Power Systems

IBM

System Limits on IBM i

Scott Forstie
Db2 for i Business Architect
forstie@us.ibm.com
@Forstie_IBMi

Tracking System Limits – Customer view

Customer Requirements

- We need to be **proactive** and understand our posture against important system limits
- I want to be able to **recognize** trends and run-away situations
- We need to **understand** how spikes like month-end processing affect our consumption of operating system resources.

IBM i Innovation

- **Leverage** the integrated IBM i operating system to instrument the automated recognition of resource consumption
- Accommodate **different types** of consumption (Job, Object, ASP, and System)
- **Db2 for i** is the repository
- Define the **criteria** for which limits are worthy of tracking

Patent filed March/2013 → "Integrated Limits Tracking, Trending, and Reporting"

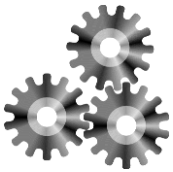
Take aways

- Achieve pro-active systems management via regular review of system health detail

- Use modern reporting tools to push out system health detail

System Limits Architecture

User Job – Long running data purge running with commitment control



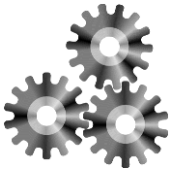
10,000th row deleted

110,000th row deleted

210,000th row deleted

System event notification

Low priority QDBSRVnn jobs



INSERT into…

QSYS2/GET_JOB_INFO() UDTF

QSYS2/SYSLIMTBL

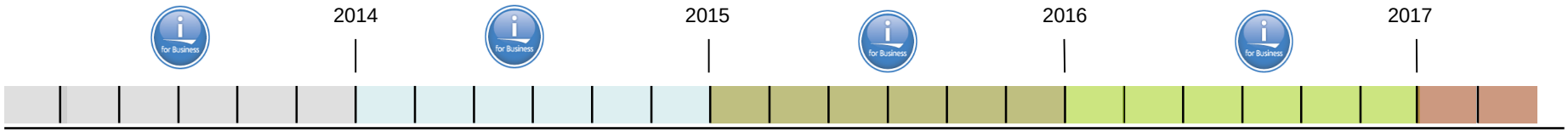
QSYS2/SQL_SIZING

QSYS2/SYSLIMITS

IBM i System Limits – Where does the data reside?

Object	Type	Purpose
QSYS2/SYSLIMTBL	*FILE SQL Table	System wide (including iASP) physical file repository for tracked System Limits. Designed to have the smallest storage footprint.
QSYS2/GET_JOB_INFO	User Defined Table Function	Accepts a job name as input and returns a single row of information about an active job.
QSYS2/SQL_SIZING	*FILE SQL Table	Table where architected limits are defined, including translated descriptions.
QSYS2/SYSLIMITS	*FILE SQL View	The external interface which joins detail from the preceding three resources.

Tracking System Limits – Enhancement Timeline



System Limits added in 2013:

- **Active jobs**
- **Rows locked in a unit of work**
- **Row change operations in a unit of work**
- **Spool files**
- **File members**

System Limits added in 2014:

- **Database File limits**
- **Library size limit**
- **Journal size limits**
- **Journal sequence limits**
- **Journal object limits**
- **IFS limits (IBM i 7.2 and up)**

System Limits added in 2015:

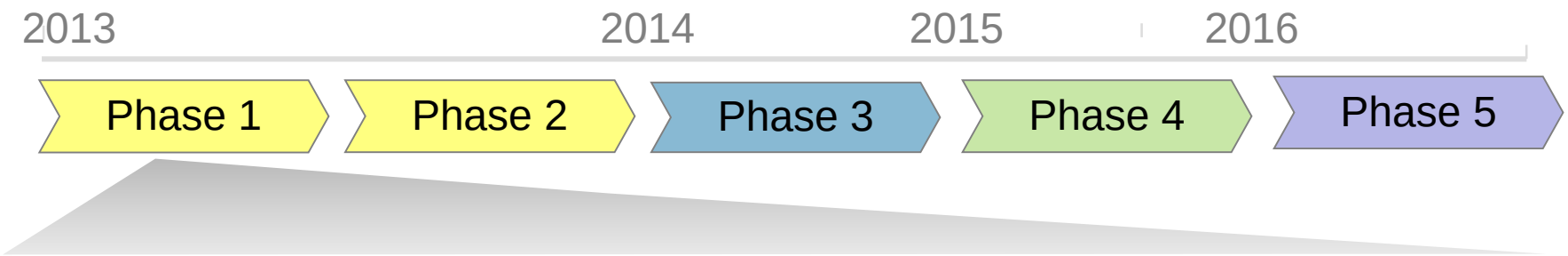
- **Database Index Size (IBM i 7.1 & up)**

System Limits added in 2016:

- **Add columns to QSYS2/SYSLIMITS**
- **Extended Dynamic *SQLPKG limit**

http://bit.ly/SystemLimitsOnIBMi

IBM i System Limits – One of every type



Work Management System Limit:	Architectural Limit
• Total jobs	970K
Commitment Control Job Limits:	
• Rows locked in a unit of work	500 Million
• Row change operations in a unit of work	<no limit>
Spool ASP Limit:	
• Spool files	2.6 Million
Database Object Limit:	
• File members	32K

Epic Phase

Phase 1 – Details

Limit description	Limit ID	Maximum	Floor	Increment
Maximum number of jobs	19000	970,000 485,000 (6.1)	1,000	400
Maximum number of rows locked in a unit of work	16200	500,000,000	10,000	100,000
Maximum number of row change operations in a unit of work	16201	0	10,000	100,000
Maximum number of spooled files in the system and basic user ASPs	19002	2,610,000	10,000	5,000
Maximum number of members	16100	32,767	100	100

Maximum number of Jobs – Percentage consumed

```
WITH TT(JOB_MAXIMUM)
  AS (SELECT CURRENT_NUMERIC_VALUE
        FROM QSYS2.SYSTEM_VALUE_INFO
        WHERE SYSTEM_VALUE_NAME = 'QMAXJOB')
SELECT LAST_CHANGE_TIMESTAMP AS INCREMENT_TIME,
CURRENT_VALUE AS JOB_COUNT, TT.JOB_MAXIMUM,
DEC(DEC(CURRENT_VALUE,19,2) / DEC(TT.JOB_MAXIMUM,19,2) *
100,19,2) AS PERCENT_CONSUMED
FROM QSYS2.SYSLIMITS, TT
WHERE LIMIT_ID = 19000 ORDER BY CURRENT_VALUE DESC
```

INCREMENT_TIME	JOB_COUNT	JOB_MAXIMUM	PERCENT_CONSUMED
2015-05-18 00:33:25.439414	71408	163520	43.66
2015-05-16 08:00:13.560947	71008	163520	43.42
2015-05-18 01:00:23.118807	70031	163520	42.82
2015-05-12 22:42:48.345298	69008	163520	42.20
2015-05-12 22:42:33.200108	68608	163520	41.95
2015-05-12 22:31:28.636105	68208	163520	41.71
2015-05-18 01:01:01.333811	68140	163520	41.67
2015-05-18 01:02:01.376725	65246	163520	39.90
2015-05-18 01:07:04.412267	54952	163520	33.60
2015-05-12 21:47:34.281314	49808	163520	30.45

Example: Data purge under commit

SELECT SIZING_NAME, CURRENT_VALUE FROM QSYS2.SYSLIMITS WHERE JOB_NAME = upper('297851/Q ... - Rchaptf3.rch.s...

