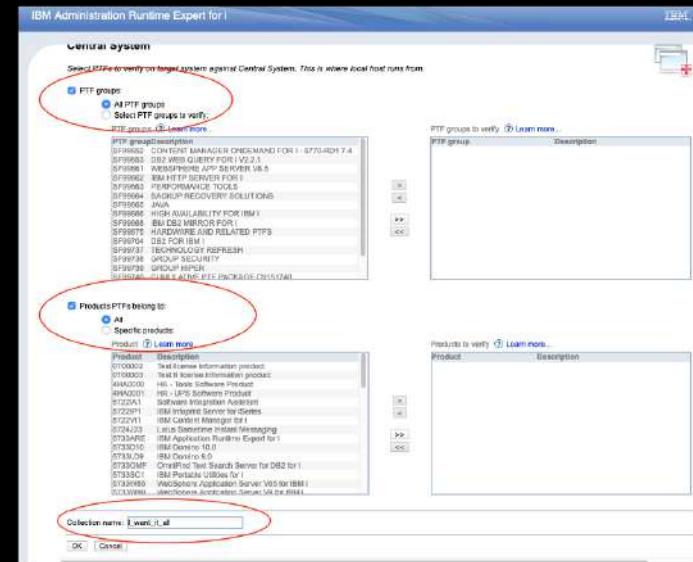
The Db2® for i Predictive Query Governor can stop the initiation of a query if the estimated run time (elapsed execution time) or estimated temporary storage for the query is excessive. The governor acts *before* a query is run instead of while a query is run

Limit ID	Limit Description	Maximum	Alerting Level	Alerting Cadence
15000	<b>Maximum number of all rows in a partition</b>	4,294,967,288	Greater than 90%	Once per day
15003	<b>Maximum size of the data in a table partition</b>	1,869,169,767,219	Greater than 90%	Once per day
15104	<b>Maximum number of variable-length segments</b>	65,533	Greater than 90%	Once per day
15400	<b>Maximum *MAX4GB Index Size</b>	4,294,967,296	Greater than 90%	Once per day
15401	<b>Maximum *MAX1TB Index Size</b>	1,869,166,411,776	Greater than 90%	Once per day
15403	<b>Maximum Encoded Vector Index Size</b>	2,199,023,255,552	Greater than 90%	Once per day

# PTF Concept

ARE for distributing PTFs

Recommended for all systems		
All systems will stay current on the latest Cumulative PTF Package, HIPER Group PTF, and Database Group PTF that are listed in the table below. To view detailed information about the PTF, click the PTF ID link.		
CUM Package	HIPER, Database and Java Groups	
IBM i 7.4	IBM i 7.3	
CUM Package	<a href="#">SF99740</a>	<a href="#">SF99730</a>
HIPER Group	<a href="#">SF99739</a>	<a href="#">SF99729</a>
Database Group	<a href="#">SF99704</a>	<a href="#">SF99703</a>
Java Group	<a href="#">SF99665</a>	<a href="#">SF99725</a>
HTTP Group	<a href="#">SF99662</a>	<a href="#">SF99722</a>
Security Group	<a href="#">SF99738</a>	<a href="#">SF99728</a>



A and B side concepts are relative to LIC and not to the operating system or LPP PTFs. When a new system is shipped or when the operating system is upgraded to a new release, the A side and B side match. When LIC PTFs are temporarily applied, they are applied to the B side. If you have temporarily applied LIC PTFs and you are running on the A side, you will not be running with the PTF

# Electronic Service Agent



Electronic Service Agent provides an automatic problem-reporting function. It helps predict and prevent hardware errors by early detection of potential problems. It also reports software errors. Electronic Service Agent downloads fixes and automatically submits problems to IBM when appropriate. Supplemental system service information is sent to IBM and made available to IBM support centers to aid in problem resolution.

# Watches



Watches provide a way to automate tasks when certain events occur. An event can be a message, a Licensed Internal Code (LIC) log (also known as a VLOG), or a Problem Activity Log (PAL) entry.

Trying to track down a message sent to the job log of a prestart job is much like looking for a needle in a haystack; on busy systems, there could be hundreds of jobs to look through. If the error was relatively minor, the jobs may end and not generate a job log.

Watches make life easier if you need to track down an intermittent error or a difficult-to-find issue in a prestart job.

# ARE – Application Runtime Expert

IBM Power Systems

Problem – Application not working/starting – How do you check all files and directories that can affect your application?

The screenshot shows the ARE interface with several sections:

- Application Runtime dirs/files:** A tree view of directory structures with icons. Several nodes are circled in red.
- Backup File–Owner & file size now:** A button.
- User profiles:** A list of profiles (Bldship, Bldtest) with icons. Some are circled in red.
- System Values:** A list of values with icons. Some are circled in red.
- TCP/IP Configuration:** A list of configurations with icons. Some are circled in red.
- Dependent Servers:** A list of servers with icons. Some are circled in red.
- File is missing!**: A message box.
- Adv directory has \*PUBLIC \*EXCLUDE authority, PASE needs access to this!**: A message box.
- Debug properties left turned**: A message box.
- Someone turned on SYSTEM 36 MODE!**: A message box.
- LOCATE set User Prof file/text**: A message box.
- DNS server is not configured correctly. DNS look up timing out causing significant application delays**: A message box.
- Host servers not running**: A message box.

