You Can't Win Them All

CPU Reduction Ideas that Did and Didn't Work

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Longpela
CPT Global

Who is David Stephens?

- z/OS mainframe systems consultant
- Over 12 CPU reduction projects in 6 years
- Projects From 1 week to 9 months
- Wide variety of client sites
- Member of small team of experienced professionals with CPT Global

In This Session

- What I do when arriving at a new site
- Tactics to start identifying ‘interesting’ CPU consumers
- Strategies for digging down further to find reduction ideas
- 6 Real Life cases: 3 that worked, 3 that didn’t

Preliminary: Before Beginning

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Before Starting:

- Understand how reducing CPU saves money:
  - Reduce MLC Costs
  - Reduce ISV software costs
  - Reduce outsourcing costs
  - Eliminate / delay processor upgrade
  - Eliminate / reduce Capacity On Demand
- Goal: save money (CPU reduction is just a means)

Preliminary: Before Beginning

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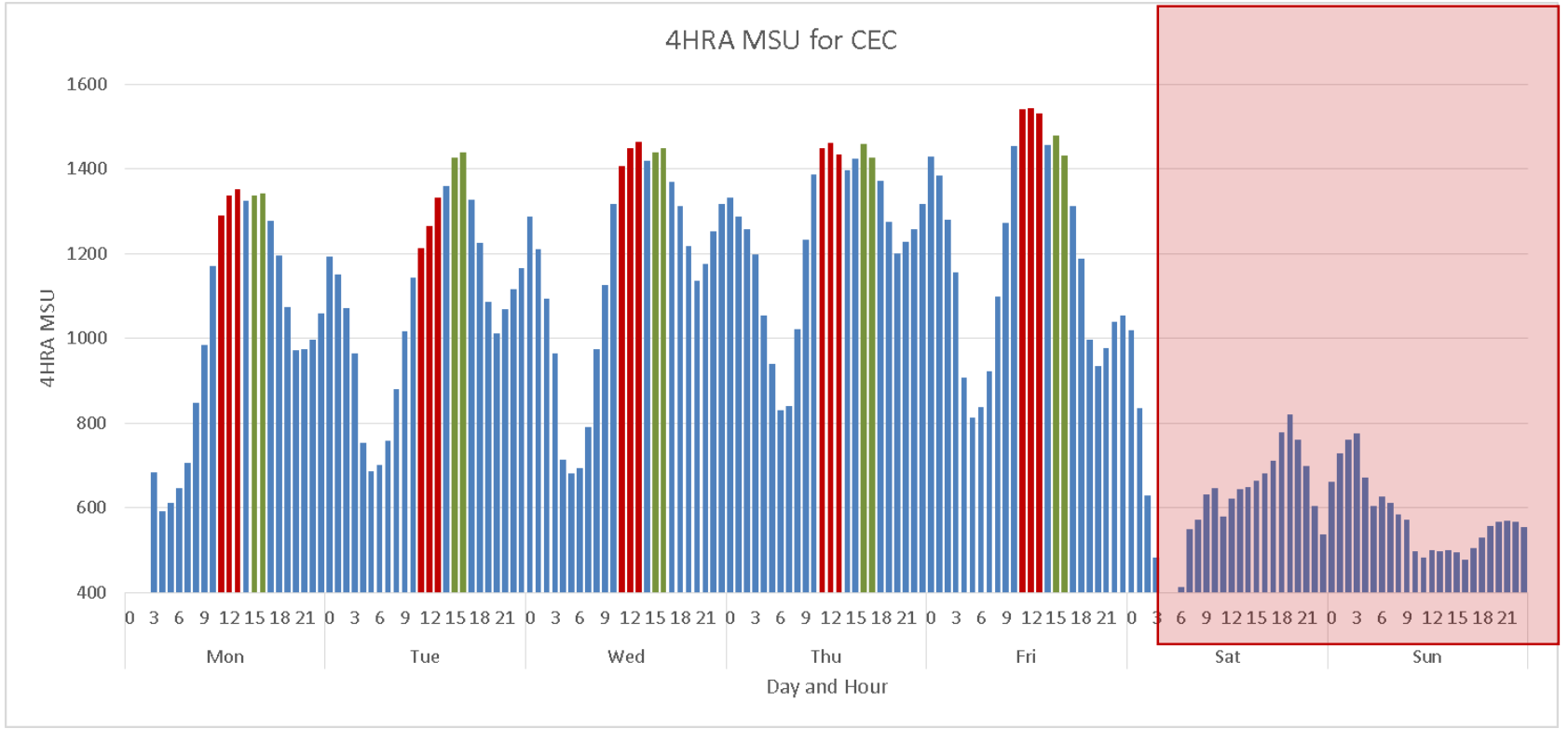
Before Starting

- Understand how CPU is charged:
  - 4HRA Software Costs?
  - Peak MSU Usage?
  - $/CPU Second?

- This will impact CPU tuning

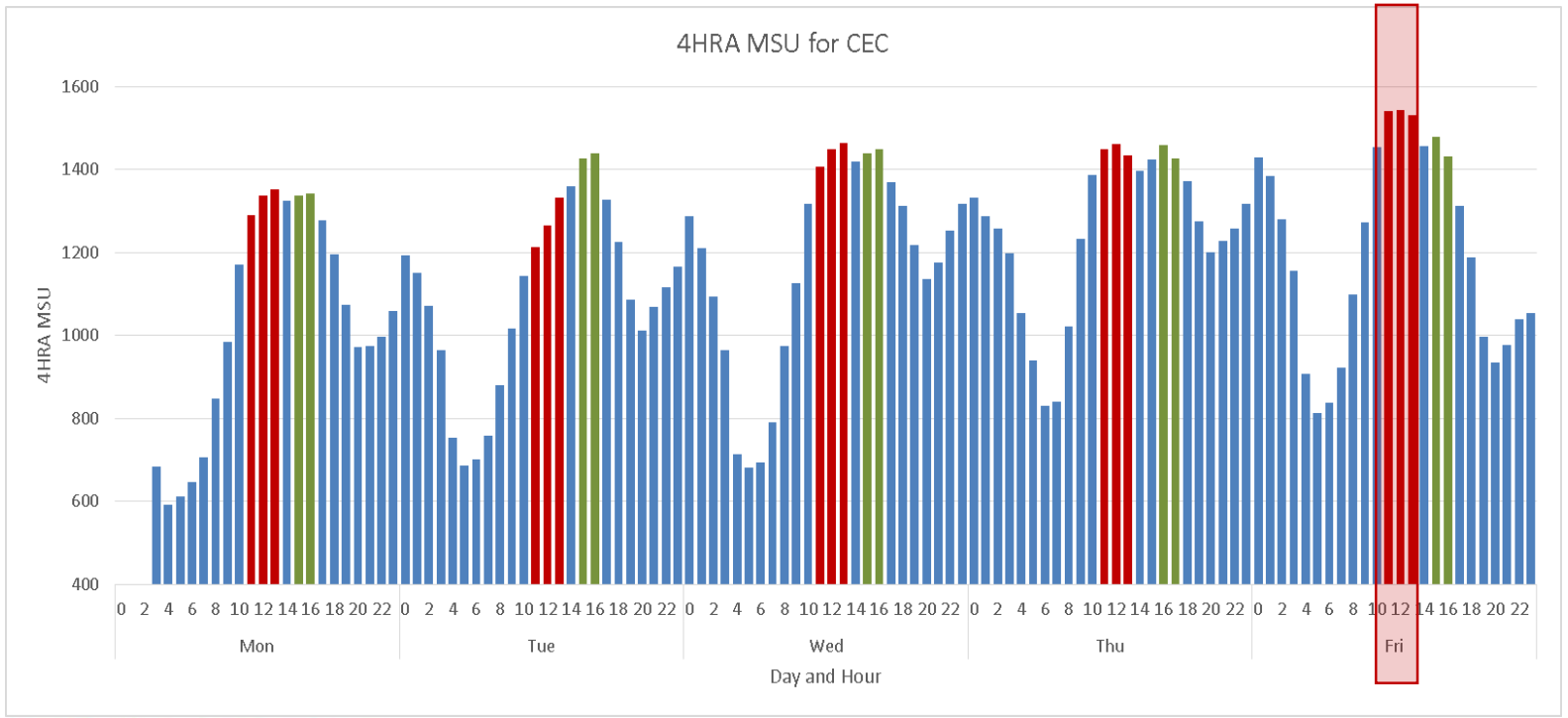
Case 1: Target Hours to Tune

- Identify periods or corridors that drive peak usage.
  - Eliminate periods that don't contribute to peak usage.
  - For example, eliminate weekends



Case 1: Target Hours to Tune

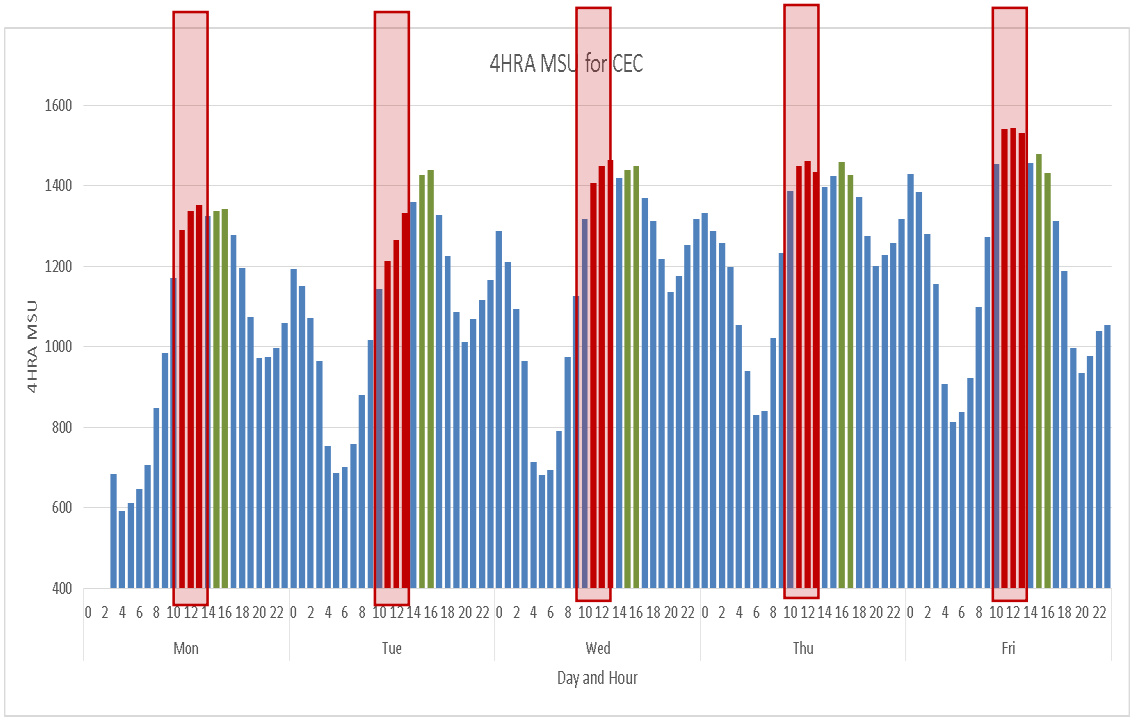
- Identify periods or corridors that drive peak usage.
- Eliminate hours of the day that don't contribute to peak