SIZING_NAME	CURRENT_VALUE
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	10000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	10000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	110000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	110000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	210000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	210000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	310000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	310000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	410000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	410000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	510000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	510000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	610000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	610000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	710000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	710000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	810000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	810000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	910000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	910000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	810000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	710000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	610000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	510000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	410000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	310000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	210000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	110000
MAXIMUM NUMBER OF ROW CHANGE OPERATIONS IN A UNIT OF WORK	10000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	810000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	710000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	610000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	510000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	410000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	310000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	210000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	110000
MAXIMUM NUMBER OF ROWS LOCKED IN A UNIT OF WORK	10000

Floor

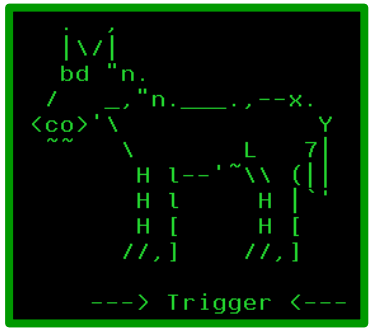
Increments reflect increasing number of deleted rows

Note… we deleted 1 million rows, the high point is not recorded

Commit or Rollback releasing the locks

Too many Rows locked in a job

Need an exclusive lock

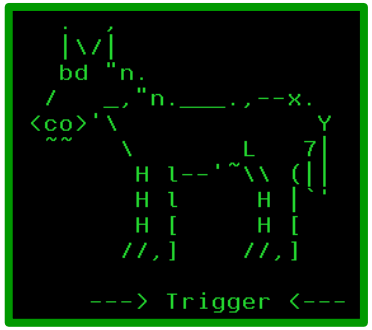



```
CL: ALCOBJ OBJ((QSYS2/SYSLIMTBL *FILE *EXCL)) CONFLICT(*RQSRLS) ;
CL: DLCOBJ OBJ((QSYS2/SYSLIMTBL *FILE *EXCL));

CREATE OR REPLACE TRIGGER MYLIB.SYSTEM_LIMITS_STOP_RUN_AWAY
         AFTER INSERT ON QSYS2.SYSLIMTBL
         REFERENCING NEW AS N FOR EACH ROW MODE DB2ROW
SET OPTION USRPRF=*OWNER, DYNUSRPRF=*OWNER
BEGIN ATOMIC
DECLARE V_CMDSTMT VARCHAR(200) ;
DECLARE ERROR INTEGER;
DECLARE EXIT HANDLER FOR SQLEXCEPTION SET ERROR = 1;
/* ------------------------------------------------------------- */
/* If someone exceeds 200,000 row locks,hold job & alert the operator */
/* ------------------------------------------------------------- */
IF (N.LIMIT_ID = 16200 AND
    N.CURRENT_VALUE > 200000) THEN
 SET V_CMDSTMT = 'HLDJOB JOB(' CONCAT N.JOB_NAME CONCAT ')';
 CALL QSYS2.QCMDEXC( V_CMDSTMT );

 SET V_CMDSTMT = 'SNDMSG MSG(''Job held: '
     CONCAT N.JOB_NAME CONCAT ' because User:' CONCAT N.USER_NAME
     CONCAT ' holds ' CONCAT N.CURRENT_VALUE
     CONCAT ' row locks' CONCAT ' '') TOUSR(*SYSOPR) MSGTYPE(*INFO) ';
 CALL QSYS2.QCMDEXC( V_CMDSTMT );
END IF;
END;
```

Trigger example

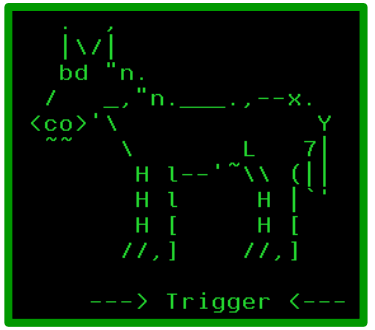
```
                                Display Messages
                                                          System:   LP24UT27
Queue . . . . . :   QSYSOPR                 Program . . . . :   *DSPMSG
  Library . . . :     QSYS                    Library . . . :
Severity  . . . :   99                      Delivery  . . . :   *HOLD

Type reply (if required), press Enter.
  Journal receivers QSQTTJ0040 and *N detached.
  Journal receivers QSQTTJ0041 and *N detached.
  Job 142256/QUSER/QZDASOINIT held by user QSYS with option SPLFILE(*NO).
  From  . . . :   QSYS            02/26/15   11:35:55
  Job held: 142256/QUSER/QZDASOINIT because User:SCOTTF holds 210000 row
    locks
```