IBM Application Runtime Expert for i

Console > Result

## Console

System verification status: 5/5 complete

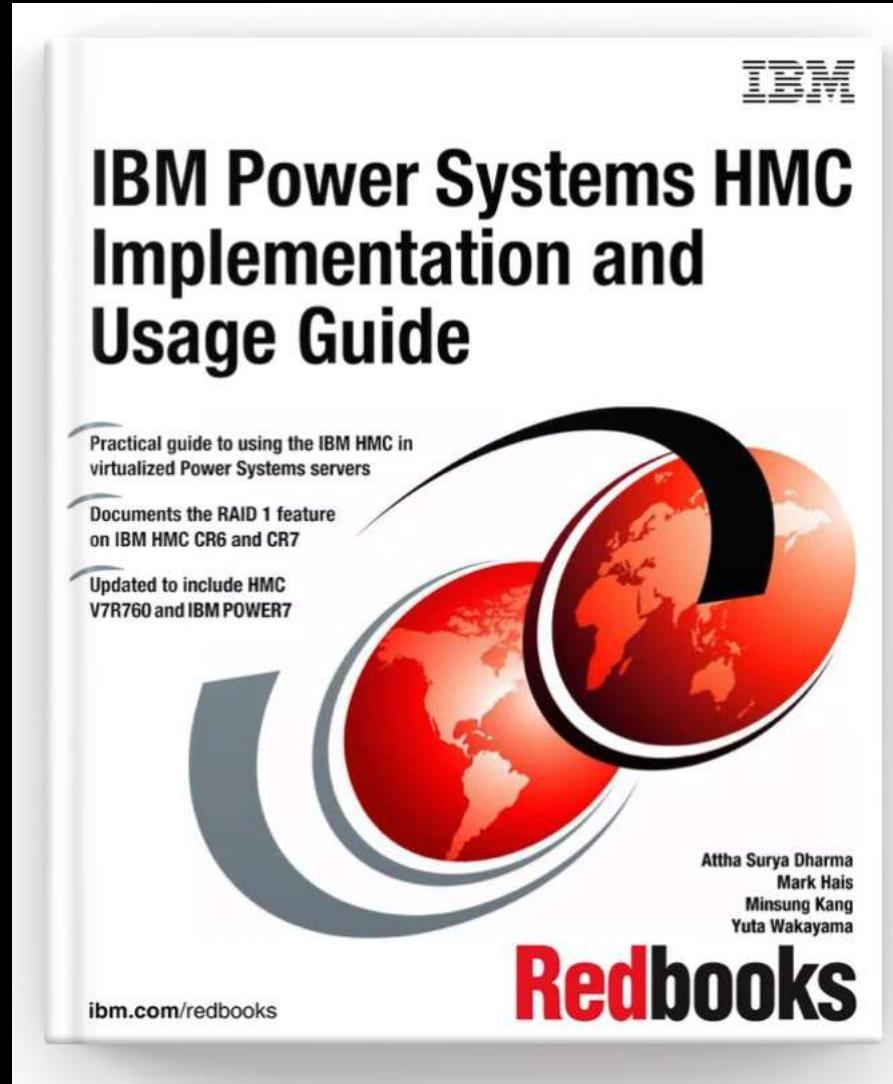
System name	Template	Status	Result
system1	areDemo	Complete	✗ 7 errors, 0 warnings
system2	areDemo	Complete	✓ No problems found.
system3	areDemo	Complete	✗ 8 errors, 0 warnings
system4	areDemo	Complete	✗ 4 errors, 0 warnings
system5	areDemo	Complete	✓ No problems found.

[Summary Report](#)  
[Detailed Report](#)  
[XML Report](#)  
[Runtime Log](#)

Back Stop all

# Redbooks

(Because setup things the right way)





*time to get back on track*

# MSGID & System Reference Codes



CPE3496 - Data space index used as a directory is invalid.

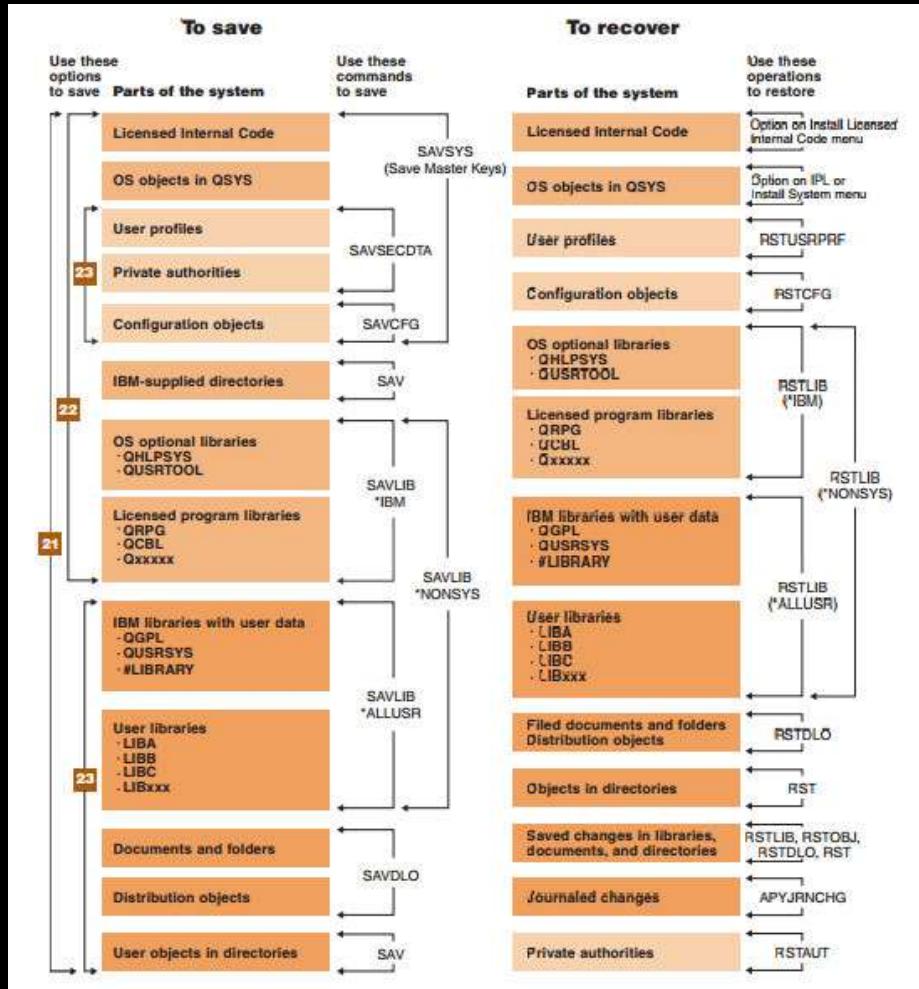
CPE3441 - The socket protocol family is not supported.

CPE3005 - File is not opened for read operations

CPF0610 - File &1 in &2 not available.

CPE3500 - Object is a read only object.