Case 1: Target Hours to Tune

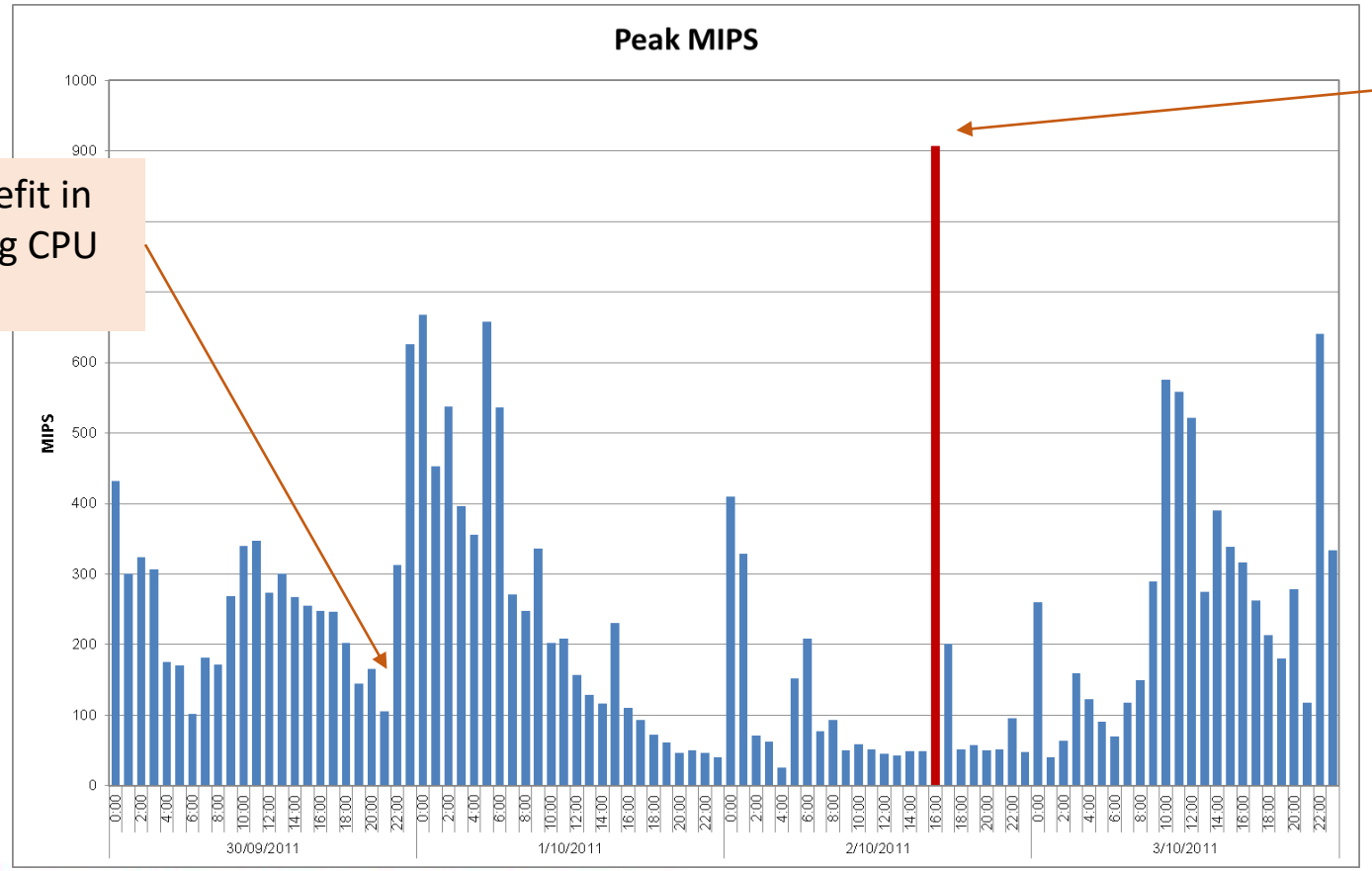
- Corridors reduce time periods to tune
- Reduces work, maximize tuning effort
- Goal: maximum $ savings for minimum amount of time
- (No-one will pay me for a week to find 3 MIPS CPU savings)

In this example, only tune for 4 hours every weekday



Case 1: Target Hours to Tune

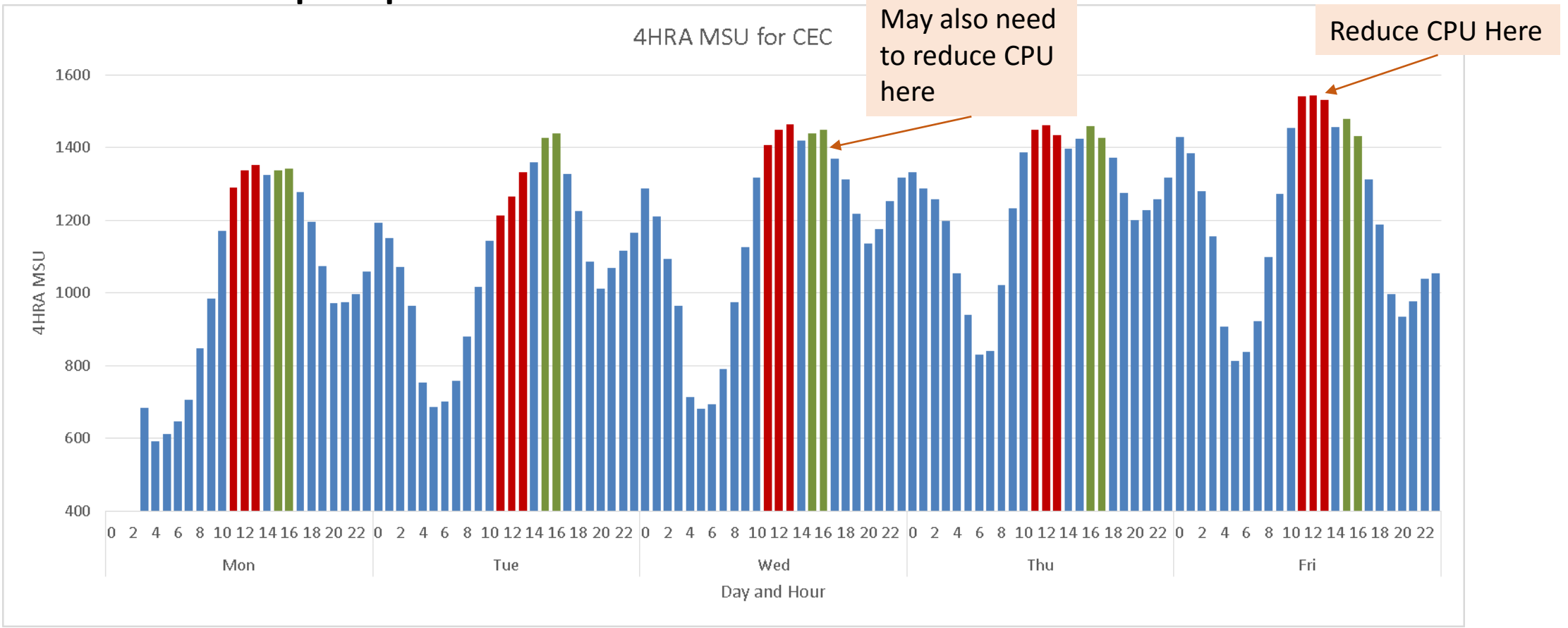
Bottom Line: tune where the maximum benefit is



(A real MIPS chart)

Case 1: Target Hours to Tune

Beware multiple peaks



Case 1: Target Hours to Tune

SCRT isn't enough

- Shows first occurrence of highest and 2nd highest peaks (and how often)
- Not enough information to accurately show all peaks
- I use my own usage graphs

==N5==========

DETAIL LPAR DATA SECTION

	Highest	Hour Count	Date/Time	2nd Highest	Hour Count	Date/Time
LPAR1	257	2	20 Aug 2015 - 19:00 UTC	254	1	22 Aug 2015 - 18:00 UTC
LPAR2	53	1	22 Aug 2015 - 02:00 UTC	50	1	22 Aug 2015 - 01:00 UTC
LPAR3	4	258	21 Aug 2015 - 23:00 UTC	3	227	02 Aug 2015 - 01:00 UTC
LPAR4	6	3	21 Aug 2015 - 19:00 UTC	5	25	20 Aug 2015 - 18:00 UTC
LPAR5	35	1	27 Aug 2015 - 20:00 UTC	34	1	26 Aug 2015 - 20:00 UTC
LPAR6	191	1	04 Aug 2015 - 16:00 UTC	189	1	04 Aug 2015 - 17:00 UTC
LPAR7	283	1	02 Aug 2015 - 04:00 UTC	269	1	02 Aug 2015 - 03:00 UTC
CPC	573	1	05 Aug 2015 - 03:00 UTC	566	1	05 Aug 2015 - 12:00 UTC

Case 1: Target Hours to Tune

- We are looking for usage ‘patterns’

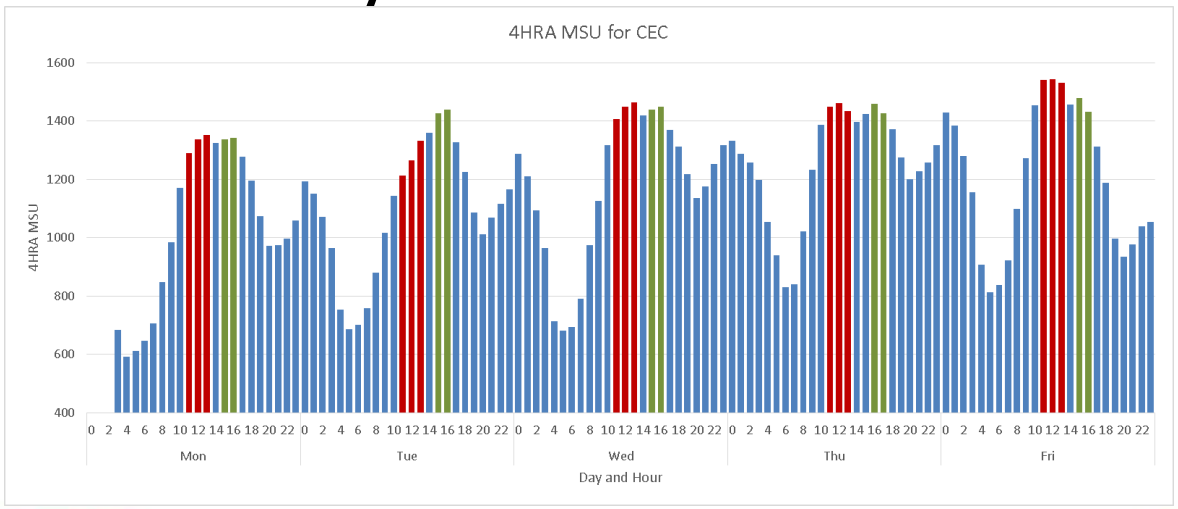
  (for example: peak every Tuesday, every night at midnight, month end between 0600 and 0800)

- Bar graphs only show two dimensions - see peaks over a week.