What the operator would see

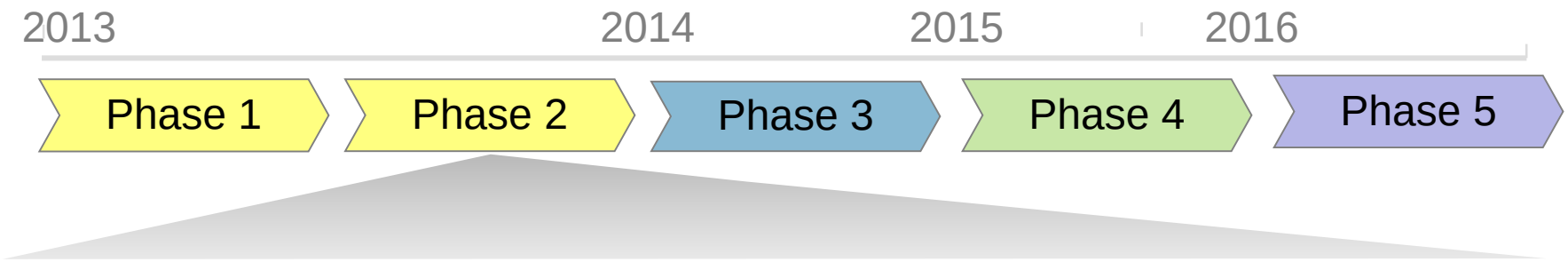


Alert when a DB file is growing very large

```
CL: ALCOBJ OBJ((QSYS2/SYSLIMTBL *FILE *EXCL)) CONFLICT(*RQSRLS) ;
CL: DLCOBJ OBJ((QSYS2/SYSLIMTBL *FILE *EXCL));

CREATE OR REPLACE TRIGGER MYLIB.SYSTEM_LIMITS_LARGE_FILE
         AFTER INSERT ON QSYS2.SYSLIMTBL
         REFERENCING NEW AS N FOR EACH ROW MODE DB2ROW
SET OPTION USRPRF=*OWNER, DYNUSRPRF=*OWNER
BEGIN ATOMIC
DECLARE V_CMDSTMT VARCHAR(200) ;
DECLARE ERROR INTEGER;
DECLARE EXIT HANDLER FOR SQLEXCEPTION SET ERROR = 1;
/* ------------------------------------------------------------- */
/* If a table is nearing the maximum size, alert the operator    */
/* ------------------------------------------------------------- */
IF (N.LIMIT_ID = 15000 AND
    N.CURRENT_VALUE > 3000000000) THEN

SET V_CMDSTMT = 'SNDMSG MSG(''Table: '
     CONCAT N.SYSTEM_SCHEMA_NAME CONCAT '/' CONCAT N.SYSTEM_OBJECT_NAME
     CONCAT ' (' CONCAT N.SYSTEM_TABLE_MEMBER CONCAT
     ') IS GETTING VERY LARGE - ROW COUNT =  '
     CONCAT CURRENT_VALUE CONCAT ' '') TOUSR(*SYSOPR) MSGTYPE(*INFO) ';
 CALL QSYS2.QCMDEXC( V_CMDSTMT );
END IF;
END;
```



IBM i System Limits – Database files and libraries



Database

Database Object Limits:	Architectural Limit
• All rows in a partition	4.3 Billion
• Valid rows in a partition	4.3 Billion
• Deleted rows in a partition	4.3 Billion
• Overflow rows in a partition	4.3 Billion
• Variable-length segments	65K
• Indexes over a partition	15K

File System Object Limits:	
• Object description entries in a library	360K

Database Files and Libraries – Limit details

Limit description	Limit ID	Maximum	Floor	Increment
Maximum number of all rows in a partition	15000	4,294,967,288	100,000	500,000
Maximum number of valid rows in a partition	15001	4,294,967,288	100,000	500,000
Maximum number of deleted rows in a partition	15002	4,294,967,288	10,000	100,000
Maximum number of overflow rows in a partition	15004	4,294,967,288	10,000	100,000
Maximum number of variable-length segments	15104	65,533	100	100
Maximum number of indexes over a partition	15106	15,000	20	100
Maximum number of object description entries in a library	18400	1,000,000	1,000	1,000

Maximum number of items within a library

```
SELECT LASTCHG, JOB_NAME, ASP_NUMBER,
SYSTEM_OBJECT_NAME AS LIBRARY, USER_NAME,
CURRENT_VALUE FROM QSYS2.SYSLIMITS WHERE
LIMIT_ID = 18400 ORDER BY CURRENT_VALUE DESC;
```

SELECT LASTCHG, JOB_NAME, ASP_NUMBER, SYSTEM_OBJECT_NAME AS LIBRARY, USER_NAME, CURRENT_VA ... - Erp7mlx1(Erp7mlx1)

LASTCHG	JOB_NAME	ASP_NUMBER	LIBRARY	USER_NAME	CURRENT_VALUE
2015-02-05 04:...	119720/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	58000
2015-02-05 08:...	123415/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	57000
2015-02-05 04:...	119720/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	57000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	56000
2015-02-05 04:...	119720/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	56000
2015-02-05 08:...	123415/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	55000
2015-02-05 04:...	119474/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	55000
2015-02-05 08:...	123415/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	54000
2015-02-05 04:...	119474/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	54000
2015-02-05 08:...	123416/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	53000
2015-02-04 03:...	116060/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	53000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	52000
2015-02-04 03:...	116058/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	52000
2015-02-05 08:...	123416/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	51000
2015-02-04 03:...	116057/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	51000
2015-02-05 08:...	123416/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	50000
2015-02-04 03:...	116060/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	50000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	49000
2015-02-04 03:...	116059/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	49000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	48000
2015-02-04 03:...	116060/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	48000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	47000
2015-02-04 03:...	116059/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	47000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	46000
2015-02-04 03:...	116057/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	46000
2015-02-05 08:...	123419/MS3ADM/QZSHSH	0	R3MS3DATA	MS3ADM	45000

DB2 Web Query – Turn raw data into something useful

DB2 Web Query for i — IBM — Powered By Information Builders

Risk Status Summary

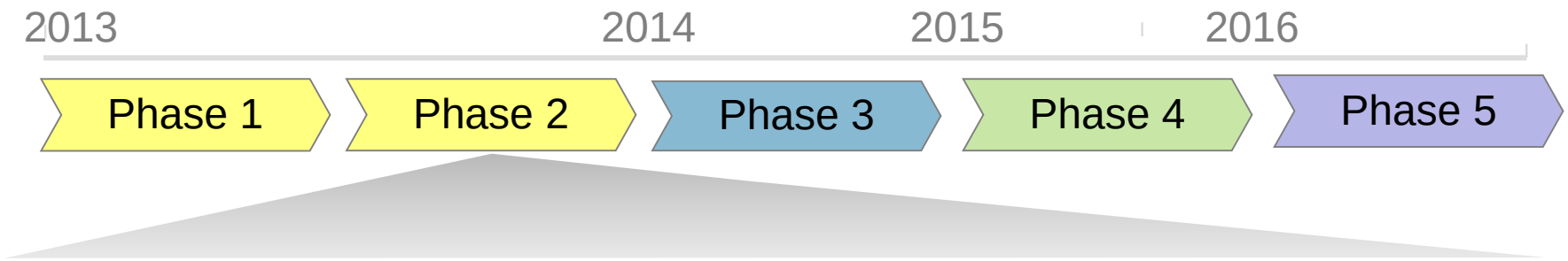
Policy Type: 2.Risk

Selected Data Center: Afternoon Database

Data Center	Region	Version	System Purpose	Backup Recovery Implementation	System Operational Owner	Security Risk Owner	System Name	Overall Risk Rating Grade	High Risk Rating Grade	Medium Risk Rating Grade	Low Risk Rating Grade
Afternoon Database	Database Systems	V7R1M0	1.Production	No	Latin America-South	Latin America-South	SYSTEM211	2.Amber	2.Amber	1.Green	1.Green
					UK	UK	SYSTEM295	1.Green	1.Green	1.Green	1.Green
							SYSTEM400	2.Amber	2.Amber	1.Green	1.Green
				Yes	Argentina	Argentina	SYSTEM329	3.Red	3.Red	2.Amber	1.Green
					Chicago	Chicago	SYSTEM203	2.Amber	2.Amber	1.Green	1.Green
							SYSTEM286	2.Amber	2.Amber	1.Green	1.Green
							SYSTEM438	2.Amber	2.Amber	1.Green	1.Green
					Hong Kong	Hong Kong	SYSTEM444	2.Amber	2.Amber	1.Green	1.Green
					North America	North America	SYSTEM205	2.Amber	2.Amber	1.Green	1.Green
					UK	UK	SYSTEM265	1.Green	1.Green	1.Green	1.Green