# Proper backup & recovery system



# IBM Support

**WELCOME  
TO  
ROCHESTER**  
*Where the winters  
are cold  
and the systems  
are hot.*

Standing behind our clients with award-winning Support Professionals

October 23, 2020

The 2020 Golden Bridge Business and Innovation Awards named IBM Support Professionals Customer Service & Support Staffer of the Year.



# QMGTOOLS

There are over **300** commands in library QMGTOOLS, and IBM adds more commands and enhances the functionality of existing commands on an ongoing basis.

```
MG          Must Gather Data Collector
(C) COPYRIGHT IBM CORP. 2009, 2012
Select one of the following:
1. System Snapshot
2. HA (High Availability)
3. Performance/Misc collection
4. Client/Server
5. Communications menu
6. Database menu
7. CTA/EWS (JAVA/HTTP/DCM/WAS)
8. Save/Restore menu
9. Misc tools
10. FTP data to IBM
11. View FTP to IBM statuses
12. Display build date
13. Check IBM for updated QMGTOOLS
14. External Storage
15. Work Management
16. Internals
17. Electronic Services
18.
19. Hardware data collection
20. HMC menu
21.
22. QSPTLIB menu
23. FTP spoolfile to IBM
24. PTF menu
25. Store FTP2IBMCMD credentials
26. QMGTOOLS Help

Selection or command
===> _____
F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
F13=Information Assistant   F16=System main menu
```

"Love it. Have been using it for years. As handy as it gets. And of course, free."

# DST/SST

DST operates in stand-alone, limited, and full paging environments. The DST tools and functions vary depending on the paging environment and the release level of the operating system. For more information, see [System paging environments](#).



System service tools (SST) provide a way to access a subset of the service tools that DST offers without requiring access to DST.

SST is available when IBM® i is operational, and can be accessed using the STRSST CL command.

# Abnormal IPL

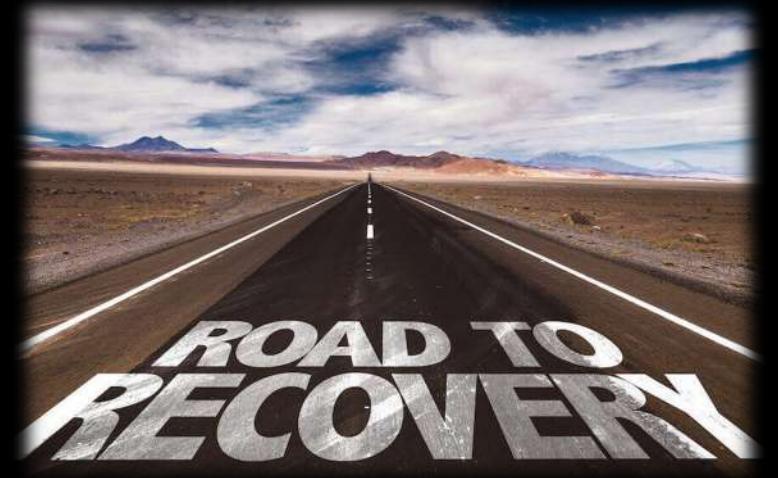
When your system ends abnormally, perhaps because of a power interruption, the next IPL can take much longer than a normal IPL. Rebuilding access paths contributes to this long IPL time

Damaged object detection

The job table cleanup IPL step is also known as Work Control Block Table cleanup (C900 2C40) IPL step

Rebuild access paths

Recover transaction integrity



# VFY Commands

Commonly used verify commands

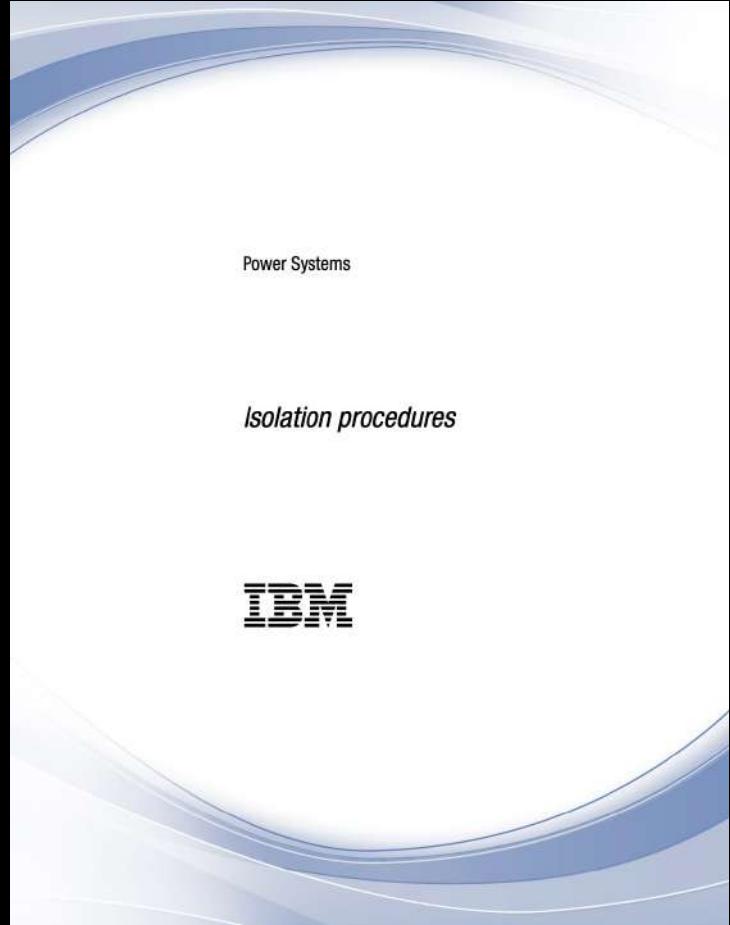
VFYCMN command to verify the correct operation of a communications card, line, or interface.

VFYOPT command to verify the correct operation of an optical library. For non-library optical units, use the verify option within the hardware service manager.

VFYPRT command to verify the correct operation of a printer.

VFYTAP Use the VFYTAP command to verify the correct operation of a tape unit.

# Problem Isolation Procedure



Is there a B600 xxxx SRC that occurred during the last IPL other than the B600 6944 and informational SRCs?

- Yes: Use the other B600 xxxx SRC to determine the problem. Go to the Start of Call and look up the new SRC to correct the problem. This ends the procedure.
- No: You connected an I/O processor in the wrong card position. Use the system configuration list to compare the cards. When you have corrected the configuration, go to the start of this procedure to verify the bus repair. This ends the procedure.