- But what if there is a peak one day a month? Or two?

- Solution: Heat Charts

  (Preferably for more than one month)



Case 1: Target Hours to Tune

Date	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
31/03/2016	1264	1254	1251	1231	1262	1254	1240	858	712	773	971	891	902	619	766	982	1183	1066	1052	973	1481	1494	1496	1121
30/03/2016	1266	1261	1199	1249	1251	1241	941	1076	731	1106	1009	906	789	690	774	851	1162	1182	892	901	1209	1264	1266	1266
29/03/2016	1265	1260	1191	1223	1265	1256	1212	789	762	815	962	961	779	687	843	815	1017	1031	880	1023	1252	1260	1266	1266
28/03/2016	166	86	190	279	326	757	648	442	553	605	828	817	947	714	658	757	1154	1200	813	900	1247	1249	1265	1266
27/03/2016	102	73	71	44	95	359	555	237	209	405	437	549	288	274	276	243	292	394	396	100	349	73	180	74
26/03/2016	179	393	416	425	230	475	359	307	150	148	145	100	118	101	147	184	363	297	327	179	155	65	100	72
25/03/2016	1266	1262	1241	1218	1259	1240	1212	1242	798	411	439	223	455	418	367	253	333	383	194	528	435	304	246	116
24/03/2016	1262	1253	1190	1256	1264	1262	1006	811	763	761	913	1017	825	640	810	752	1097	1062	819	1017	1246	1255	1266	1266
23/03/2016	1266	1241	1141	1259	1262	1262	1122	800	775	826	1024	992	828	663	751	855	1073	1210	827	1061	1243	1263	1266	1266
22/03/2016	1266	1264	1266	1259	1265	1263	1251	996	867	821	1030	942	797	638	714	749	1131	1141	937	1043	1243	1263	1266	1266
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19/03/2016	1266	1259	1260	1166	1263	1212	1226	1123	563	469	372	290	199	144	178	221	376	537	198	129	124	72	120	74
18/03/2016	1266	1255	1251	1247	1264	1262	1246	1110	835	790	984	919	738	597	745	805	1190	1132	1038	1100	1239	1213	1266	1266
17/03/2016	1265	1255	1257	1190	1264	1266	1142	766	796	626	953	1107	840	726	823	868	1136	1058	972	1001	1253	1237	1264	1266
16/03/2016	1266	1259	1196	1202	1266	1265	1113	732	767	802	981	889	792	573	772	946	1135	1069	798	971	1166	1252	1266	1266
15/03/2016	1266	1248	1262	1249	1265	1266	1084	774	779	757	975	853	760	573	733	817	1136	1113	863	970	1253	1260	1266	1266
14/03/2016	137	88	230	223	366	754	477	311	460	660	877	751	745	587	664	789	1177	1161	988	846	1131	1249	1266	1266
13/03/2016	122	68	22	7	51	388	459	317	227	268	245	312	360	308	298	203	298	568	417	64	131	276	200	103
12/03/2016	1266	1262	1266	1266	1266	1266	1266	1234	1048	763	985	811	414	247	339	642	756	440	413	267	205	62	85	76
11/03/2016	1266	1261	1265	1257	1260	1258	1242	979	1059	808	989	1024	760	670	851	887	1190	1098	905	1077	1225	1265	1266	1266
10/03/2016	1266	1264	1257	1261	1262	1258	1214	610	631	692	951	994	886	661	839	826	1199	1114	996	990	1209	1263	1266	1266
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6/03/2016	108	71	73	41	118	237	383	323	313	235	199	173	225	182	217	320	181	200	235	121	94	248	195	114
5/03/2016	1263	1260	1262	1225	1262	1230	1149	834	547	473	368	261	175	133	185	477	644	335	463	337	355	202	85	65
4/03/2016	1259	1256	1251	1245	1250	1232	1018	768	1030	816	1140	1105	987	846	904	929	1157	1172	1087	1019	1254	1263	1266	1266
3/03/2016	1264	1256	1130	1222	1264	1261	1241	1071	971	935	1049	960	843	667	742	907	1195	1176	994	891	1247	1262	1266	1266
2/03/2016	1492	1483	1428	1336	1493	1496	1495	1496	1414	1072	1176	978	855	1235	1331	1401	1465	1490	1491	1184	1260	1263	1266	1266
1/03/2016	1495	1492	1493	1492	1496	1493	1489	1427	1294	1177	1444	1218	1269	973	994	1069	1441	1458	1413	1301	1487	1495	1496	1496

Hour of Day

Date

Red : > 90%

Black : > 100% (Capacity On Demand)

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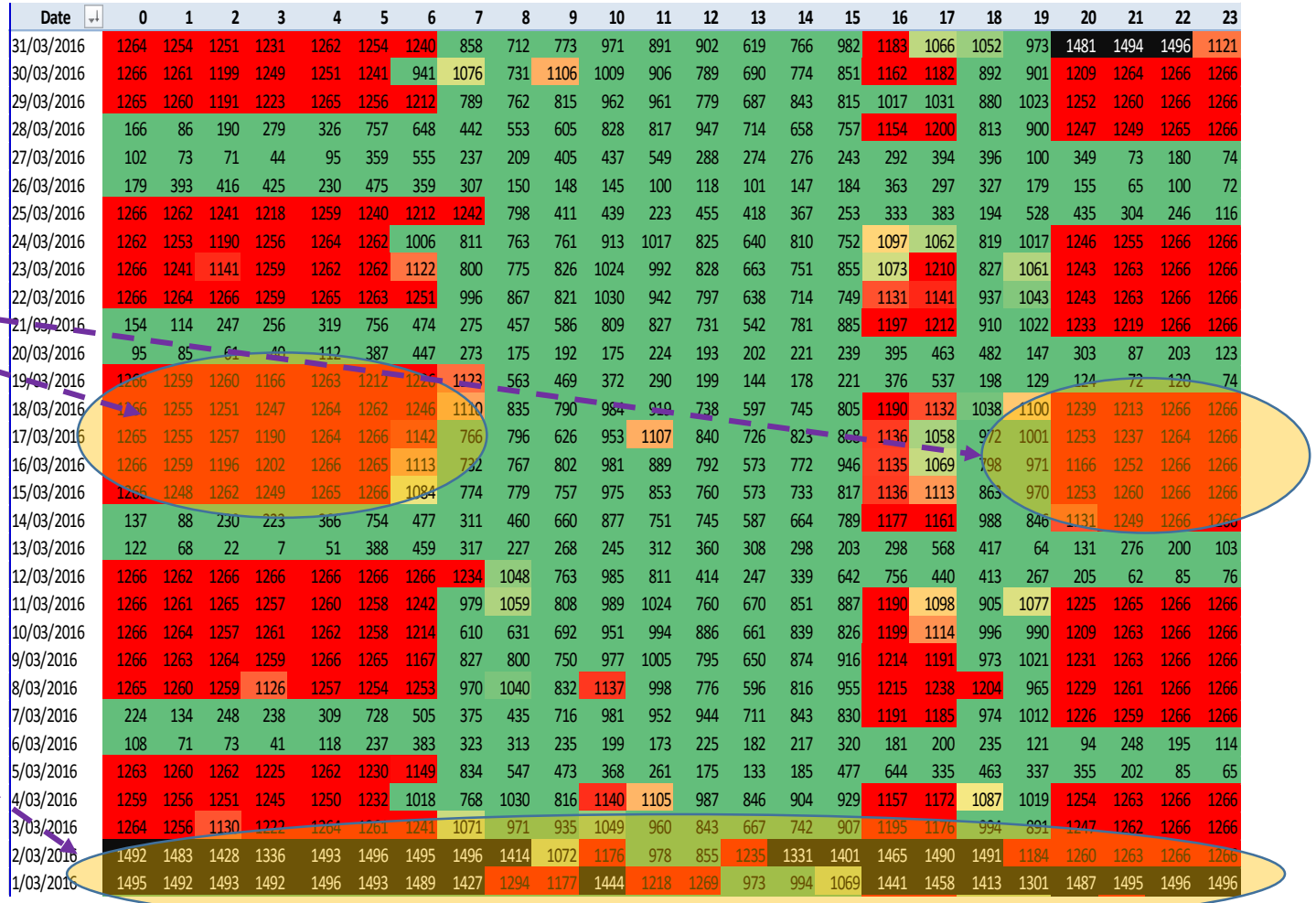
Thanks Alex Black from CPT Global for the idea

Case 1: Target Hours to Tune

Example Heat Chart

- Client pays for peak MSUs
- Runs ‘hot’ between 8pm and 6am. So tune here
- Adds extra capacity during month end – second tuning opportunity