Sizing Description	RANK	LAST_CHANGE_TIMESTAMP	percentOfMax	Sizing Value	USER_NAME	SYSTEM_SCHEMA_NAME	SYSTEM_OBJECT_NAME	JOB_NAME	CURRENT_VALUE
Maximum number of all rows in a partition	1	2016/04/29 15:09:03.075016	.0015373826	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	6603008
	2	2016/04/29 15:08:38.526389	.0014209151	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	6102784
	3	2016/04/29 15:08:14.118707	.0013044477	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	5602560
	4	2016/04/29 15:07:49.846241	.0011879802	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	5102336
	5	2016/04/29 15:07:25.289887	.0010715127	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	4602112
	6	2016/04/29 15:07:00.992059	.0009550452	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	4101888
	7	2016/04/29 15:06:35.889680	.0008385777	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	3601664
	8	2016/04/29 15:06:10.867708	.0007221103	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	3101440
	9	2016/04/29 15:05:46.087023	.0006056428	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	2601216
	10	2016/04/29 15:05:21.127199	.0004891753	4294967288	MCKINLEY		SFDB2OTR05	004340/QTCP/QTFTP00015	2100992
		2016/04/29 15:14:05.661544	.0004891753	4294967288	MCKINLEY		SFDB2OTR08	004340/QTCP/QTFTP00015	2100992
Maximum number of bytes in a stream file	1	2016/03/24 12:36:43.464518	.0001897812	1099511627776	QLWISVR	.	.	004166/QLWISVR/ADMIN2	208666624
		2016/05/16 07:55:40.228429	.0001897812	1099511627776	QLWISVR	.	.	014520/QLWISVR/ADMIN2	208666624
		2016/05/20 14:12:17.574146	.0001897812	1099511627776	QLWISVR	.	.	016332/QLWISVR/ADMIN2	208666624
		2016/05/26 01:24:20.457705	.0001897812	1099511627776	QLWISVR	.	.	018095/QLWISVR/ADMIN2	208666624
	2	2016/03/24 12:36:43.449409	.0001888275	1099511627776	QLWISVR	.	.	004166/QLWISVR/ADMIN2	207618048
		2016/05/16 07:55:40.206101	.0001888275	1099511627776	QLWISVR	.	.	014520/QLWISVR/ADMIN2	207618048
		2016/05/20 14:12:17.568270	.0001888275	1099511627776	QLWISVR	.	.	016332/QLWISVR/ADMIN2	207618048
		2016/05/26 01:24:20.377576	.0001888275	1099511627776	QLWISVR	.	.	018095/QLWISVR/ADMIN2	207618048
	3	2016/03/24 12:36:43.440385	.0001878738	1099511627776	QLWISVR	.	.	004166/QLWISVR/ADMIN2	206569472
		2016/05/16 07:55:40.200077	.0001878738	1099511627776	QLWISVR	.	.	014520/QLWISVR/ADMIN2	206569472
		2016/05/20 14:12:17.562378	.0001878738	1099511627776	QLWISVR	.	.	016332/QLWISVR/ADMIN2	206569472
		2016/05/26 01:24:20.337777	.0001878738	1099511627776	QLWISVR	.	.	018095/QLWISVR/ADMIN2	206569472
	4	2016/03/24 12:36:43.424556	.0001869202	1099511627776	QLWISVR	.	.	004166/QLWISVR/ADMIN2	205520896

IBM i System Limits – Journals

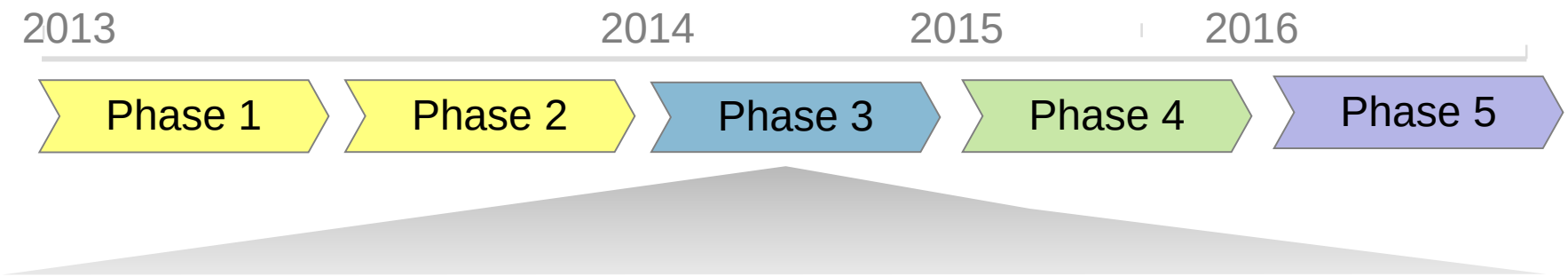


Journal Object Limits:	**Architectural Limit**
• **1TB journal receiver size**	**1Terabyte**
• **Objects that can be associated with a *MAX10M journal**	**10 Million**
• **Objects that can be associated with a *MAX250K journal**	**250,000**
• **Sequence number for a *MAXOPT3 journal**	**18 Quintillion**
• **Sequence number for a *MAXOPT1 or *MAXOPT2 journal**	**10 Billion**

Journal – Limit details

Limit description	Limit ID	Maximum	Floor	Increment
Maximum size of a journal receiver	18300	1,099,511,627,776	10,000,000,000	50,000,000,000
Maximum number of objects that can be associated with a *MAX10M journal	18301	10,000,000	10,000	200,000
Maximum number of objects that can be associated with a *MAX250K journal	18302	250,000	10,000	50,000
Maximum sequence number for a *MAXOPT3 journal	18303	18,446,744,073,709,551,600	10,000,000	100,000,000
Maximum sequence number for a *MAXOPT1 or *MAXOPT2 journal	18304	9,999,999,999	10,000,000	10,000,000

IBM i System Limits – IFS



Integrated File System Object Limits:	Architectural Limit
• Objects in a directory	0
• Directories in a directory	1 Million
• File system objects in *SYSBAS	2G
• File system objects in an independent ASP	2G
• Document library objects in a folder	65K
• Document library objects in *SYSBAS	0
• Document library objects in a user ASP	349K
• Bytes in a stream file	1T
• Bytes in a document	2G

Integrated File System – Limit details

Limit description	Limit ID	Maximum	Floor	Increment
Number of objects linked in a directory	18402	0	100,000	10,000
Maximum number of directories linked in a directory	18403	1,000,000	1,000	1,000
Maximum number of file system objects in *SYSBAS ASPs	18404	2,147,483,647	100,000	10,000
Maximum number of file system objects in an independent ASP	18405	2,147,483,647	100,000	10,000
Maximum number of document library objects in a folder	18406	65510	1,000	500
Number of document library objects in the system ASP	18407	0	100,000	10,000
Maximum number of document library objects in a user ASP	18408	1,000,000	100,000	10,000
Maximum number of bytes in a stream file	18409	1,099,511,627,776	16,777,216	1,048,576
Maximum number of bytes in a document	18410	2,147,483,647	16,777,216	1,048,576

