The SMurF's are EXCELing

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Royal Bank of Scotland

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Session IG

Agenda

- Introduction and Disclaimer
- SMF and Db2 Overview
- Tools and Data
- Using the Data
- The End Game

Introduction and Disclaimer

- Primarily Db2 orientated
  - More DBA than sysprog
  - Same principles apply though to any data source
- Not an in depth session on performance tuning
- Not a session on advanced EXCEL features

- So, what is it?
- It’s for people who wish they had this…

Introduction and Disclaimer (contn)

- …but only have this!

- Those two old clubs being
  - Db2 Performance Database
  - MS EXCEL

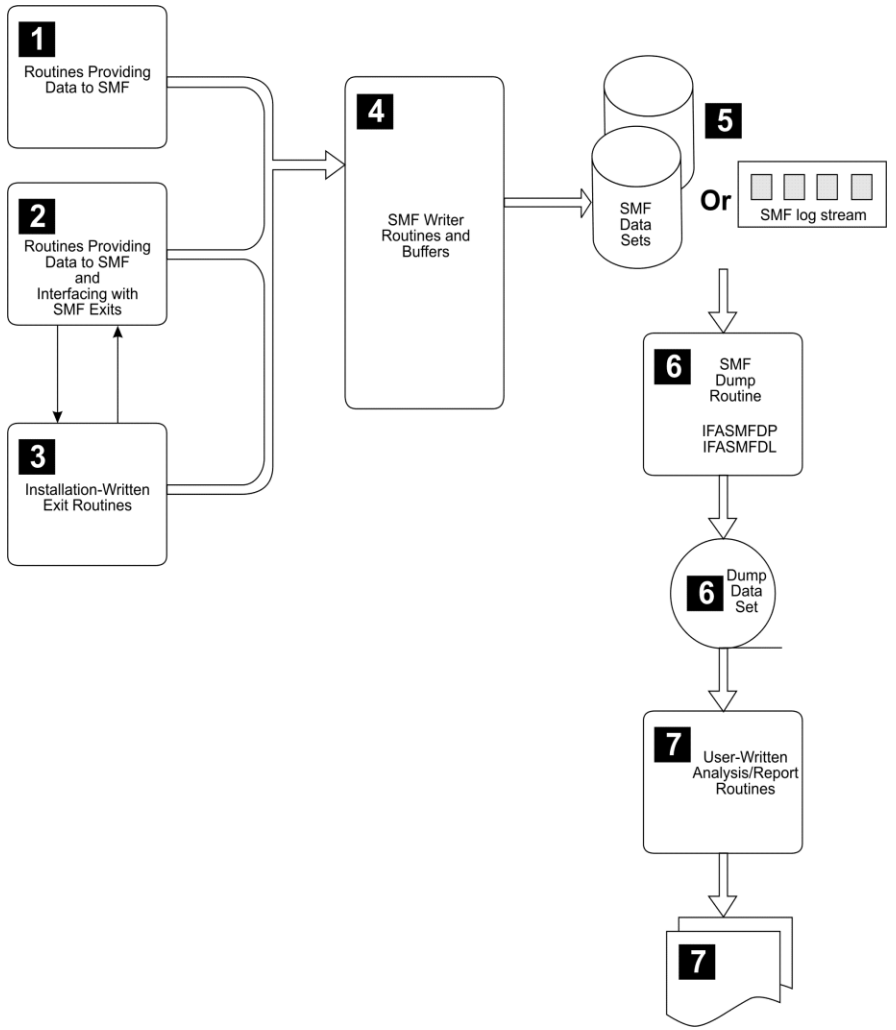
- And to stretch the allegory to limit
  - The bag is SMF!

Introduction and Disclaimer (Cont)

- Royal Bank of Scotland
  - 5 Production Db2 Data Sharing Groups
    - Main DSG has 10 active members on 10 LPARs
      - 680M CICS transactions per day (17000 txns per second at peak)
      - 20M distributed transactions per day
      - 15M RRS transactions per day
      - 200K Utility executions per day
      - 300GB of Db2 SMF data per day alone
    - Problem? What to do with it all!