Date	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
31/03/2016	1264	1254	1251	1231	1262	1254	1240	858	712	773	971	891	902	619	766	982	1183	1066	1052	973	1481	1494	1496	1121
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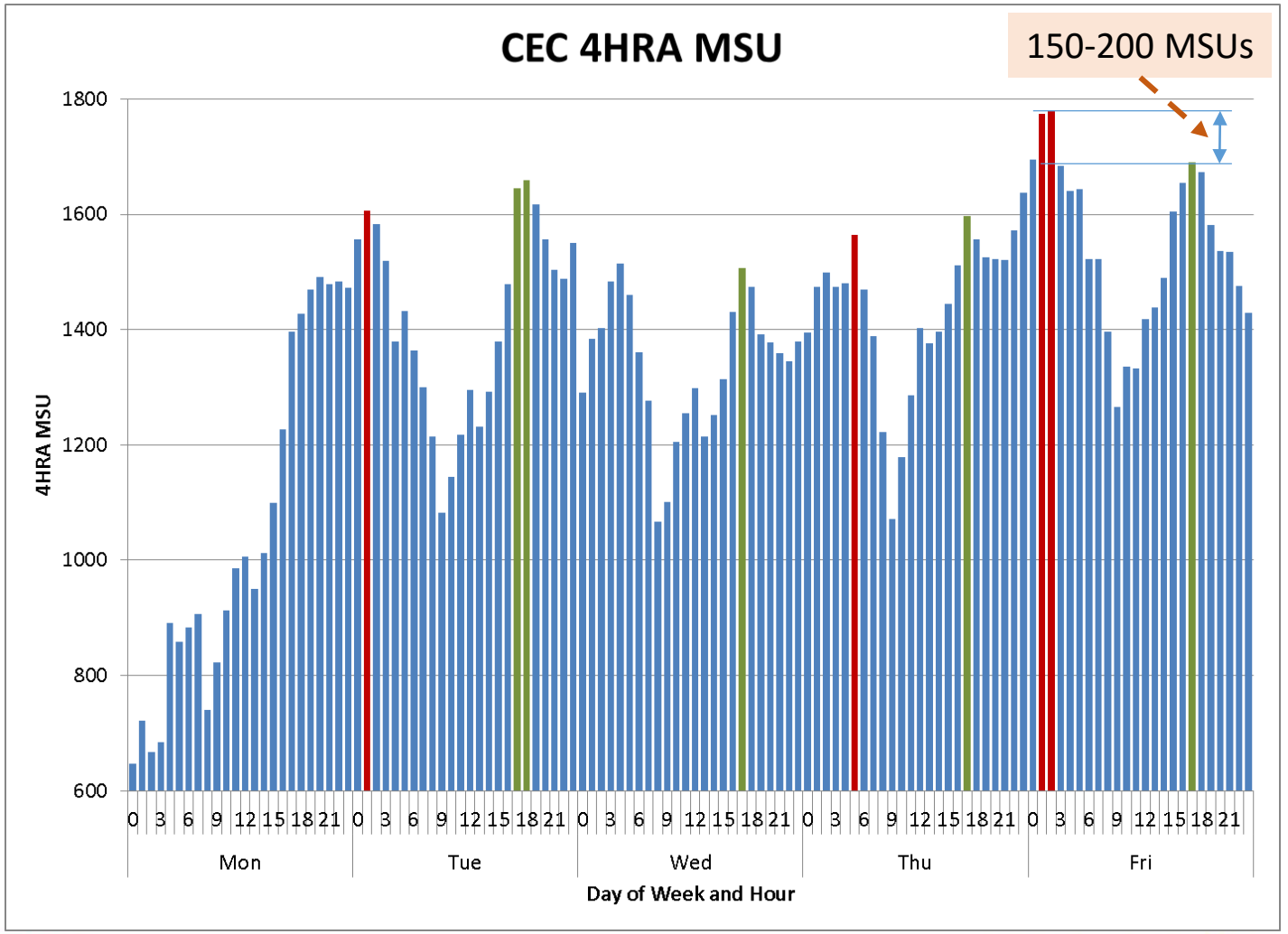
Case 1: Target Hours to Tune

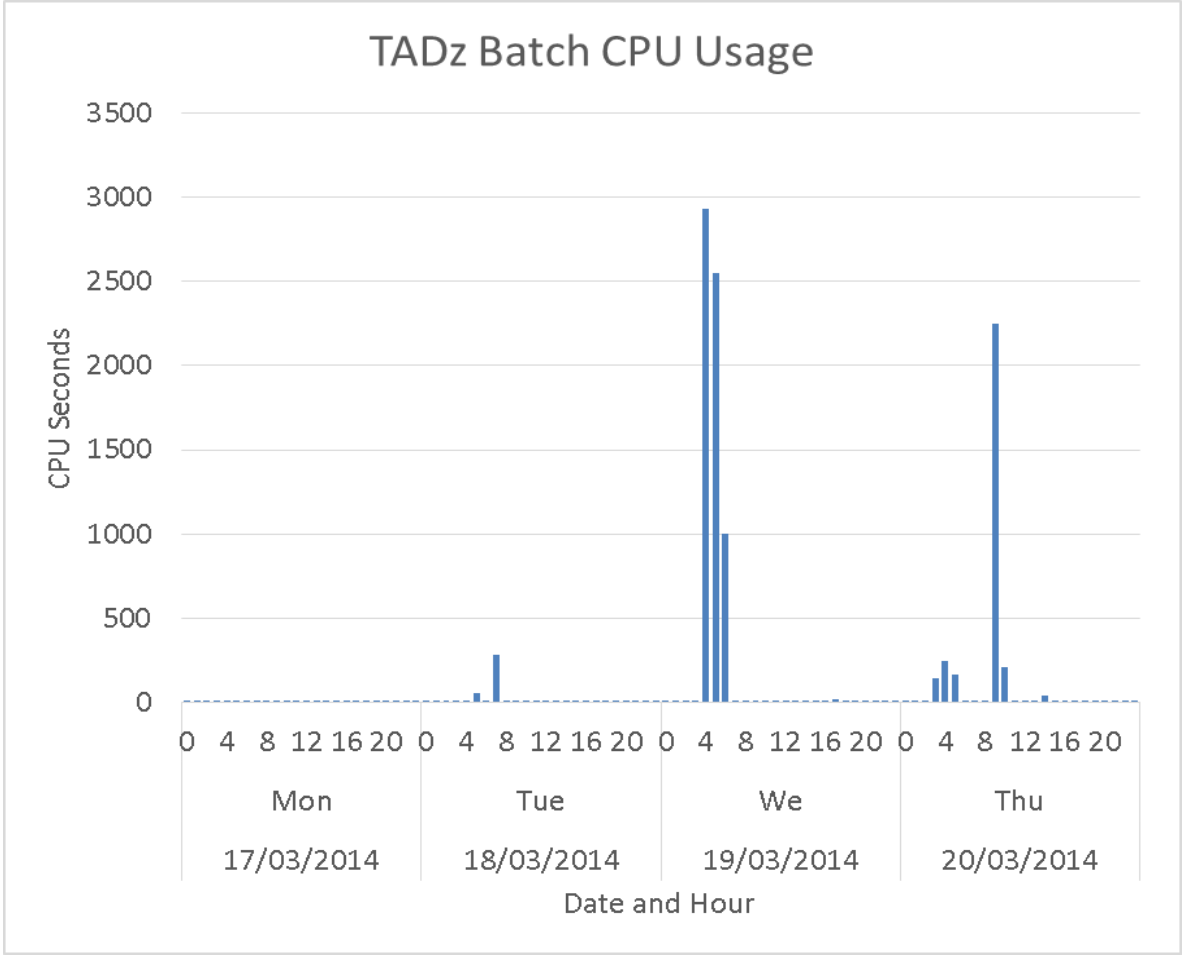
Case Study:

- Reduce Peak 4HRA MSU
- Primary Peak 02:00-06:00 Wed-Fri (Red. Hour varies month to month. No month-end peak)
- Secondary Peak 16:00-18:00 Tue-Fri (Green. Hour varies month to month. No month-end peak)
- Primary peak 150-200 MSUs above secondary



Case 1: Target Hours to Tune

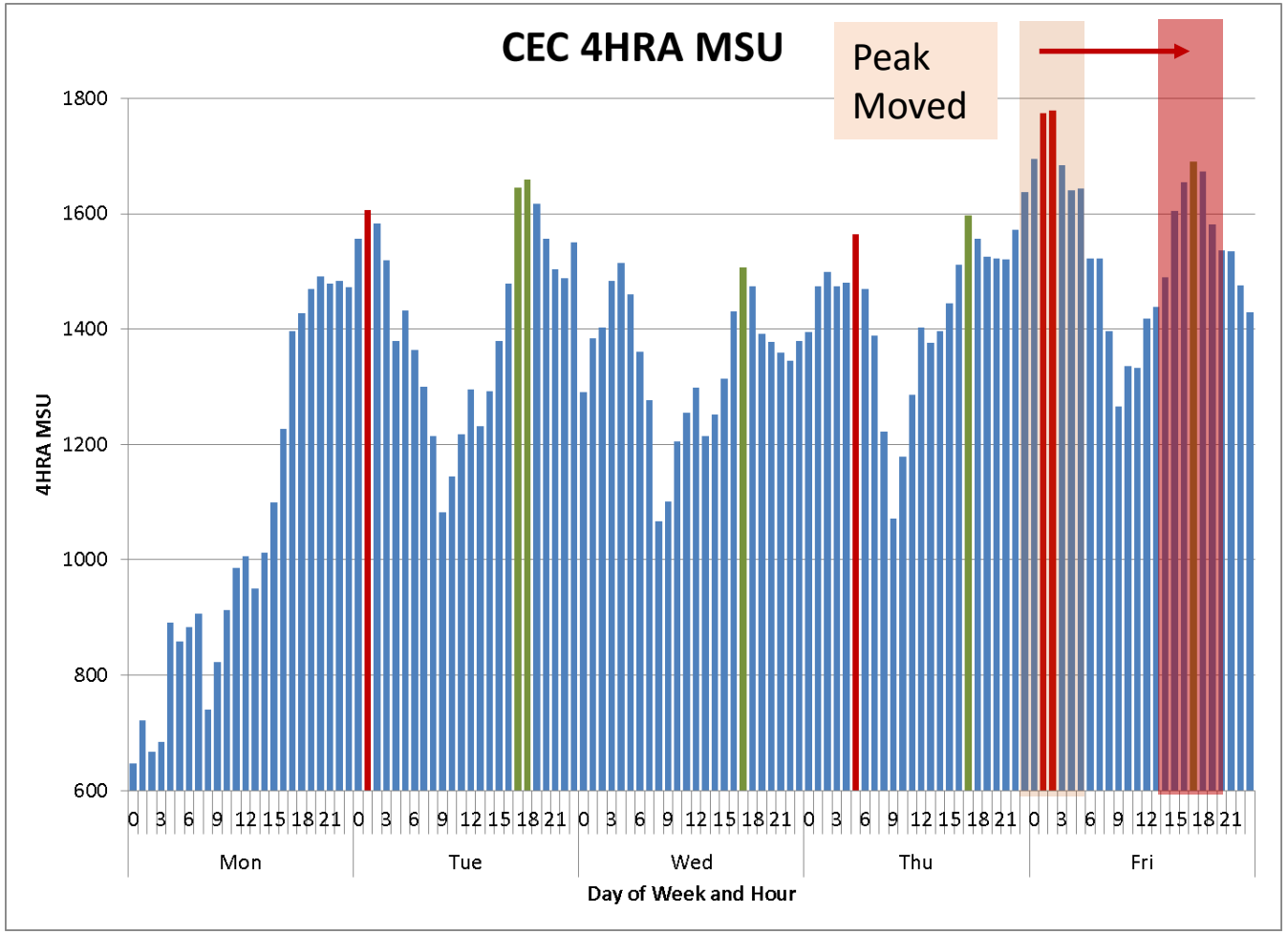
- Idea: move TADz housekeeping jobs out of peak (from02:00-06:00 peak to weekend)
- Savings: up to 55-65 MSUs (depending on peak)
- Moving non-critical jobs out of peak can be a good CPU reduction strategy



Case 1: Target Hours to Tune

Result: 0 MSU Savings

- Peak moved permanently from 02:00-06:00 to 16:00-18:00
- Moving workloads out of peak not necessarily a permanent solution.
- Review regularly