# PAL/SAL

- Use the *Product activity log* option to analyze the log data of a specific subsystem. Some subsystem selections are:

- All logs
- Processor
- Magnetic media
- Local workstation
- Communications (SDLC, BSC, X.25, token ring, remote workstation, IDLC, if supported by the system).
- Power
- Licensed program
- Licensed Internal Code

The service action log (SAL) is a subset of the product activity log. The SAL is a utility that scans the PAL and displays entries that require service representative action. It pulls out the relevant information from those entries and formats it to the display to show service information, such as failing resource names, field replaceable unit (FRU) part numbers, and FRU locations

# Control Panel



The physical control panel is your initial interface with the server. You can use the physical control panel to perform functions such as IPL, power on, and power off.

Function code	Function selected
01	Displays the current IPL parameters. This function is available in both normal and manual operating mode.
02	Used to select the IPL type, system operating mode, and firmware IPL mode. This function is available in both normal and manual operating mode.
03	Restarts an IPL of the system using the selected IPL parameters. This function is available only in manual operating mode and when the system power is on.

The IPL to apply MF99207/MF99301 will hang at SRC code C6003962 indefinitely when IPLing to the B side.

- You must perform an A side (A-Manual) IPL in order to get the system back on line.

# IBM i Community

60+ IBM i User Groups and Communities to Join

By Tom Huntington on July 19, 2019



# The IBM i Community

In addition to the regional groups listed above, there are many other IBM i user groups and resources to explore:

**IDUG DB2 User Group:** IDUG is the foremost independent, user-driven community that provides a direct channel to thousands of professional DB2 users across the globe.

**imPower Technologies:** Jim Buck has an online offering that includes RPG Free/RDi education. The site states its goal as being driven to deliver the highest quality IBM i educational training that transforms corporate culture, nurtures and enhances workforce skills, and delivers maximum ROI for the corporate education budget. This is a good tool for educating new IBM i technologists.

**The Large User Group (LUG):** LUG counts almost 100 large companies among their members, all of which have made significant investments in their IBM i platforms. These companies are located around the world and span multiple industries.

**North East User Group Conference:** NEUGC is an annual IBM i event held in New England for IBM i (Power Systems, iSeries, AS/400). It's designed to bring together IBM user groups from Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. They also have a Facebook page.

**Young i Professionals:** This is an international group of technology professionals that represent all "young" entrants into the job market or "young" users of IBM i, iSeries, System i, and AS/400.

**ILE-RPG Developers:** This organization provides educational resources and a LinkedIn community dedicated to reinvigorating development using ILE-RPG in IBM's AS/400, iSeries, or IBM i on Power.

**System i Developer:** SiD is a consortium of experts in RPGIV, SQL, DB2, ILE, RSE/RDi/RDP/WDSc, and PHP offering education, training/services, and conferences, including the RPG & DB2 Summit, in support of RPG and DB2.

**IBM i Community:** An emerging community for RPG/COBOL/DB2 professionals.

**PUB400.COM:** A free, public server running IBM i 7.4 for everyone  
IBM i also has a Facebook page.

## IBM Power Systems Community

Connect, learn, share, and engage with the IBM Power Systems Community.

Ask a question

This Community ▾

The screenshot shows the homepage of the IBM Power Systems Community. At the top right is a dropdown menu labeled "This Community ▾". Below the header, there are three main navigation tabs: "Operating Systems" (with a gear icon), "IBM i" (with a server icon), and "Latest Discussions" (with an "Add" button). Under "Operating Systems", there is a brief description: "The core of your mission-critical systems". Below the tabs are links for "Group Home", "Discussion 99", "Library 40", "Blogs 22", "Events 1", and "Members 412". The "IBM i" tab is currently selected. The "Latest Discussions" section displays two posts. The first post, by Fernando Plaza, is titled "RE: QSYS2.EXIT\_POINT\_INFO" and says: "Thank Robert and thanks Rudi ... Yes ... I needed to read a little more .. ----- Fernando Plaza". The second post, by Robert Berendt, is also titled "RE: QSYS2.EXIT\_POINT\_INFO" and says: "Your English is better than any foreign language I know. Even so I had a tough time understanding your request. I am trying to guess. There are two exit point services: EXIT\_POINT\_INFO: Provides information about the first screen on WRKREGINF and 5=Display ...". Both posts have a small profile picture next to them. At the bottom right of the discussion area, it says "1 person recommends this."

# The IBM i Community

Canada

Ontario (Toronto) – Toronto Users Group and Facebook

United States

The largest of the user groups is COMMON, which brings together IBM technology users across scores of local chapters across the globe. COMMON also has a Facebook User Group page with over 200 members.

California – Orange County Educational Advancement Network (OCEAN)

Connecticut – Fairfield Application System User Group

Georgia – IBM i Tech Community

Illinois – Omni Users Group

Indiana

•STATUS

•Mid-Range Michiana Users Group

Massachusetts – NEMUG

Michigan

•Southeast Michigan iSeries Users Group

•Midrange Meetup

•MITEC

•WMSUG

Minnesota – QUSER

Missouri – Gateway/400 Group

New Hampshire – New Hampshire Midrange Users Group

New Jersey – NESTU

New York

•Midrange Users Group of Western New York

•Long Island Systems Users Group (LISUG)

Ohio – TriState Midrange Users Group

Rhode Island – New England Midrange Users Group

Tennessee – IMUG

Texas – Metro Midrange Systems Association

Utah – Utah IBM i Professionals Association (formerly Greater Salt Lake Midrange User Group)

Vermont – Vermont Midrange User Group (VTMUG) and Facebook

Virginia – Mid-Atlantic Group of IBM i Collaborators (MAGIC)

Washington – Pacific Midrange Systems Association

Wisconsin – Wisconsin Midrange Computer Professional Association and Facebook

South America

Argentina (Buenos Aires) – COMMON Argentina

Brazil – COMMON Latino

Peru – COMMON Peru

Asia/Oceania/Pacific

Australia – Interaction Australasia

Japan – COMMON Japan (iSUC)

Korea – SISA Korea

Russia – AIX Portal and Facebook

Europe

There is a COMMON Europe website and Facebook page as well as these individual country pages.