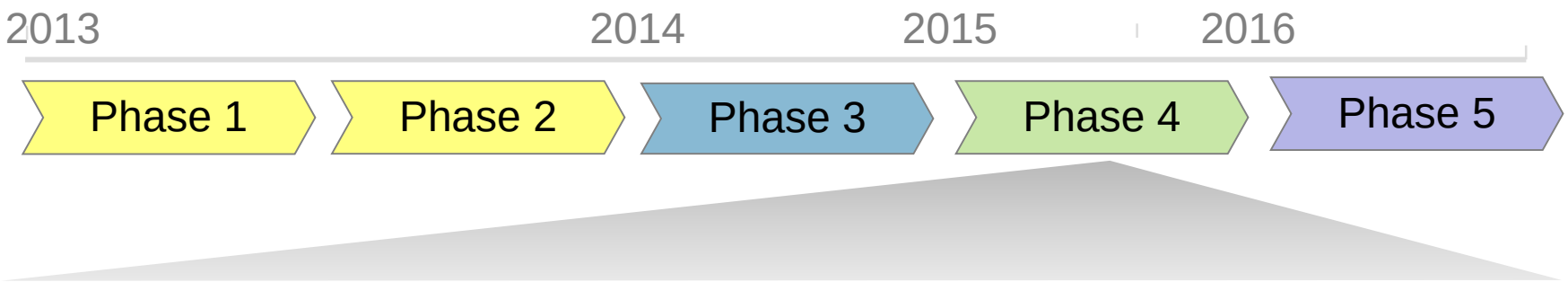
Find the largest IFS Stream Files

```
SELECT LASTCHG, JOB_NAME, ASP_NUMBER, IFS_PATH_NAME,
USER_NAME, CURRENT_VALUE FROM QSYS2.SYSLIMITS WHERE
LIMIT_ID = 18409 ORDER BY CURRENT_VALUE DESC;
```

SELECT LASTCHG, JOB_NAME, ASP_NUMBER, IFS_PATH_NAME, USER_NAME, CURRENT_VALUE FROM QSYS2.S ... - Rchastca(Rchastca)

LASTCHG	JOB_NAME	ASP_NUMBER	IFS_PATH_NAME	USER_NAME	CURRENT_VALUE
2015-01-03 23:...	337465/VCPDTA/QJVACMDSRV	1	/orbtrc.18122014.0929.20.txt	VCPDTA	1099511535858
2015-01-03 23:...	337465/VCPDTA/QJVACMDSRV	1	/orbtrc.18122014.0929.20.txt	VCPDTA	1099510485672
2015-01-03 23:...	337465/VCPDTA/QJVACMDSRV	1	/orbtrc.18122014.0929.20.txt	VCPDTA	1099509435486
2015-01-03 23:...	337465/VCPDTA/QJVACMDSRV	1	/orbtrc.18122014.0929.20.txt	VCPDTA	1099508385300
2015-01-03 23:...	337465/VCPDTA/QJVACMDSRV	1	/orbtrc.18122014.0929.20.txt	VCPDTA	1099507335114
2015-02-26 15:...	407956/QACE/QP0ZSPWP	1	/QIBM/UserData/ACE/log/server.log	QACE	61870255
2015-02-27 12:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	49286416
2015-02-27 10:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	48237784
2015-02-27 08:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	47189088
2015-02-27 06:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	46140361
2015-02-27 04:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	45091718
2015-02-27 02:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	44042651
2015-02-27 00:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	42993987
2015-02-26 22:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	41945337
2015-02-26 20:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	40896606
2015-02-26 18:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	39848021
2015-02-26 16:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	38799357
2015-02-26 14:...	405803/QBRMS/Q1ACPDST	1	/tmp/brms/qbrms	QBRMS	37750700
2015-02-26 13:...	413714/QBRMS/QBRMSYNC	1	/tmp/brms/qbrms	QBRMS	36702048
2015-02-26 13:...	413707/HERBST/QPADEV09K6	1	/tmp/brms/flightrec	HERBST	22021074
2015-02-27 04:...	407982/EBANK/QJVACMDSRV	1	/ebank/logs/EBANK00052.log	EBANK	22020395
2015-02-27 00:...	407982/EBANK/QJVACMDSRV	1	/ebank/logs/EBANK00052.log	EBANK	20971806
2015-02-26 21:...	407982/EBANK/QJVACMDSRV	1	/ebank/logs/EBANK00052.log	EBANK	19923136
2015-02-26 18:...	407982/EBANK/QJVACMDSRV	1	/ebank/logs/EBANK00052.log	EBANK	18874543
2015-02-26 14:...	407982/EBANK/QJVACMDSRV	1	/ebank/logs/EBANK00052.log	EBANK	17825926

IBM i System Limits – Phased coverage



Database Object Limit:	Architectural Limit
• Maximum *MAX4GB Index Size	4.3GB
• Maximum *MAX1TB Index Size	1.7TB
• Maximum Encoded Vector Index Size	2TB

Db2 for i – Index Limit details

Limit description	Limit ID	Maximum	Floor	Increment
Maximum *MAX4GB Index Size	15400	4,294,967,296	838,860,800	167,772,160
Maximum *MAX1TB Index Size	15401	1,869,166,411,776	8,388,608,000	8,388,608,000
Maximum Encoded Vector Index Size	15403	2,199,023,255,552	1,677,721,600	8,388,608,000

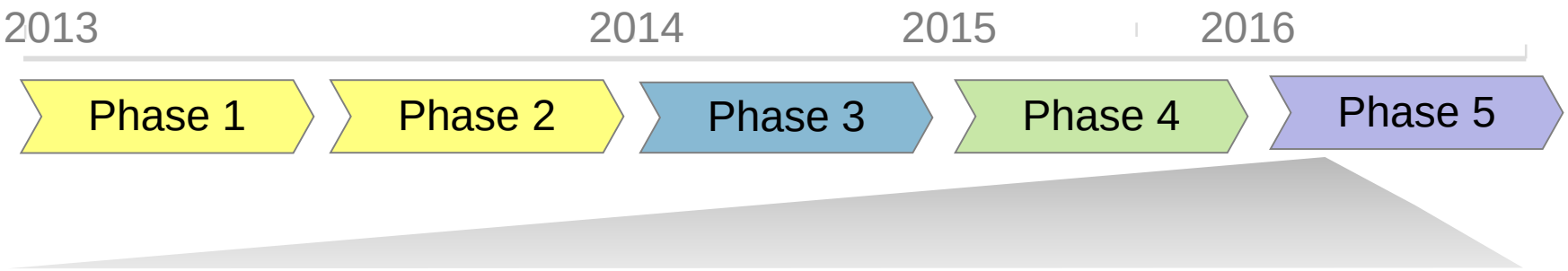
Db2 for i – Index Limit example data

```
SELECT * FROM QSYS2.SYSLIMITS
   WHERE LIMIT_ID IN (15400,15401,15403)
   ORDER BY CURRENT_VALUE DESC
```