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Case 2: Target Subsystems

- Find out the highest CPU consumers in our peak period.
- Use SMF Type 30 *Interval* Records
- Most Sites Have Merrill MXG, CA MICS, SAS ITRM or IBM TDSz
- Can also use products like Black Hill EasySMF, Unicom Expetune

Case 2: Target Subsystems

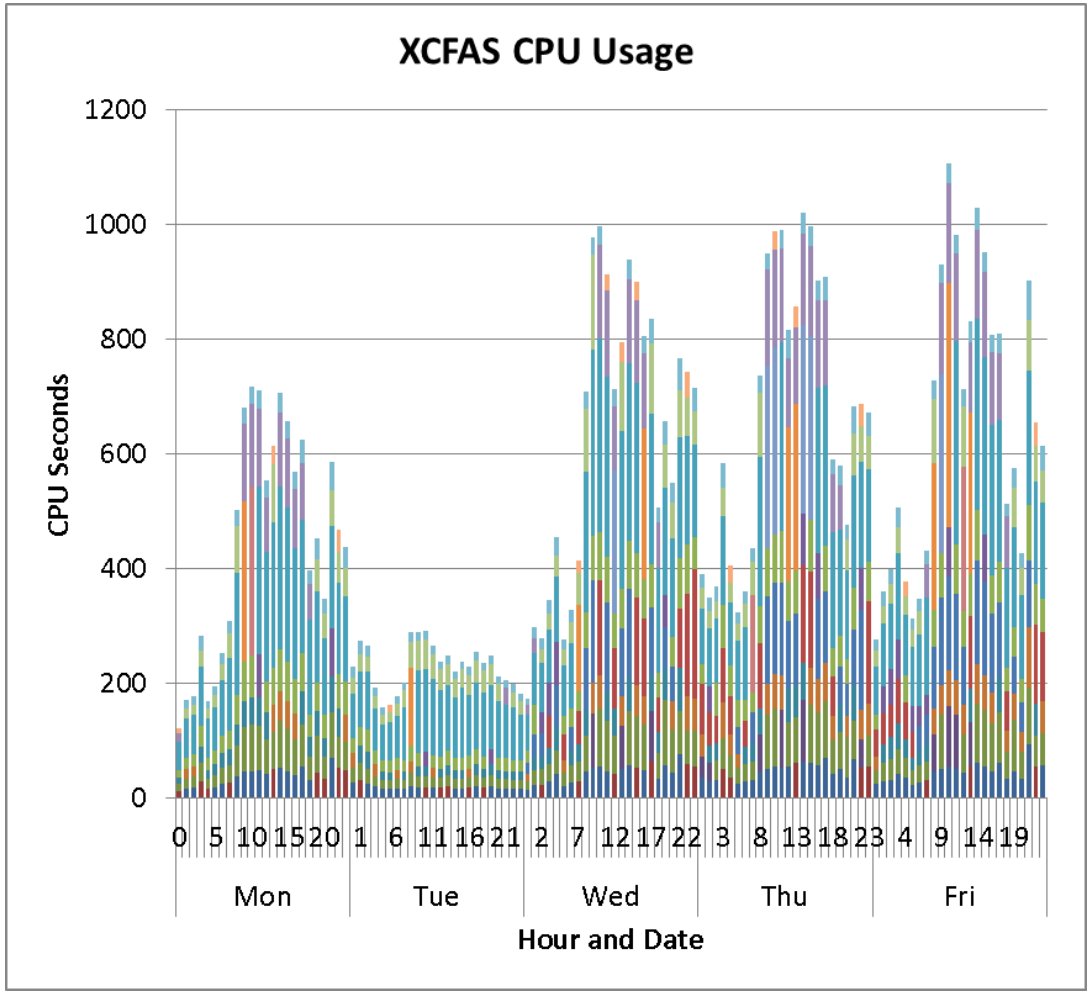
- Sum CPU Usage for Our Period
- By CEC, LPAR as Appropriate
- Sort Highest to Lowest

Job	CPU Secs
TCPIP	8978.31
STC001	2826.02
CDIRECT	1635.53
XCFAS	1262.1
PHK1MSTR	1101.04
PHK1CHIN	996.58
TN3270	934.38
NET	784.22
PHZ3MSTR	648.66
CQMMSTR	586.12
PHK5CHIN	533.65
PHZ8CHIN	470.28
RMF	461.18
PHK5MSTR	454.22
DB2MIRLM	445.56

Case 2: Target Subsystems

Case Study:

- XCFAS Address Space CPU High
- 250 MIPS during peak period
- Indicates Coupling Facility Issue
- Target to reduce peak MIPS



Case 2: Target Subsystems

RMF Monitor III Coupling Facility Activity Report:

- Synchronous Average Service Time High
- Asynchronous Rate High for Synchronous Requests
- Investigate Coupling Facility Performance

CF: ALL	Type	ST	System	CF	--- Sync		-------- Async			
				Util	Rate	Avg	Rate	Avg	Chng	Del
Structure Name				%		Serv		%	%	
DAA0_LOCK1	LOCK	AP	*ALL	20.4	20.5	52	3092	119	0.0	0.0
	LOCK	AS	*ALL	23.9	19.0	49	3092	122	0.0	0.0
DAC0_LOCK1	LOCK	AP	*ALL	24.9	27.3	42	3076	167	0.0	0.0
	LOCK	AS	*ALL	21.4	16.0	54	3075	167	0.0	0.0
ISTGENERIC	LIST	AP	*ALL	0.4	49.0	11	38.5	150	0.0	0.0
	LIST	AS	*ALL	0.3	0.1	48	38.5	152	0.0	0.0
OPERLOG	LIST	AP	*ALL	2.8	2.2	1026	160.1	1446	0.0	0.0
	LIST	AS	*ALL	32.9	1.4	1486	146.8	1468	0.0	0.0

Case 2: Target Subsystems

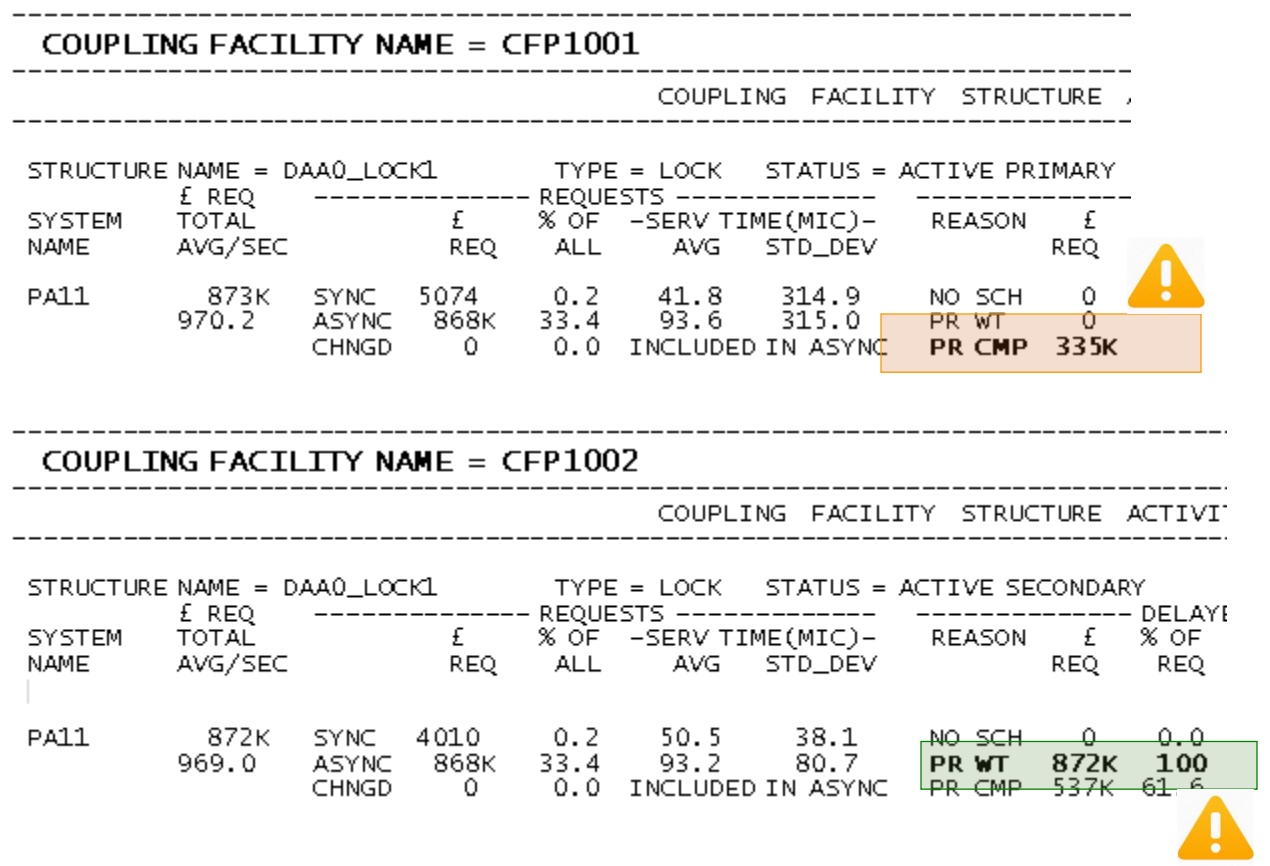
- RMF Monitor III Coupling Facility Overview Report:
  - Coupling Facility CPU % Not Excessive, not sharing processors
  - Storage Not Exhausted
  - No problem here

```
Samples: 50      Systems: 20   Date: 11/23/11  Time: 09.35.00  Range: 100   Sec

CF Policy: CFRMGEO3    Activated at: 11/22/11 17.57.05

----- Coupling Facility ------  ------ Processor -------  Request  - Storage --
Name      Type  Model Lvl  Dyn  Util% Def Shr Wgt Effect  Rate     Size   Avail

CFP1001   2817    M66  17  OFF  16.4    1   0       1.0    21404    12G  4510M
CFP1002   2817    M66  17  OFF  14.1    1   0       1.0    15369    12G  4761M
CFP1003   2097    E26  16  OFF   0.7    1   0       1.0    548.7  9889M  9386M
CFP1004   2097    E26  16  OFF   1.1    1   0       1.0    793.3  9889M  9345M
```

Case 2: Target Subsystems

RMF Monitor I Coupling Facility Report:

- Coupling Facility 1 – high PR CMP (waiting for Coupling Facility 2 to complete)
- Coupling Facility 2 – high PR WT (waiting for subchannel to CF1)
- Problem only occurs on traffic between CF1 and CF2.
- Problem only occurs on duplexed structures