Austria – COMMON Austria and Facebook

Belgium – COMMON Belgium

Czech Republic and Slovenia – COMMON Czech Republic and Slovenia

Denmark – COMMON Denmark

France

•COMMON France

•Club Informatique Pays de Loire (Forum)

•Le Club Informatique de Bretagne

Germany – COMMON Deutschland

Italy

•Italian Power Association

•Faq400

Luxembourg – COMMON Luxembourg

The Netherlands – COMMON Netherlands

Norway – COMMON Norway

Poland – COMMON Poland

Russia – AIX Portal and Facebook

Sweden – COMMON Sweden (Data 3) and Facebook

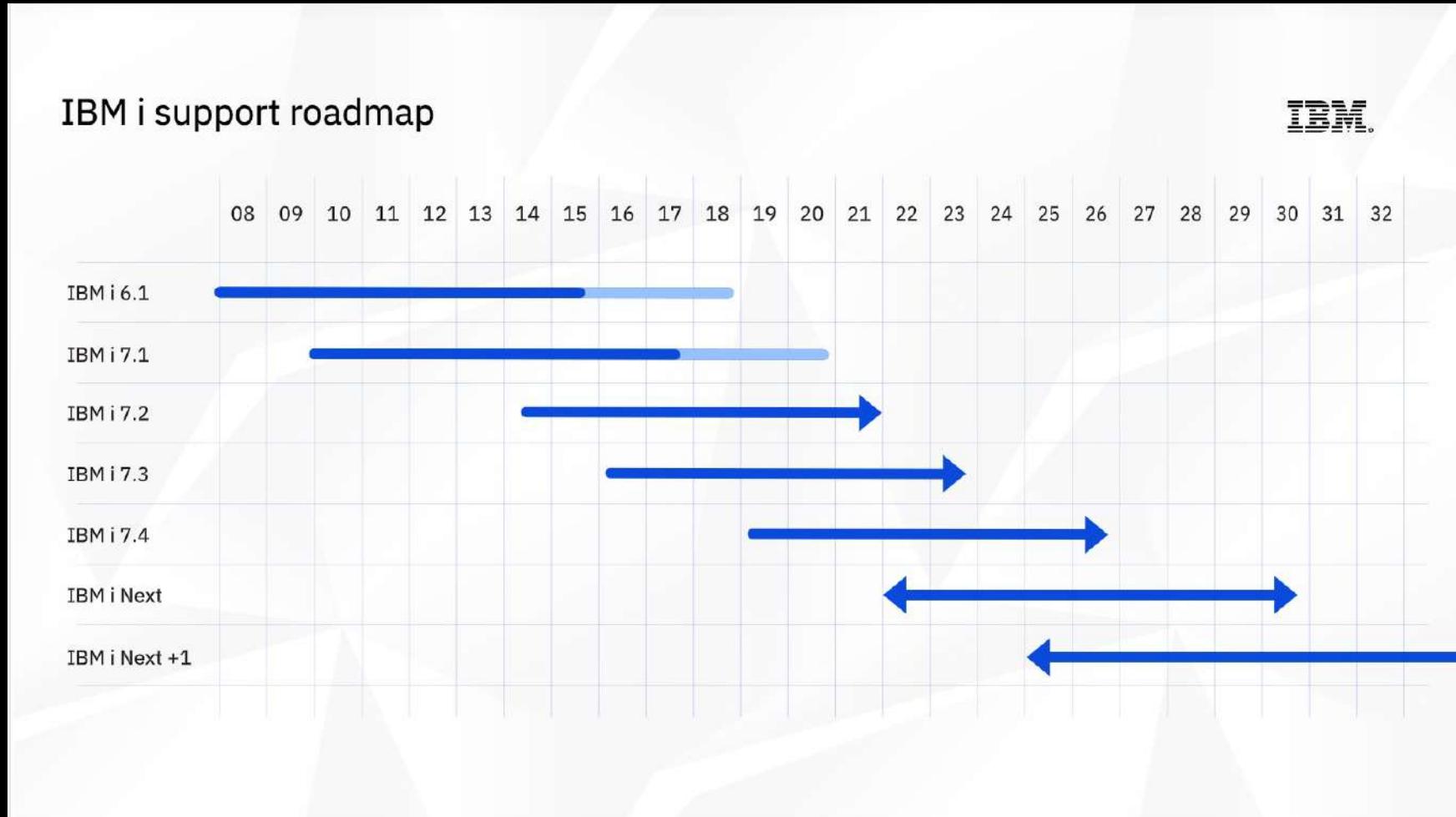
Switzerland – COMMON Romandie (French) and COMMON Switzerland (German)

United Kingdom

•COMMON Great Britain and Facebook

•IBM i Southampton on LinkedIn and i-Community

# 10+ Years strategy



And your programs will run on it..<sup>89.</sup>

# RFE – Request For Enhancement

“The IBM i platform’s greatest strength is its committed user base, whose long-lasting loyalty is unique in the annals of the business computer industry. IBM encourages its committed customers to get involved with shaping the future of the platform through the Request for Enhancement (RFE) process, which plays out in the public for all to see.”

224 votes	Request about Printing forms with ruled line on ACS.
	■ Description & Background On IBM i Access for Windows or Pcomm, it is possible to output forms to the printer by a GDI printing capability of a windows printer session. But that is not possible on ACS...  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>
150 votes	SQL prompting in ACS  The new SQL tool in ACS make so much more sense than the old STRSQL - however, the prompt feature from the STRSQL where schemas, tables, columns can be selected from drop-down to construct SQL statement...  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>
140 votes	DB2 service for IFS listing  I'd like to be able to get a list of IFS files within a directory using a DB2 service.  For example, to get the root directory: SELECT * FROM TABLE(QSYS2.GET_IFS('/')) A  Which would return a list of...  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>
138 votes	Enhance the interface for Run SQL Script in IBM i ACS  I would like to see the Run SQL Script interface support** dot prompting for columns with descriptions, types and length. For example when typing in a select statement the user would use an alias s...  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>
128 votes	New built-in function %SPLIT.  The new built-in function %SPLIT can be used to extract an array of elements from a source string.  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>
120 votes	Allow use of RPG constants in embedded SQL  When a constant is defined in RPG, allow that constant to be used in embedded SQL statements so that the value of the constant does not have to be hard coded in the SQL statement.  Allow the constant ...  <span style="background-color: #2e6b2e; color: white; padding: 2px;">Delivered</span>