SELECT * FROM QSYS2.SYSLIMITS WHERE LIMIT_ID IN (15400,15401,15403) ORDER BY CURRENT_VAL ... - Z1014p12.rch.stglabs.ibm.com(Z1014p12)

LAST_CHANGE_TIMESTAMP	SIZING_NAME	USER_NAME	CURRENT_VALUE	MAXIMUM_VALUE	JOB_NAME
2015-04-20 12:08:45...	MAXIMUM EVI INDEX SIZE	HANSEL	10066345983	2199023255552	211234/HANSEL/QPADEV0001
2015-04-08 11:30:04...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	4294967296	4294967296	208446/HANSEL/QPADEV000G
2015-04-08 13:00:34...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	4294967296	4294967296	208446/HANSEL/QPADEV000G
2015-04-07 13:20:21...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	4194304000	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 13:15:55...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	4026531840	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 13:07:13...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3858759680	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 12:20:18...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3690987520	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 12:15:49...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3523215360	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 11:48:35...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3355443200	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 09:33:39...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3187671040	4294967296	207327/HANSEL/QPADEV000G
2015-04-07 09:29:03...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	3019898880	4294967296	207327/HANSEL/QPADEV000G
2015-04-01 11:24:57...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2852126720	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 11:20:57...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2684354560	4294967296	204641/HANSEL/QPADEV000G
2015-04-14 15:00:17...	MAXIMUM *MAX4GB INDEX SIZE	OLSTAD	2583691264	4294967296	210133/OLSTAD/QPADEV0001
2015-04-01 11:16:52...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2516582400	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 11:12:51...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2348810240	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 10:59:02...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2181038080	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 10:54:56...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	2013265920	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 10:50:53...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1845493760	4294967296	204641/HANSEL/QPADEV000G
2015-04-16 16:45:37...	MAXIMUM EVI INDEX SIZE	QSYS	1677729791	2199023255552	210291/QSYS/QDBSRV04
2015-04-20 12:06:37...	MAXIMUM EVI INDEX SIZE	HANSEL	1677729791	2199023255552	211234/HANSEL/QPADEV0001
2015-04-01 10:46:53...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1677721600	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 10:38:35...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1509949440	4294967296	204641/HANSEL/QPADEV000G
2015-04-01 10:34:23...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1342177280	4294967296	204641/HANSEL/QPADEV000G
2015-03-31 18:51:33...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1174405120	4294967296	204540/HANSEL/QPADEV000G
2015-03-31 18:47:33...	MAXIMUM *MAX4GB INDEX SIZE	HANSEL	1006632960	4294967296	204540/HANSEL/QPADEV000G

IBM i System Limits – *SQLPKG Packages



Database Object Limit:	**Architectural Limit**
• **Maximum Extended Dynamic Package Size**	**1GB**

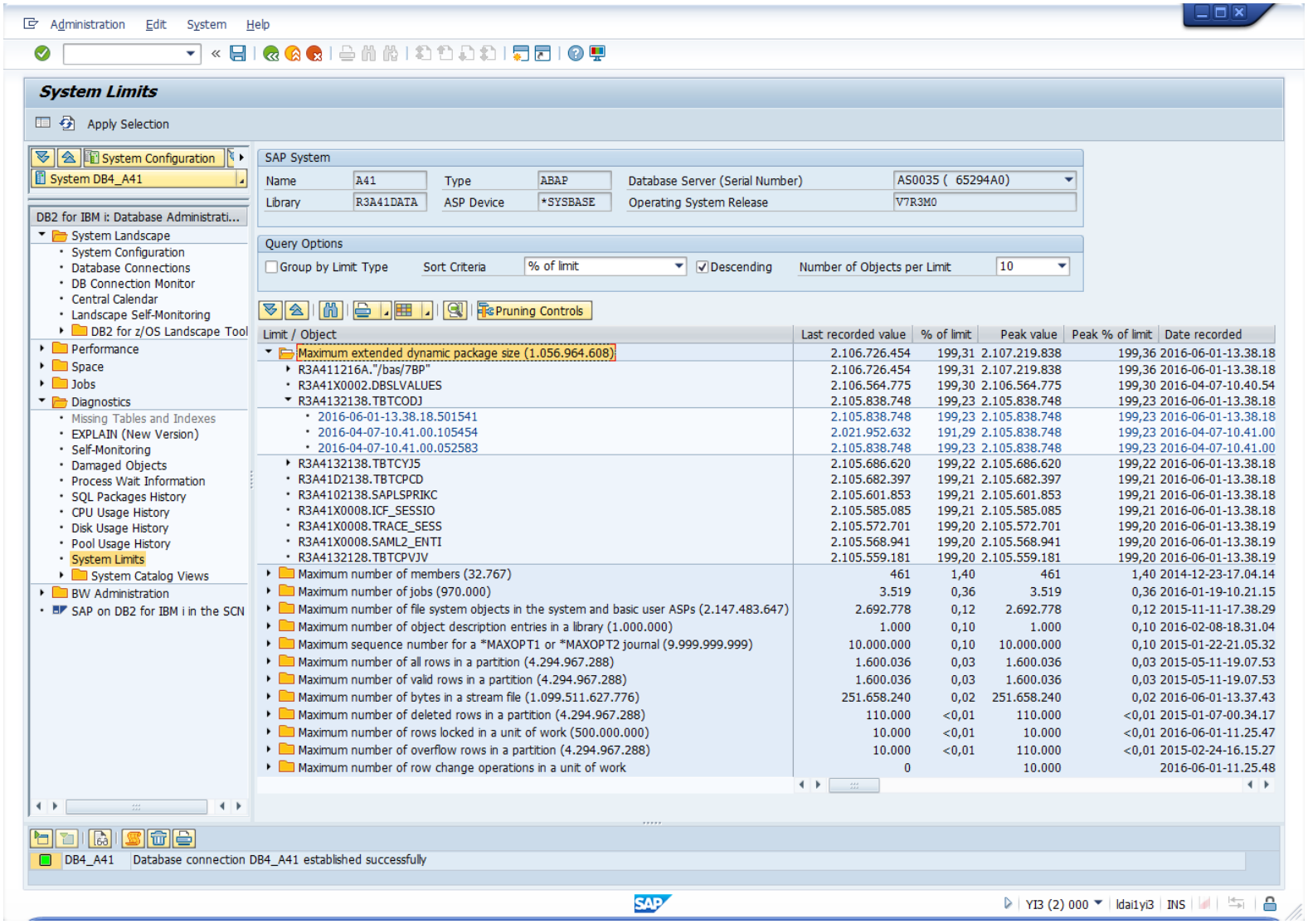
Db2 for i – *SQLPKG detail

Limit description	Limit ID	Maximum	Floor	Increment
Maximum Extended Dynamic Package Size	16806	1,056,964,608	335,544,320	8,388,608