COUPLING FACILITY NAME = CFP1001

COUPLING FACILITY STRUCTURE

STRUCTURE NAME = DAA0_LOCK1 TYPE = LOCK STATUS = ACTIVE PRIMARY

SYSTEM NAME	£ REQ TOTAL AVG/SEC		REQUESTS £ REQ	% OF ALL	-SERV TIME(MIC)- AVG	STD_DEV	REASON	£ REQ
PA11	873K 970.2	SYNC	5074	0.2	41.8	314.9	NO SCH	0
		ASYNC	868K	33.4	93.6	315.0	PR WT	0
		CHNGD	0	0.0	INCLUDED IN ASYNC		**PR CMP**	**335K**

COUPLING FACILITY NAME = CFP1002

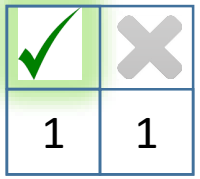
COUPLING FACILITY STRUCTURE ACTIVI

STRUCTURE NAME = DAA0_LOCK1 TYPE = LOCK STATUS = ACTIVE SECONDARY

SYSTEM NAME	£ REQ TOTAL AVG/SEC		REQUESTS £ REQ	% OF ALL	-SERV TIME(MIC)- AVG	STD_DEV	REASON	£ REQ	DELAYE % OF REQ
PA11	872K 969.0	SYNC	4010	0.2	50.5	38.1	NO SCH	0	0.0
		ASYNC	868K	33.4	93.2	80.7	**PR WT**	**872K**	**100**
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	537K	61.6

Case 2: Target Subsystems

- Recommendation: Fix hardware error on channels between coupling facilities
- Result: 200+ MIPS Savings



Case 3: Target by Program

- I prefer to use SMF30 Interval Records, listing by program
  (not job name)
- Easier to triage programs
- Catch multiple jobs using the same program

Program	CPU Secs	Description
DFHSIP	24,607	CICS
IKJEFT1B	13,811	TSO (Batch)
MQMOVER	7,228	MQ CHIN
BPXPRFC	6,736	UNIX (SFTP)
DSNYASCP	6,349	DB2 MSTR
CSQYASCP	3,868	MQ MSTR
SORT	3,618	Sort
BPXBATA2	3,500	UNIX from Batch (SFTP)
BPXPRECP	3,157	Unix
IKJEFT01	3,096	TSO (Batch)
EZBTCPIP	2,645	TCP/IP
DMINIT	2,015	Connect:Direct
IGG0CLX0	1,860	Catalog
HASJES20	1,443	JES2
IXCINJST	1,434	XCF
	1,325	(GRS)
IKJEFT1A	1,223	TSO (Batch)
IMWHTTPD	1,216	HTTP Server

Case 3: Target by Program

Case Study:

- Program IKJEFT1B High
- High CPU IKJEFTxx normally DB2 batch.
- Client aiming to remove a CP => peak MSU reduction

```
//STEP1      EXEC  PGM=IKJEFT1B,PARM='REXX1'
//SYSTSPRINT DD  SYSOUT=*
//SYSTSIN    DD  DUMMY
//SYSEXEC    DD  DISP=SHR,DSN=SYS5.SYSEXEC
//SYSPRINT   DD  SYSOUT=*
```

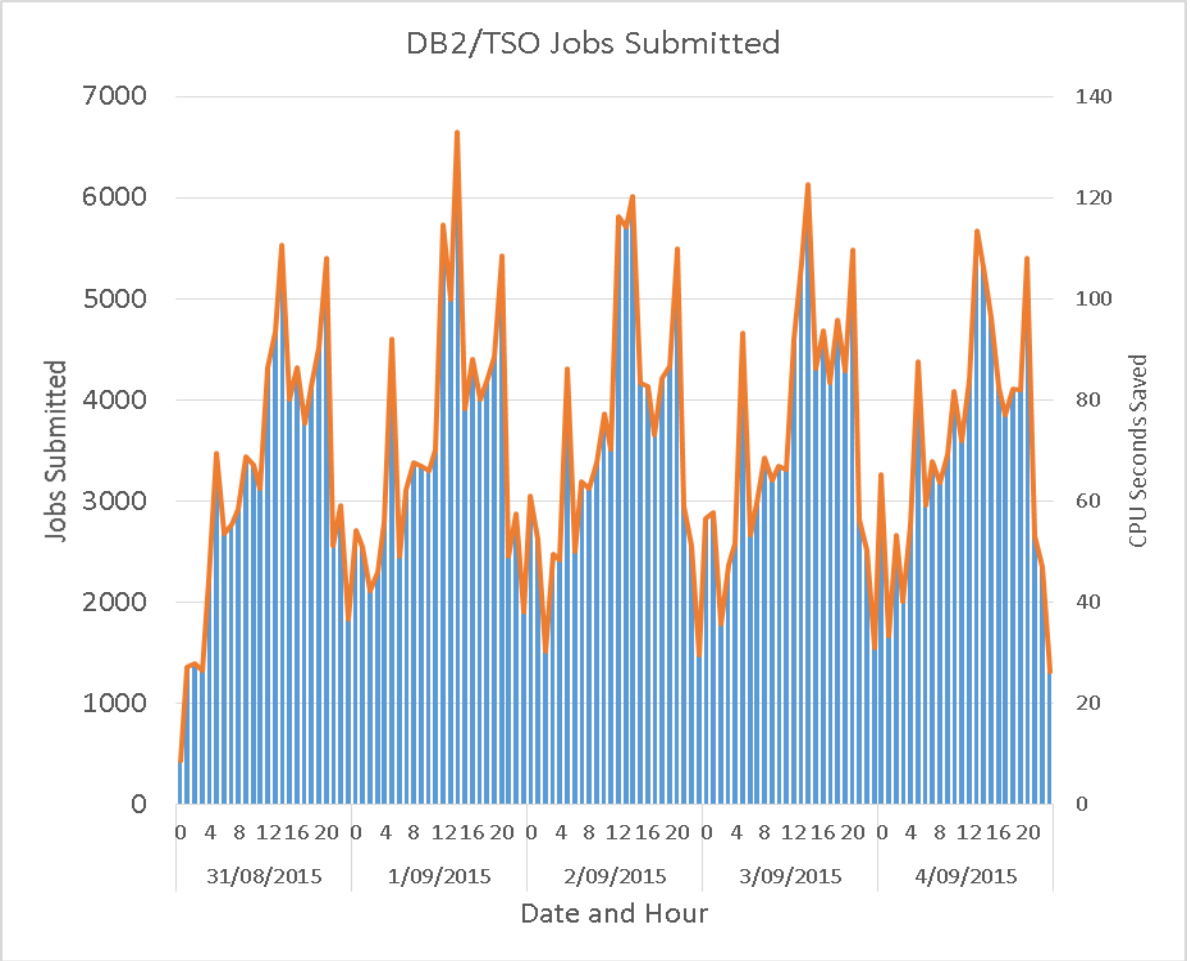
- Analysis showed many small jobs using same JCL to execute REXX
- REXX called RRSAF DB2 (COBOL) program
- DB2 program did not use TSO or REXX facilities

Case 3: Target by Program

Recommendation:

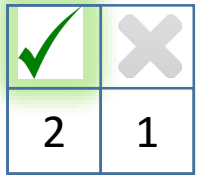
- Call program directly
- Saving: 0.02 CPU seconds per step.
- Up to 7000 jobs submitted in peak hours

```
//STEP1       EXEC   PGM=DB2PGM1
//STEPLIB     DD   DISP=SHR,DSN=LOADLIB1
//SYSPRINT    DD   SYSOUT=*
```



Case 3: Target by Program

- Result: 5-6 MSU Savings
- Client identified further jobs for more savings



Case 4: Sampling Tools

SHARE
EDUCATE • NETWORK • INFLUENCE

- Sometimes looking at JCL or configuration options doesn't help.
- In this case, I use a sampling tool:
  - Compuware Strobe
  - Macro4 FreezeFrame
  - IBM APA
  - CA Mainframe Application Tuner

Case 4: Sampling Tools

Take care in setting up

- Enough samples to get results we trust; not so many as to burn CPU

I like 1,000 – 1,500 samples per minute.

More if duration < 1 minute

30 minute sample for continuously running started tasks

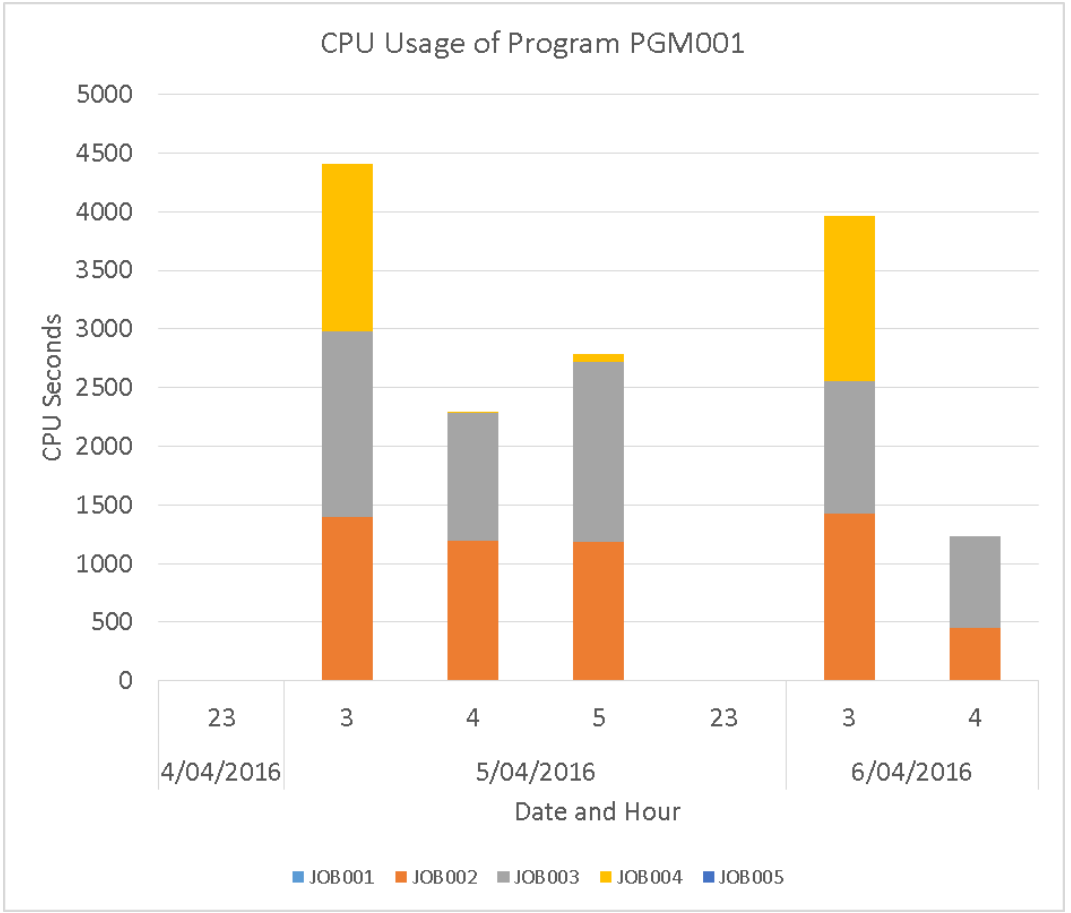
```
Command ===>                                                Scroll ===> CSR

  1. Job Information   3. Multi Steps     5. Subsystems     7. Schedule
  2. Options           4. Active Jobs      6. Sysplex        8. Sched Options
_____________________________________________________________________________
Panel 1. Job Information

  Job Name/Pattern . . JOB1          System Name . . . *
                      (Inactive)
  Step Specification
    Step No. . . . . .               Specify step number  program name
    Program Name . . . PROG1         step name or step name + Proc step
    Step Name  . . . .               name. Use panel 3 to specify more
    ProcStepName . . .               than one step.

  Description  . . . . Longpela Expertise Analysis
  Number of Samples  . 30000         Measure to step end . . . Y
  Duration (min:sec) . 30:00         Delay by (secs) . . . . .
  Notify TSO User  . . ADCWNXS       Retain file for (days)  . 30
                                     USS observations  . . . .       Max.  10
```