SMF and Db2 Overview

- What is SMF?
  - Systems Management Facility
  - Gathers measurement data from multiple sources
    - CICS, Db2, MQ, Websphere
  - Used for (amongst others)
    - System usage reports
    - Historical analysis
    - Capacity Planning, Performance Analysis
    - Reporting on SLA's



SMF and Db2 Overview

- Each SMF Record assigned a type
  - Types 0-127 reserved for IBM products
  - Types 128-255 available for user records
- Most commonly used types are
  - Job statistics – type 30
  - RMF – type 70 thru 79
  - CICS – 110
  - MQ – 115 and 116
  - DB2
    - Statistics – 100
    - Accounting – 101
    - Performance - 102

SMF and Db2 Overview

- Db2 Traces
  - Instrumentation Facility Component (IFC) allows 6 trace types
    - Statistics
    - Accounting
    - Audit
    - Performance
    - Monitor
    - Global
  - Trace types use trace classes (and can have subtypes)
  - Trace classes consist of one or more IFCIDs
    - IFCID = Instrumentation Facility Component ID

SMF and Db2 Overview

- Sample SMF Type/Db2 Trace/IFCID relationships

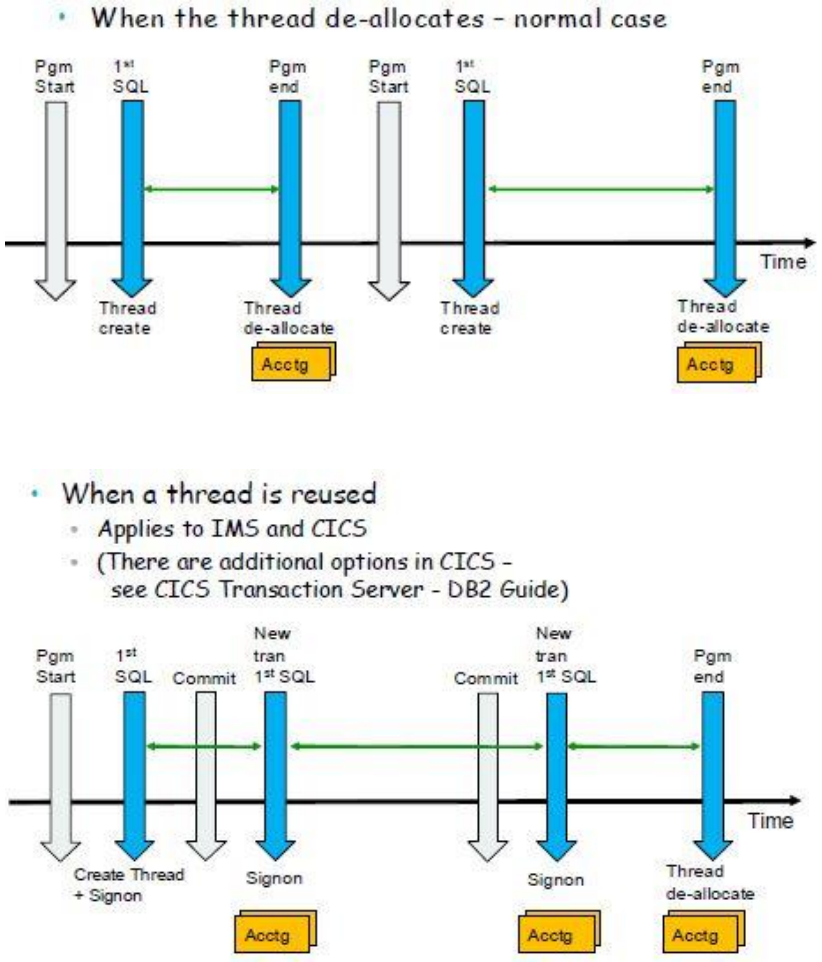
IFCID	TRACE	CLASS	SMF TYPE	SMF SUBTYPE	DESCRIPTION
001	STATISTICS	1	100	0	SYSTEM SERVICES STATISTICS
002	STATISTICS	1	100	1	DATABASE STATISTICS
202	STATISTICS	1	100	2	BUFFER POOL PARAMETERS
230	STATISTICS	5	100	3	DATA SHARING GLOBAL STATISTICS
225	STATISTICS	1	100	4	STORAGE STATISTICS
172 196 105	STATISTICS	3	102		DEADLOCK AND TIMEOUT STATISTICS DB TS MAPPING
003	ACCOUNTING	1	101	0	PLAN ACCOUNTING
003	ACCOUNTING	2	101	0	PLAN IN DB2 TIME
003	ACCOUNTING	3	101	0	PLAN WAIT TIME
239	ACCOUNTING	7	101	1	PACKAGE ACCOUNTING
239	ACCOUNTING	8	101	1	PACKAGE WAIT TIME
239	ACCOUNTING	10	101	1	PACKAGE ACCOUNTING DETAILS