## Your ideas matter!

As of today:  
36 new  
54 planned  
522 delivered



*“When a client submits an RFE, it goes through an advisory council, which prioritizes them so that enhancements are made in a way that makes sense for the broader business. “IBM entertains a huge number of RFEs,” says Butterill. “Some of them find their way into the TRs. Some of them find their way into the next releases that we’re developing. Some of them are even available but the person submitting them just doesn’t know or isn’t aware that it’s already there, or it isn’t implemented quite the way they expected.”*

# The IBM staff



# THANK YOU!

# EXTRA SLIDES ABOUT IBM POWER



# 80% Utilization

## **System Performance Utilization Guarantee**

When a Client acquires a POWER9 E980 or E950 Enterprise Server and the Client runs eligible workloads, IBM guarantees the system will perform as warranted with a System Utilization Rate of up to 80%. Should the Client not be able to achieve 80% system utilization rate, assuming there is sufficient work to drive the machine to 80% utilization, IBM will assist with the attainment of 80% system utilization rate, at no additional cost.

Component	Description
Integrated Virtualization Manager (IVM)	You can use the graphical interface of the Virtual I/O Server (VIOS) management partition on some servers that are not managed by a Hardware Management Console (HMC).
Live Partition Mobility	You can migrate an active or inactive AIX®, Linux, or IBM i logical partition from one system to another by using Live Partition Mobility.
Management	Management tools such as HMC, IVM, and PowerVC help to aggregate and manage resources by using a consolidated logical view.
Micro-Partitioning® technology	You can allocate processors to partitions in increments of 0.01, which allows multiple partitions to share the processing power of the system. When the firmware is at level 7.6, or later, micropartitions can be defined as small as 0.05 of a processor and can be changed in increments as small as 0.01 of a processor. A maximum of 20 micropartitions can be created per core.
N-Port ID Virtualization (NPIV)	NPIV is a standard technology for Fibre Channel networks. With NPIV you can connect multiple partitions to one physical port of a physical Fibre Channel adapter.
Partition suspend and resume	A running AIX, Linux, or IBM i logical partition can be

## VMWare – Hyper-V, KVM

The hypervisor can consume as much as 25% of the system resources when acting as the VM agent.

PowerVM Active Memory™ Sharing	You can share memory among partitions in a shared memory pool, by using PowerVM Active Memory Sharing.
PowerVP™	Power Virtualization Performance (PowerVP) is a performance monitoring solution that provides detailed and real-time information about virtualized workloads that are running on Power Systems™. You can use PowerVP to understand how virtual workloads use resources, to analyze performance bottlenecks, and to make informed choices about resource allocation and virtualized machine placement.
PowerVM NovaLink	PowerVM NovaLink is a software interface for virtualization management that you can install on a PowerVM server. PowerVM NovaLink enables highly scalable modern cloud management and deployment for critical enterprise workloads. You can use PowerVM NovaLink to provision large numbers of virtual machines on PowerVM servers quickly and at reduced cost.

# PowerVM

Think what could be done if Intel or AMD would own VMWare and Microsoft..  
Or Microsoft made their own CPU and all infrastructure around it

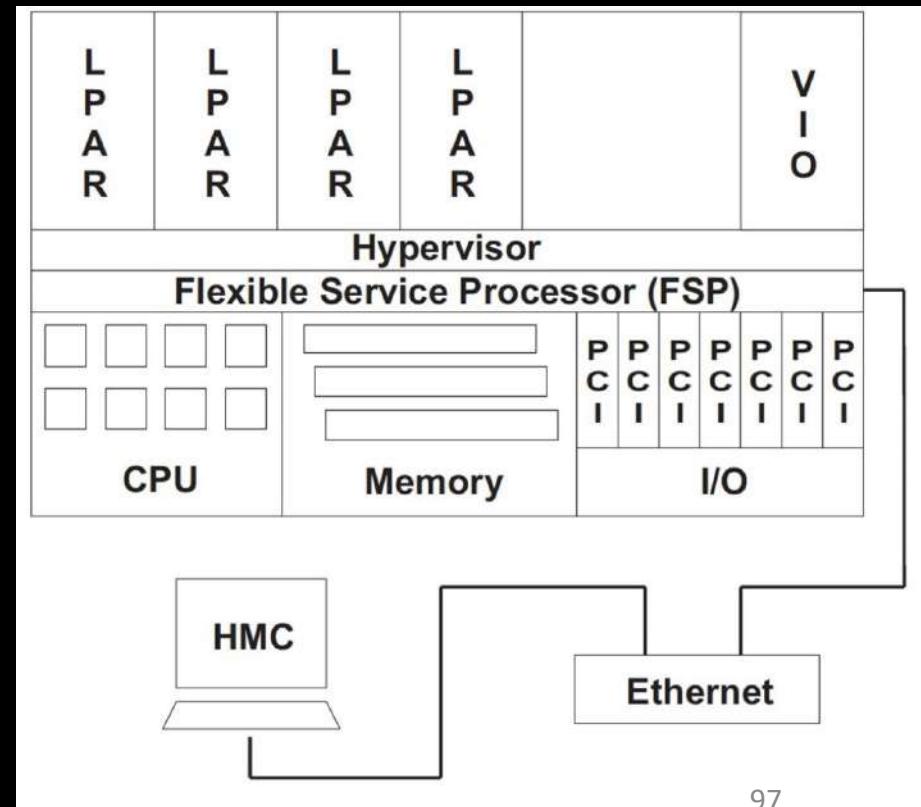
Remote restart	Remote restart is a high availability option for logical partitions. When an error causes a server outage, a partition that is configured for remote restart can be restarted on a different physical server. Sometimes, it might take longer to start the server, in which case remote restart function can be used for faster re-provisioning of the partition. This can be done faster than restarting the server that failed and then restarting the partition.
Shared processor pools	You can assign priorities to partitions, and the hypervisor allocates processing power as needed by the applications. This feature provides automatic nondisruptive balancing of processing power between partitions assigned to shared pools, which results in increased throughput and the potential to reduce processor-based software licensing costs. This feature is supported on POWER6®, POWER7®, and POWER8 processor-based servers.
Shared storage pools	Shared storage pools provide distributed storage access to all VIOS logical partitions in the cluster. On VIOS Version 2.2.0.1, Fix Pack 24, Service Pack 1, you can create a cluster of only one VIOS partition that is connected to the same shared storage pool. On VIOS Version 2.2.1.3, or later, you can create a cluster that consists of up to 16 VIOS partitions.
Single Root I/O Virtualization	Single root I/O virtualization (SR-IOV) is a Peripheral component interconnect express (PCIe) standard architecture that define extensions to PCIe specifications to enable multiple logical partitions running simultaneously within a system to share PCIe devices. The architecture define virtual replicas of
Thin provisioning	Thin provisioning helps reduce the amount of unused storage that is allocated to applications or users. Allocation of actual space on the storage subsystem is deferred until the data is written to disk.
Thick provisioning	Thick provisioning helps reserve storage space for virtual disks, thus ensuring that no failures occur because of lack of storage space.
VIOS	You can share physical I/O resources on the server between client partitions by using VIOS.