Sample to end of step for batch

Case 4: Sampling Tools

Case Study: High CPU in Program PGM001

- Used in several different batch jobs
- COBOL program
- Reducing peak CPU (MIPS)
- Consumed 300 MIPS averaged over 9 hour peak period



Case 4: Sampling Tools

Compuware Strobe Analysis

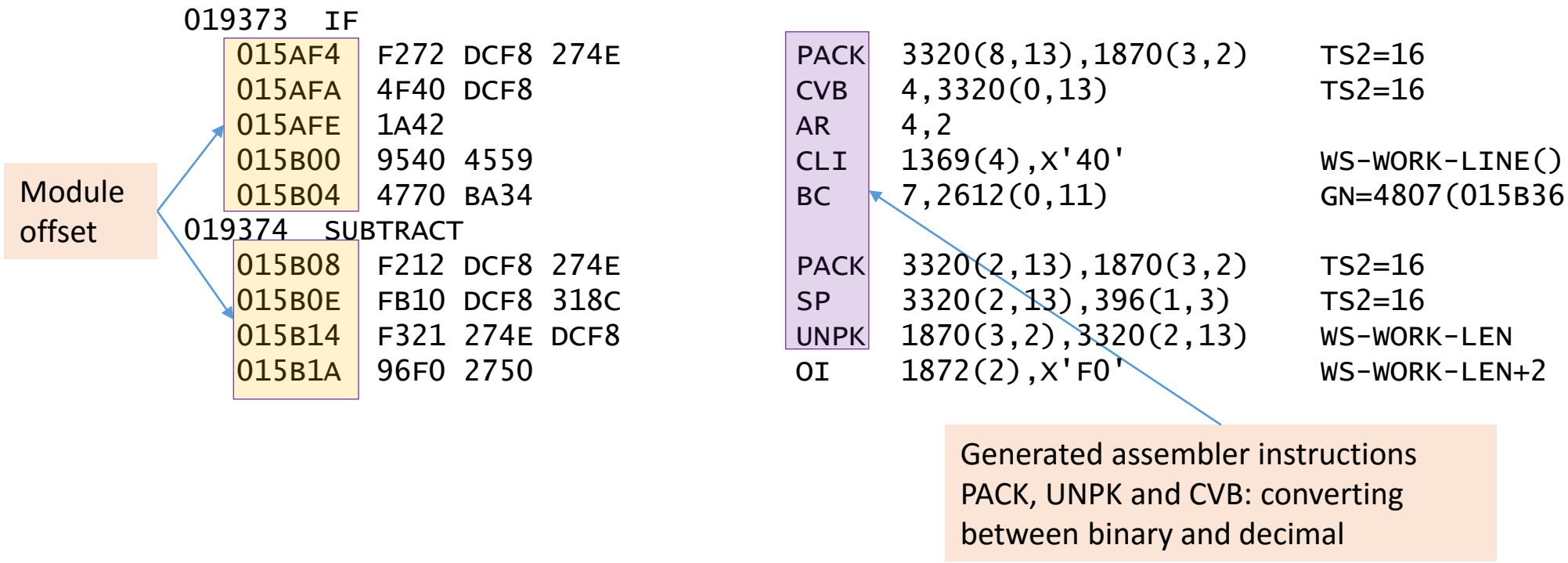
```
-  #IEP                                  ** MOST INTENSIVELY EXECUTED PROCEDURES **
-MODULE     SECTION     LINE      PROCEDURE/FUNCTION          STARTING   PROCEDURE   CPU TIME  PERCENT    CUMULATIVE %
  NAME       NAME      NUMBER          NAME                   LOCATION     LENGTH     SOLO      TOTAL       SOLO      TOTAL

 PGM001                                                      015B00          64     52.29      52.34      52.29      52.34
 PGM001                                                      015AC0          64     19.31      19.33      71.61      71.67
 PGM001                                                      026200          64      4.77       4.78      76.38      76.45
 PGM001                                                      014FC0          64      3.78       3.78      80.16      80.24
 .COBLIB    IGZCPAC           IGZCUST   UNSTRING                                    3.49       3.50      83.65      83.73
 PGM001                                                      024E00          64      1.19       1.19      84.84      84.92
 .VSAM      IDA019L1                    VSAM RECORD MANAGEMENT                      1.15       1.16      85.99      86.08
 PGM001                                                      025180          64      1.06       1.06      87.05      87.14
 PGM001                                                      0251C0          64      1.01       1.01      88.06      88.15
 PGM001                                                      0261C0          64       .96        .96      89.03      89.11
```

Very high CPU in module PGM001 at this offset.

(Note: This Strobe report set to show module offsets in groups of 64 bytes. So these offsets are the *start* of a 64 byte range. Can generate Strobe with a 2 byte range, but produces a lot of output)

Case 4: Sampling Tools

Listing of COBOL source with LIST option to get Assembler:



Case 4: Sampling Tools

COBOL code:

```
PERFORM
    UNTIL WS-LEN-FOUND
       IF WS-WORK-LINE (WS-WORK-LEN:1) = SPACES
           SUBTRACT 1 FROM WS-WORK-LEN
           IF WS-WORK-LEN = 0
               SET WS-LEN-FOUND TO TRUE
           END-IF
       ELSE
           SET WS-LEN-FOUND TO TRUE
       END-IF
   END-PERFORM.
```

Definitions

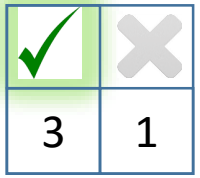
```
05 WS-LEN-FOUND-SW          PIC 9(01) VALUE 0.
   88 WS-NOT-LEN-FOUND      VALUE 0.
   88  WS-LEN-FOUND         VALUE 1.
05 WS-WORK-LEN              PIC 9(03).
```

Better Definitions

```
05 WS-LEN-FOUND-SW          PIC X(01) VALUE 0.
   88 WS-NOT-LEN-FOUND      VALUE 0.
   88  WS-LEN-FOUND         VALUE 1.
05 WS-WORK-LEN              PIC 9(03) COMP.
```

Case 4: Sampling Tools

- Recommendation: COBOL code change
- Result: 140 MIPS Savings



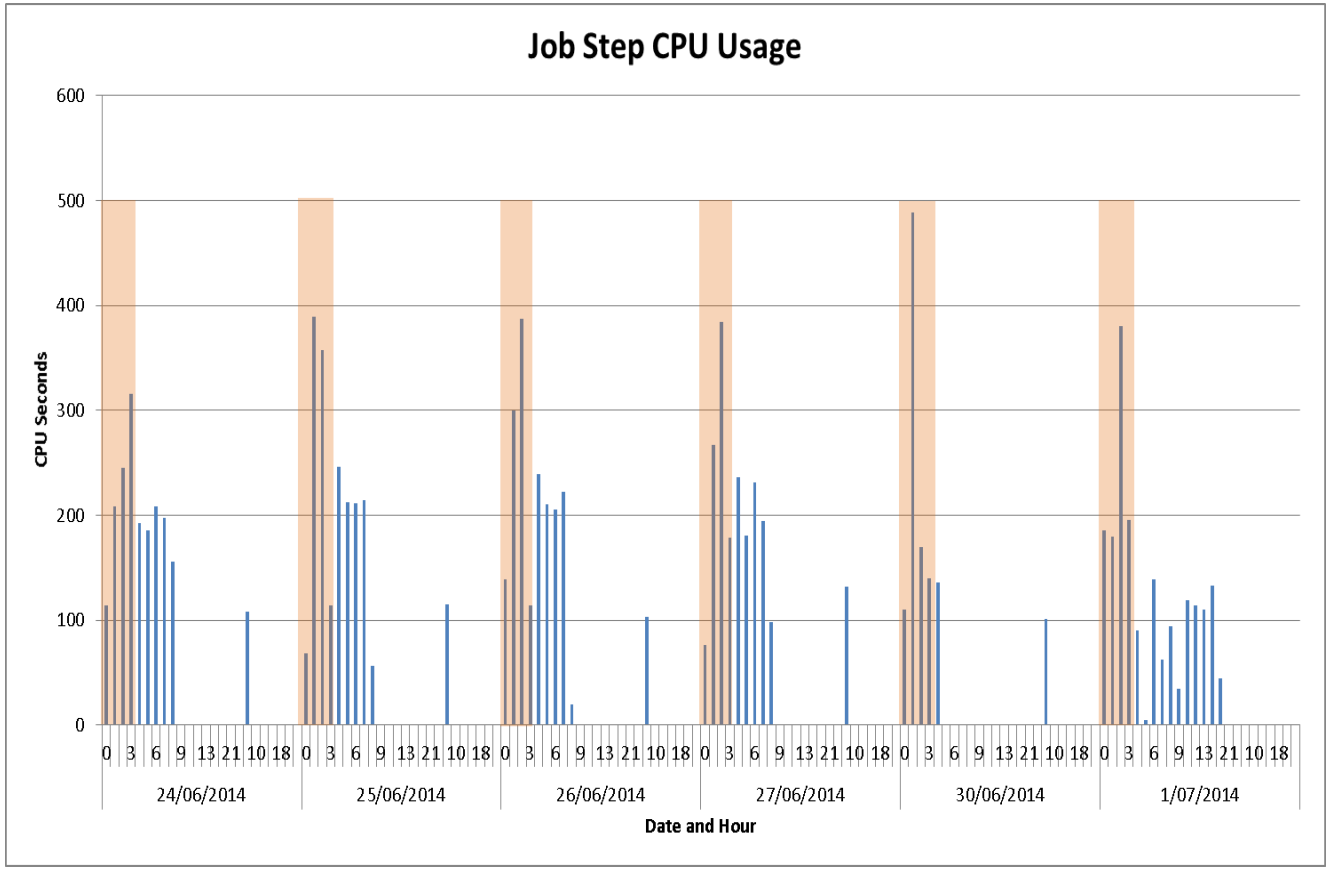
Case 5: System Modules

- Sampling Tools Show CPU usage of application programs and system programs.
- System modules can tell a lot about what the address space is doing