SMF and Db2 Overview

- Db2 Accounting Data
  - Primarily used for looking at thread/application level issues
  - Contains Package level information
  - Contains information on
    - Identification of thread
    - Elapsed, CPU, and wait times
    - SQL statements counters
    - RID list processing
    - Query parallelism
    - Group buffer pool and buffer pool activity
    - Data-sharing locking
    - Stored Procedures
    - Locking activity
    - Resource limit facility (RLF)
    - Distributed data facility (DDF)
    - Packages & DBRMs executed

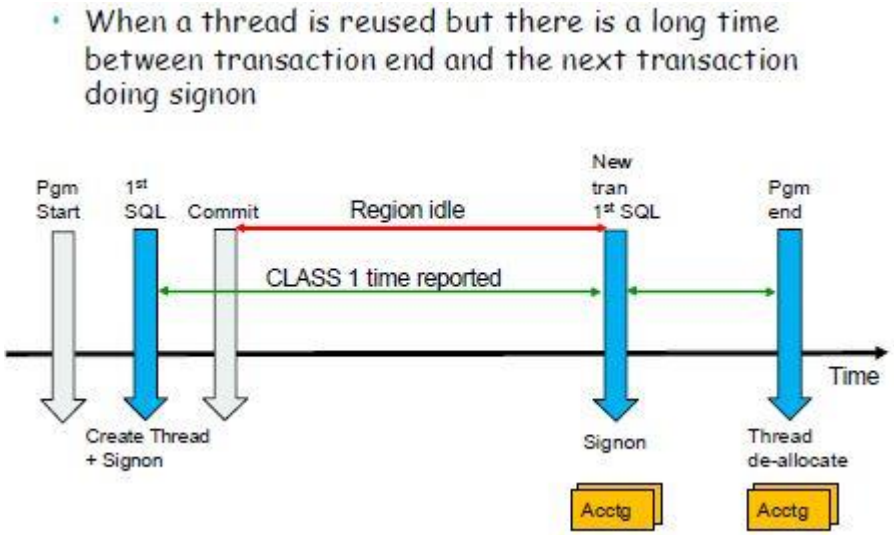
SMF and Db2 Overview

- Db2 Accounting Data
  - Produced when
    - Thread ends (deallocates or abends)
    - Thread is reused
      - Watch out for Class 1 elapsed gotcha
        - Class 1 elapsed will include wait time between protected thread re-use
      - New CICS txn may not cut record if:
        - Protected entry thread
        - Txns on DB2ENTRY use same authid
        - ACCOUNTREC=NONE or TASK