However, POWER was designed with virtualization in mind almost from the very beginning and features a built-in hypervisor that operates with as little as a 2 percent loss in efficiency (as compared to running a workload directly on the hardware, without using a hypervisor).

# Flexibel Service Processor

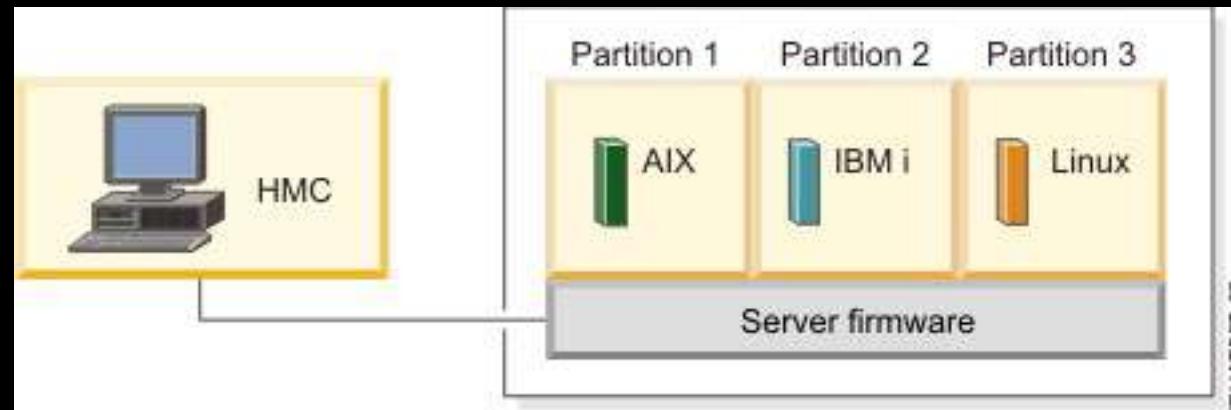
The service processor monitors the operation of the firmware during the boot process and also monitors the hypervisor for termination. The hypervisor monitors the service processor and reports a service reference code when it detects surveillance loss. In the IBM PowerVM environment, it will perform a reset/reload if it detects the loss of the service processor.

Advanced System Management Interface (ASMI) is a graphical interface that is part of the service processor firmware. The ASMI manages and communicates with the service processor. The ASMI is required to set up the service processor and to perform service tasks, such as reading service processor error logs, reading vital product data, and controlling the system power.



# HMC

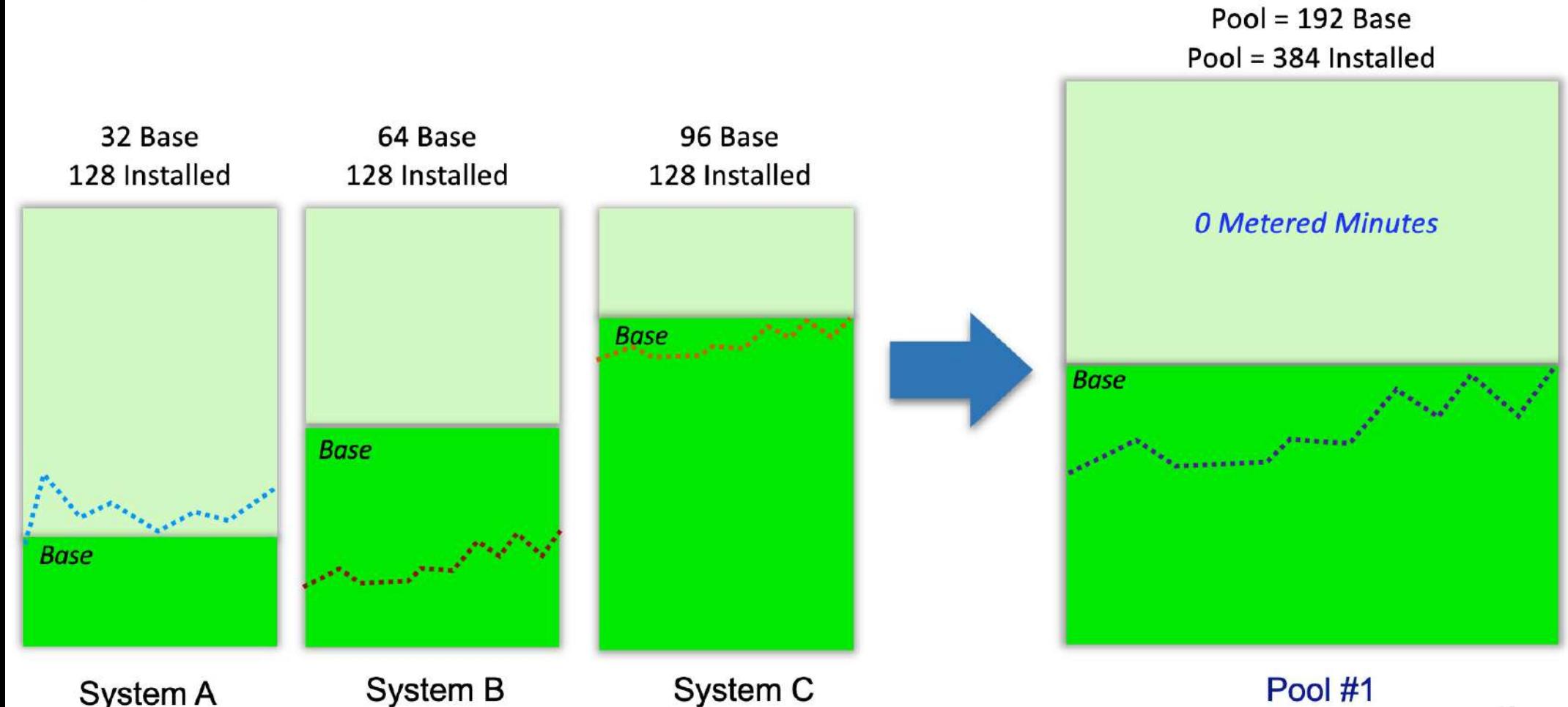
The *Hardware Management Console (HMC)* is a hardware appliance that you can use to configure and control one or more managed systems.