Case 5: System Modules

Case Study: High CPU in user batch program

- Shaded Areas Peak period (4HRA)
- Consumed 11 peak 4HRA MSUs



Case 5: System Modules

- IBM APA Analysis shows VSAM consumes most of CPU
- Job uses one VSAM dataset. Default buffering (BUFNI=1, BUFND=2)

```
IDA019L1  Virtual I/O          68.26 ************************************
           (VIO) and VSAM

 IEAVELK    Supervisor          12.86 ******
            Control
 > CPUREL     CSECT in          12.68 ******
              IEAVELK
 > CPUOBT     CSECT in           0.18
              IEAVELK

 IGZCPCO    COBPACK             3.45 **
 > IGZEVIO    VSAM              3.45 **
              input/output
```

68% of CPU in VSAM processing

Case 5: System Modules

- Recommendation: Improve Buffering:

```
//VSAM001 DD    DSN=VSAM001.DSET,
//              DISP=SHR,BUFND=46,BUFNI=3
```

- Dataset opened for sequential and random access, so hedge our bets, and use optimal buffering for both:
  - BUFND = (Control Intervals in a Control Area + 1 string) / 2 = (90+1)/2
  - BUFNI = large enough for all index records
  - Can get CIs / CA and number of index records from IDCAMS LISTCAT

Case 5: System Modules

Result: No Change

- More from APA:

VSAM using POINT Macro

```
Name      Description              Percent of CPU Time * 10.00%  +/-2.8%
                                         *....1....2....3....4....5....6....7....8....9....*
> DATAMG       Data Mgmt          98.25 **************************************************
                 Processing
    > VSAM001      VSAM             97.79 **************************************************
      > POINT        PGM002+3750    97.78 **************************************************
        > IDA019L1     Virtual      97.78 **************************************************
                       I/O (VIO)
                       and VSAM
          > IDA019R3     Virtual    97.75 **************************************************
                         I/O
                         (VIO)
                         and VSAM
```

✓	✗
3	2

Case 5: System Modules

- Program using skip-sequential processing.
- BUFND/BUFNI not helping
- Skip-sequential only uses one index buffer per string.
- More from APA:

```
VSAM file VSAM001 OPENed at 23:37:31.07 Saturday Mar 21 2015

DDNAME                VSAM001
Open Intent           KEY,DIR,SEQ,IN
Dataset Name          VSAM.DSET
Management Class      MCNORLSE
Storage Class         SCNOGRSP
Device Type           3390
% Free Bytes in CI    10%                          Initial        Last
Volume Serial         BTC526    CI Splits          0              0
CI Size               8,192     CA Splits          0              0
Record Size (LRECL)   148       Logical Records    6,063          6,063
Number of Extents     1         Deleted Records    0              0
SHAREOPTIONS          (2 3)     Insrted Records    0              0
Organization          KSDS      Retrved Records    3,728,434      6,733,782
CIs per CA            90        Updated Records    0              0
Free CIs per CA       4         Bytes Free Space   458,752        458,752
Free Bytes per CI     819       Number of EXCPs    2,255,860      5,085,761
% Free CIs in CA      5%
Strings               1         String Waits       0
DATA Buffers          49        String Waits HWM   0
INDEX Buffers         3
Avg Response Time     0.0768    Avg Pending Time   0.0000
Avg Disconnect Time   0.0000    Avg Connect Time   0.0640
Avg Queued Time       0.0000    Total I/Os         952,268
Cache Candidates      952,268   Cache Hits         952,268
```

Only 6,000 records, retrieved 3 million times!

Case 5: System Modules

Solution: Batch LSR

```
//VSAM001 DD   DSN=SN=VSAM001.DSET,
//             DISP=SHR
//FDI1564I DD   SUBSYS=(BLSR,'DDNAME=VSAM001','BUFND=1024,BUFNI=3')
```

This worked. 6 MSUs saved.

Case 6: Program Products

- I use sampling products on everything - not just user batch programs or CICS subsystems.
- Some program products provide source
- Even with no source, can find some possible CPU savings.

Case 6: Program Products

Case Study: High CPU in HP Exstream batch

- One job using 3000 CPU seconds
- Macro4 FreezeFrame:

```
Name       Description              Percent of CPU Time * 10.00%  +/-0.4%
                                          *....1....2....3....4....5....6....7....8....9....*
  APPLCN     Application Code         89.16 *******************************************
  > ENGEXE     Application Program    89.00 *******************************************
  > CMPSERVS   Application Program     0.16
  SYSTEM     System/OS Services       10.71 *****
  > LERUNLIB   Language                10.41 *****
               Environment Runtime
  > MVS        MVS System               0.30
  > SVC        SVC Routines             0.00
  DATAMG     DataMgmt Processing       0.10
  NOSYMB     No Module Name            0.01
```

89% of CPU in product modules. Not much we can do here.

A bit of CPU in dataset compression

Language Environment looks interesting

We have already seen how DATAMG can possibly be reduced. But nothing for us here

Case 6: Program Products

- Language Environment Breakdown

```
Name      Description              Percent of CPU Time * 10.00%  +/-0.4%
                                        *....1....2....3....4....5....6....7....8....9....*
  > LERUNLIB  Language               10.41 *****
              Environment Runtime
    > CELHV003  DLL for XPLINK C     7.81 ****
                applications
      > EDCMMOVE  memmove()          2.50 *
      > EDCZHINV  CRTL Main          1.11 *
                  invocation
                  event XPLINK
      > EDCALLOC  SPC malloc(),      0.02
                  calloc(),
                  realloc(), SPC
                  free()
```

Moving memory. Not much we can do.

XPLink processing. Not much here either.

High memory overhead can be reduced with LE memory tuning. But no such overhead here.

Case 6: Program Products

- QSAM File Compression
- No zEDC
- From SMF Type 30 Records and ISPF DSLIST / IDCAMS LISTCAT:

DD	Dataset	Size	Record Length	Blocksize	Compress	EXCPs
CSFIN	P.CSF102DP.R020.SORTOUT.OCSFREG	500M	2504	32,760	66%	132,000
OPAGE112	P.CSF102DP.R020.OPAGE18	6.8G	8205	32,760	0%	428,000
OPAGE1360	P.CSF102DP.R020.OPAGE960	415M	8205	32,760	0%	14,000
OPAGE61	P.CSF102DP.R020.OPAGE61	415M	8205	32,760	0%	1,000
AUDITLOG	P.CSF102DP.R020.AUDITLOG	6.7M	133	32,718	25%	1,000

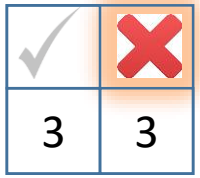
Losing disk space with inefficient blocksize.

Not much benefit from compression.

Case 6: Program Products

- Recommendation:
- Remove compression, change blocksizes to half-track

- Result: Declined by client. 0.16% CPU saving not worth it



Case 6: Program Products

- Sampling products are great at estimating saves.
- Can use this information to decide if an idea is worth it

PGM001 at offset 015B00		52.29%
PGM001 at offset 015AC0		19.31%
IDA019L1	Virtual I/O (VIO) and VSAM	68.26%
CMPSERVS	Application Program	0.16%

Program = 70%* 300 MIPS = 210 MIPS
80% savings = **170 MIPS**

VSAM = 68.26%* 11 MSUs = 7.5 MSUs
80% savings = **6 MSUs**

Compression = 0.16% * 3000 seconds = 4.8 seconds
100% savings = **4.8 seconds**

Summary

- 6 CPU Savings Case Studies
- Some successes, some failures
- No fancy tools or products
- Tools used:
  - SMF records (Type30, 70)
  - Sampling Tool
  - RMF Monitor III
  - RMF Monitor I
  - IDCAMS LISTCAT
  - ISPF DSLIST (3.4)

Summary – CPU Reduction Ideas

Have covered six possible CPU reduction ideas. But there is no limit to the possibilities – this is just a start.

- Move workloads out of peak periods
- Coupling Facility Analysis
- Review JCL of frequently submitted jobs
- COBOL code changes
- VSAM Dataset Tuning
- Review system modules identified by sampling product

Summary - Basic Tactics

1. Determine where CPU costs money, and how to save

2. Determine period of time to target analysis

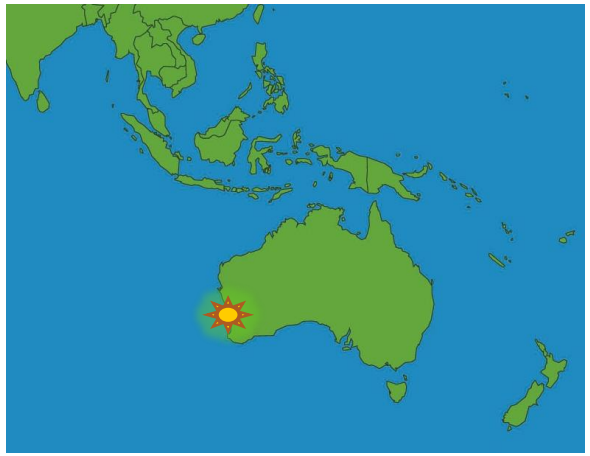
3. Use SMF Type 30 Interval records to identify address spaces (sort by descending program name)

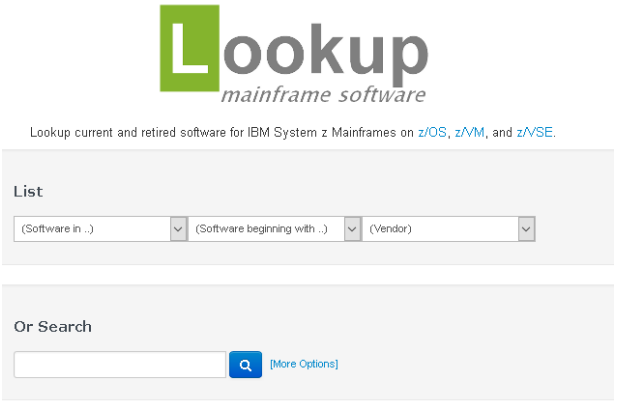
4. Use Sampling Tool to dig down further and estimate saves.

Don’t forget system modules and program products when using your sampling tool

About Longpela Expertise

- Small z/OS consulting firm started in 1996
- Based in Perth, Western Australia. Work worldwide
- Systems consultants: z/OS, CICS, IMS and more
- Behind www.lookupmainframesoftware.com and "*What On Earth is a Mainframe*" book.





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