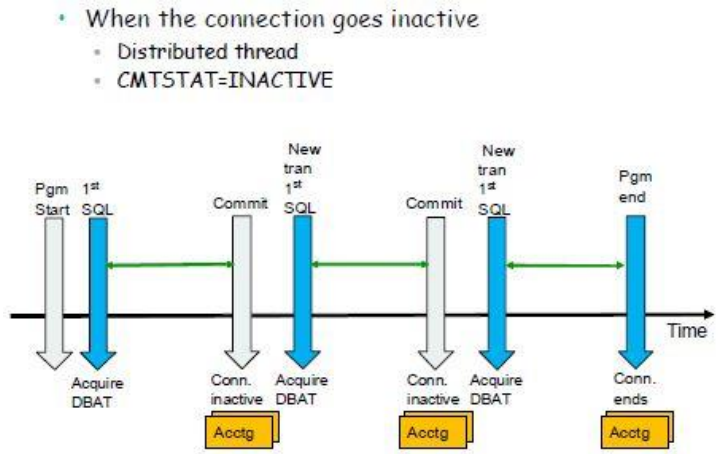
SMF and Db2 Overview

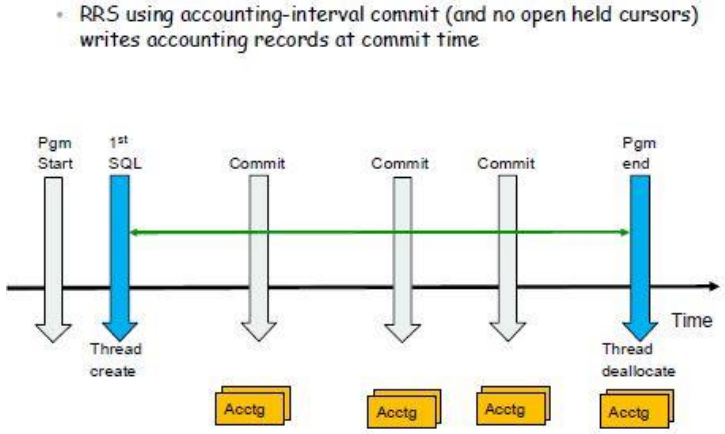
- Db2 Accounting Data



SMF and Db2 Overview

- Db2 Accounting Data
  - DDF cuts records at commit time
    - With CMTSTAT=INACTIVE
  - RRS can cut at commit time
    - Using accounting-interval commit
    - No open held cursors
  - When using rollup Accounting (DDF/RRS)
    - ACCUMAC>1
    - Record cut at ACCUMAC=x for whichever aggregation type chosen (ACCUMUID)





SMF and Db2 Overview

- Db2 Statistics
  - Interval driven
    - STATIME=1 (default since Db2 V10)
    - Recommend starting when Db2 starts – SMFSTAT zparm
  - Start classes 1,3,4,5,6 (7,8 also very useful)
    - Class 1 = Db2 statistics
    - Class 3 = exceptions like deadlock, timeout, take extent
    - Class 4 = exceptions related to distributed activity
    - Class 5 = data sharing stats
    - Class 6 = storage stats
    - Class 7 = DDF location stats
    - Class 8 = Dataset I/O stats

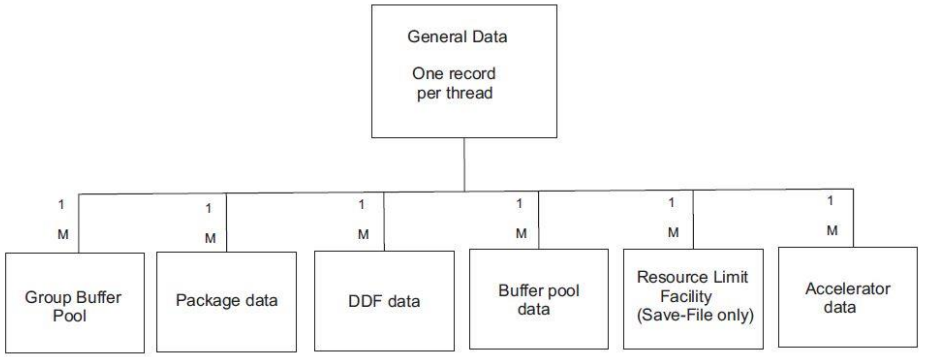
SMF and Db2 Overview

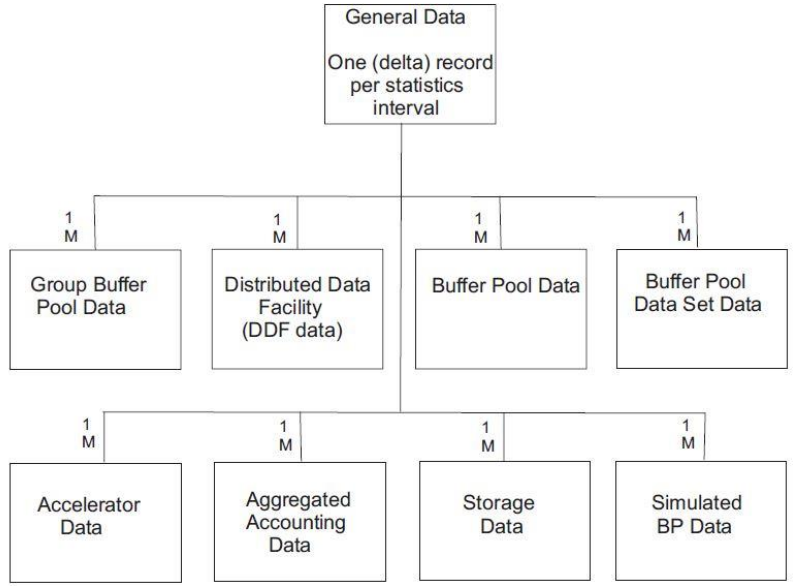
- Db2 Statistics
  - Used for looking at Db2 Subsystem level data
  - Gathers a lot of data on (amongst others) -