Power Systems™

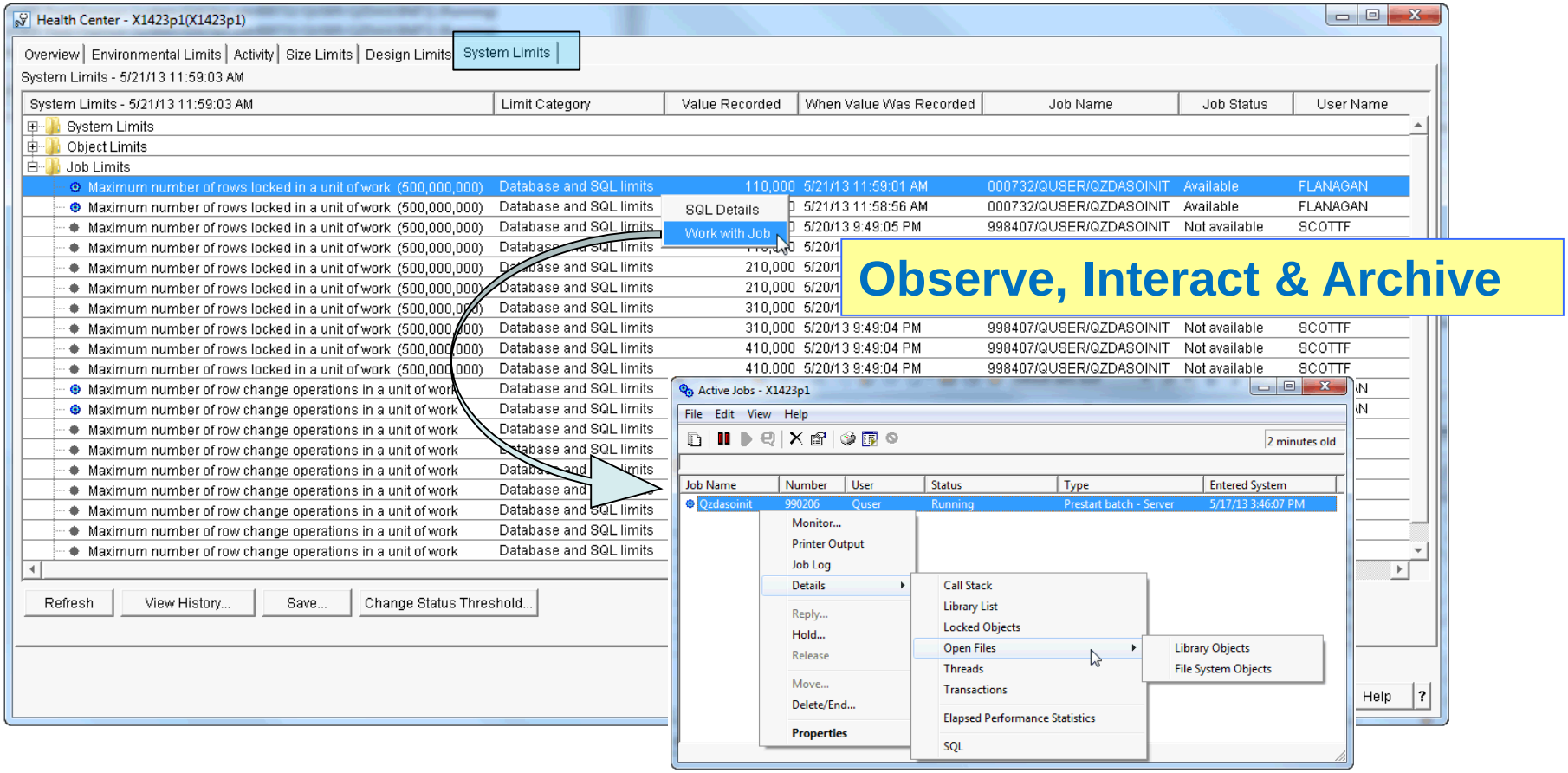
IBM

SAP on i – DBA Cockpit



IBM i System Limits – Navigator

- IBM i Navigator includes System Limits within the Db2 for i Health Center
- Enabled for both Navigator clients (Windows and Web)



Resources

Knowledge Center

http://www-01.ibm.com/support/knowledgecenter/ssw_ibm_i_72/rzajq/rzajqserviceshealth.htm

Articles…

http://iprodeveloper.com/systems-management/ondemand-tracking-important-system-limits-ibm-i

http://iprodeveloper.com/systems-management/gain-big-insights-db2-i-system-limits-phase-2

Take aways

- Achieve pro-active systems management via regular review of system health detail

- Use modern reporting tools to push out system health detail

Alerting for System Limits

- IBM i sends alert messages to QSYSOPR for a subset of high consumption of some of the most critical limits
- Message help: **ibm.biz/DB2foriAlerts**

Limit ID	Limit description	Maximum	Alerting Level	Alerting cadence
15000	**Maximum number of all rows in a partition**	4,294,967,288	Above 90%	Once per day
15400	**Maximum *MAX4GB Index Size**	4,294,967,296	Above 90%	Once per day
15401	**Maximum *MAX1TB Index Size**	1,869,166,411,776	Above 90%	Once per day
15403	**Maximum Encoded Vector Index Size**	2,199,023,255,552	Above 90%	Once per day
15104	**Maximum number of variable-length segments**	65,533	Above 90%	Once per day

www.ibm.com/developerworks/ibmi/techupdates/db2

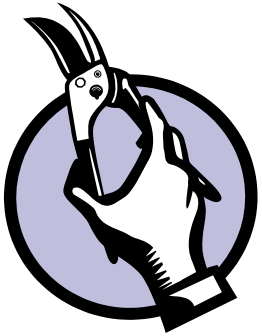
Backup

System Limits Pruning Controls

Db2 for i supplied global variables for System Limits:

```
CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_PRUNE_BY_ASP
        INTEGER DEFAULT  100

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_PRUNE_BY_JOB
        INTEGER DEFAULT  50

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_PRUNE_BY_OBJECT
        INTEGER DEFAULT  20

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_PRUNE_BY_SYSTEM
        INTEGER DEFAULT  100
```

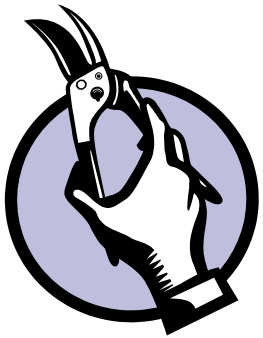
When the pruner runs, delete rows that are neither:
one of the xx high points
one of the yy most recently logged entries