In this figure, you can see the logical partitions and the server firmware on the server. The *server firmware* is code that is stored in system flash memory on the server. The server firmware directly controls the resource allocations on the server and the communications between logical partitions on the server. The HMC connects with the server firmware and specifies how the server firmware allocates resources to the managed system.

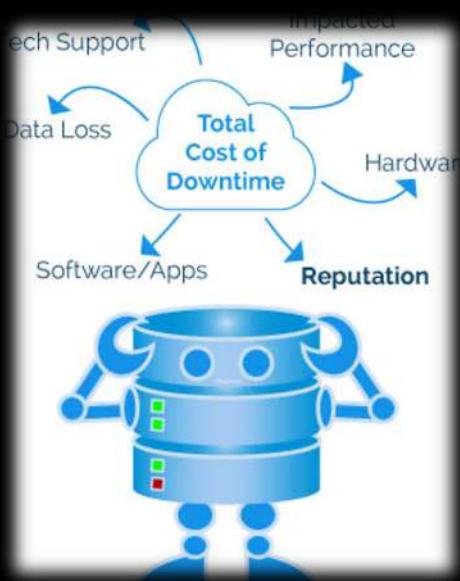
# Power Enterprise Pools

*Processor Example - Pool has 1 system using more than its Base Processor Activations, but another system is idle, using less than its Base Processor resources at the same time, so 0 Metered resource usage is recorded*



# LPM – Live Partition Mobility

Live Partition Mobility, a component of the PowerVM Enterprise Edition hardware feature, provides the ability to move AIX, IBM i, and Linux logical partitions from one system to another. The mobility process transfers the system environment that includes the processor state, memory, attached virtual devices, and connected users.





Auditing  
Cost

# PowerSC

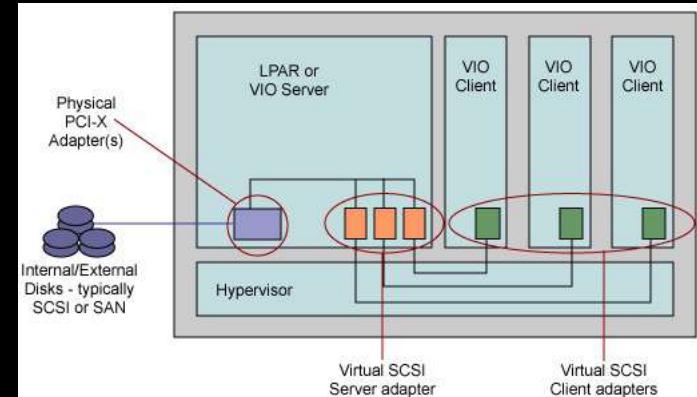
## PowerSC Tools for IBM i

Tools / Feature	Function	Benefit
<b>Compliance Assessment and Event Monitoring Tool</b>	Daily compliance dashboard report/s at LPAR, system or enterprise level with event monitoring	Enables compliance officer to demonstrate adherence to pre-defined security policies
<b>Security Diagnostics</b>	Reports detailing security configuration settings and identifying deficiencies	Reduces operator time involved in remediating security exposures
<b>Privileged Access Control</b>	Controls the number of privileged users	Ensures compliance with industry guidelines on privileged users
<b>Secure Administrator for SAP</b>	Manages and controls access to powerful SAP administrative profiles	Eliminates sharing of SAP administrative profiles with enhanced security auditing
<b>Access Control Monitor</b>	Monitors security deviations from application design	Prevents user application failures due to inconsistent access controls
<b>Network Interface Firewall for IBM i Exit Points</b>	Controls access to Exit Point interfaces such as ODBC, FTP, RMTCMD, etc	Reduces threat of unauthorized security breach and data loss
<b>Audit Reporting</b>	Consolidates and reduces security audit journal information	Simplifies audit analysis for compliance officer and/or auditors
<b>Certificate Expiration Manager</b>	Simplifies management of digital certificates expiration	Helps operators prevent system outages due to expired certificates
<b>Password Synchronization</b>	Aids users with enhanced PWD management	Maintains consistent PWDs and SVRAUTE
<b>Password Validation</b>	Enhances operating system password validation	Ensures that passwords are not trivial
<b>Two Factor Authentication</b>	Service Program to enable 2FA in applications	Includes PWD Reset and Signon utilities
<b>Single Sign On (SSO) Suite</b>	Simplifies implementation of SSO and password synchronization	Reduces password resets and simplifies end user experience

# VIOS

You can use the VIOS to perform the following functions:

- Sharing of physical resources between logical partitions on the system
- Creating logical partitions without requiring additional physical I/O resources
- Creating more logical partitions than there are I/O slots or physical devices available with the ability for logical partitions to have dedicated I/O, virtual I/O, or both
- Maximizing use of physical resources on the system
- Helping to reduce the storage area network (SAN) infrastructure



## Is VIOS Important?

Yes! It gives you the flexibility of being able to share resources across multiple client LPARs. By sharing resources such as fibre channel adapters, network adapters, and external SAN-housed disks, you can dramatically reduce the physical footprint and the power consumed—very relevant in today's green-thinking age.