System Limits Pruning Controls

Db2 for i supplied global variables for System Limits:

```
CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_SAVE_HIGH_POINTS_BY_ASP
        INTEGER  DEFAULT  25

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_SAVE_HIGH_POINTS_BY_JOB
        INTEGER  DEFAULT  5

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_SAVE_HIGH_POINTS_BY_OBJECT
        INTEGER  DEFAULT  5

CREATE OR REPLACE VARIABLE
SYSIBMADM.QIBM_SYSTEM_LIMITS_SAVE_HIGH_POINTS_BY_SYSTEM
        INTEGER  DEFAULT  25
```



System limits – Where to turn for precise detail

Number of jobs on system:

- Work with System Status (WRKSYSSTS) command – “Jobs in system” field
- Display Job Tables (DSPJOBTBL) command – compare “Available” and “Maximum” fields
- Retrieve System Status (QWCRSSTS) API

Number of spool files in ASP:

- Retrieve Spool Information (QSPSPLI) API

Number of locks or Number of changed records in a transaction:

- Work with Commitment Def (WRKCMTDFN) command

  Option 5=Display Status→F6=Display resource status → select Journal → Record Locks and Pending Changes fields or output to *PRINT and search for 'Record Pending‘
- Navigator for i

  Databases → RDB → Transactions → Database Transactions or Global Transactions → select a transaction → Resource Status → Journal tab → “Pending Changes” and “Record Locks” fields

Number of Database File Members:

- Display File Description (DSPFD) command – “Number of members” field
- Retrieve Database File Description (QDBRTVFD) API
- Db2 for i Statistical catalog (QSYS2/SYSTABLESTAT) - NUMBER_PARTITIONS column

Journal limits – What do these numbers mean?

To understand the Journal limits, examine the definition of receiver size options (RCVSIZOPT):

Receiver Size Option	Maximum Receiver Size	Maximum Sequence Number	Maximum Entry Size
*NONE	2GB	2,147,483,136	15MB
*MAXOPT1	1TB	9,999,999,999	15MB
*MAXOPT2	1TB	9,999,999,999	4GB
*MAXOPT3	1TB	18,446,744,073,709,551,600	4GB

Maximum 1TB journal receiver size

➔ The maximum is very large…CHGJRN to a new receiver

Maximum number of objects that can be associated with a *MAX10M journal

➔ The maximum is very large…redistribute objects across multiple journals

Maximum number of objects that can be associated with a *MAX250K journal

➔ Move or *MAX10M or redistribute objects across multiple journals

Maximum sequence number for a *MAXOPT3 journal

➔ Reset the sequence number

Maximum sequence number for a *MAXOPT1 or *MAXOPT2 journal

➔ Reset the sequence number or change to *MAXOPT3

File System limits:

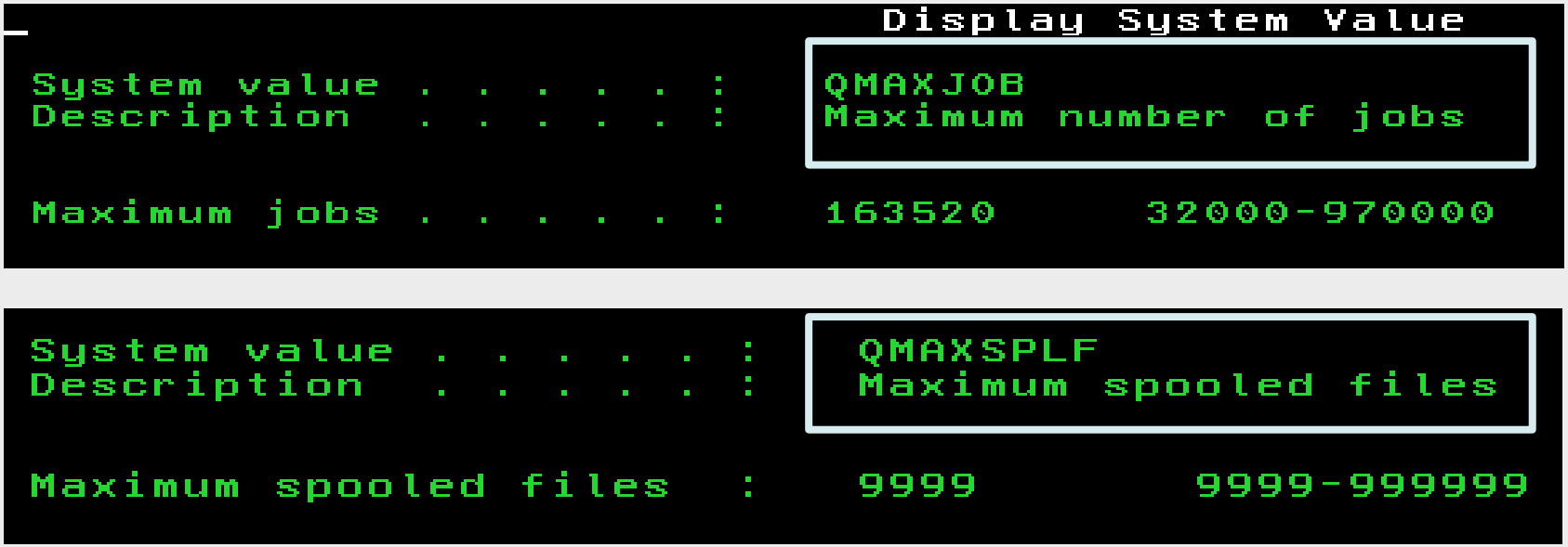
Maximum number of object description entries in a library

➔ Observe run-away creation of user profiles and similar trends

How do I configure the maximum limit values?

Only a subset of the limits are configurable.

For example: Maximum jobs & Maximum Spool files



How do I lower the commitment control lock limit?

COMMITMENT_CONTROL_LOCK_LIMIT Specifies either *DEFAULT or an Integer Value indicating the maximum number of records which can be locked to a commit transaction initiated after setting the new value. If multiple journals are involved in the transaction, the COMMITMENT_CONTROL_LOCK_LIMIT applies to each journal, not to the transaction as a whole. For example, if files F1 to F5 are journaled to journal J1, files F6 to F10 are journaled to J2, and COMMITMENT_CONTROL_LOCK_LIMIT is set to 100,000, then 100,000 record locks could be acquired for files F1 to F5 and 100,000 more locks could be acquired for files F6 to F10. The value specified for COMMITMENT_CONTROL_LOCK_LIMIT has no effect on transactions running in jobs that have already started commitment control. For the value to be effective, it must be changed prior to starting commitment control.	***DEFAULT**	* DEFAULT is equivalent to 500,000,000.
	Integer Value	The maximum number of records which can be locked to a commit transaction initiated after setting the new value. The valid Integer Value is 1 - 500,000,000.