- SQL usage
- Stored proc, triggers, UDFs
- EDM pool
- Subsystem services
- Open/Close activity
- Log activity
- Plan/package processing
- DB2 commands
- RID list processing, Dynamic statement cache
- Authorization management
- Locking activity / Data-sharing locking
- Query parallelism
- CPU times
- DB2 IFI requests
- DB2 latch counters
- Buffer pool and Group buffer pool activity
- DDF activity
- Storage statistics

Tools and Data

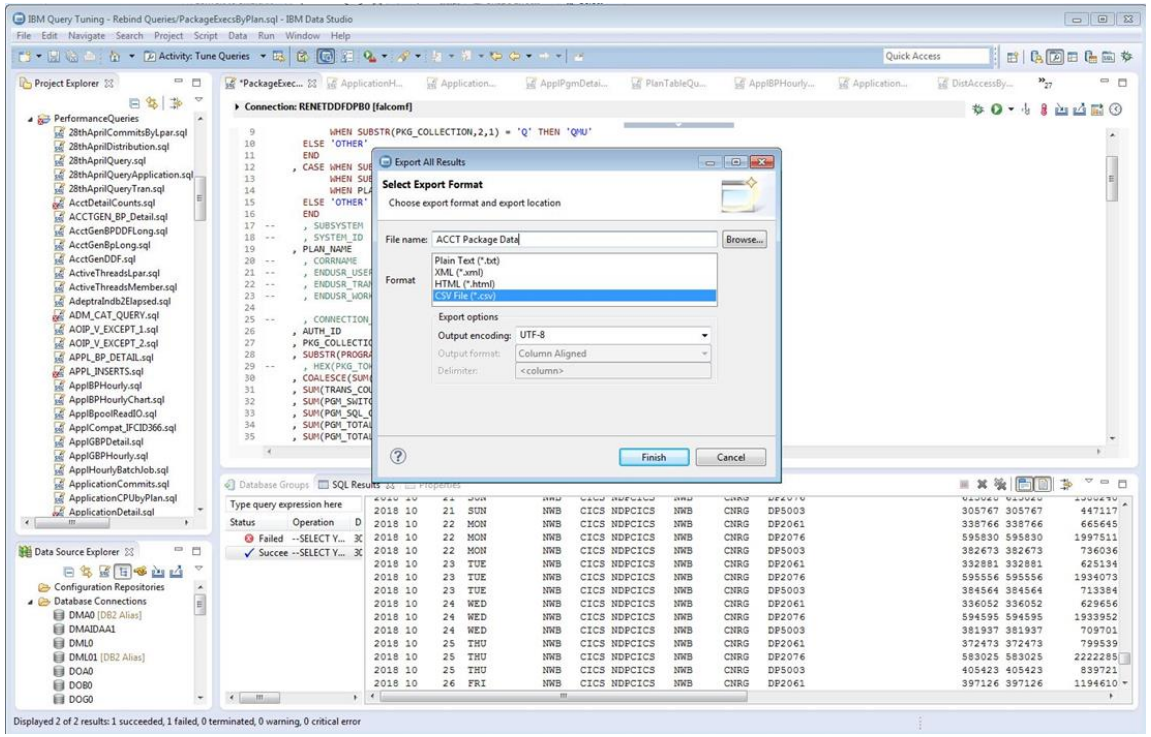
- Performance Database
  - Multiple Vendors supply their own versions
    - Can be challenge mapping their columns to the IBM field names
  - Flexible in implementation
    - Can be every accounting record (great if you have the space and time!)
    - Can be aggregated by Interval (if you don't)
    - Can retain as much historical data as you can cope with
  - Recommend custom indexing
    - Majority of searches would use PLAN, CORRNAME, AUTHID, CONNID and DATE/TIME





Tools and Data

- Tool to Query the Performance Database
  - IBM Data Studio, DBVisualizer etc
    - Basically anything that lets you export to CSV file
  - Or use unload utility on mainframe
- Have standard set of SQLs
  - General accounting data
  - Package level accounting data
  - Bufferpool level accounting data
  - Bufferpool level statistics data
  - Group bufferpool level statistics



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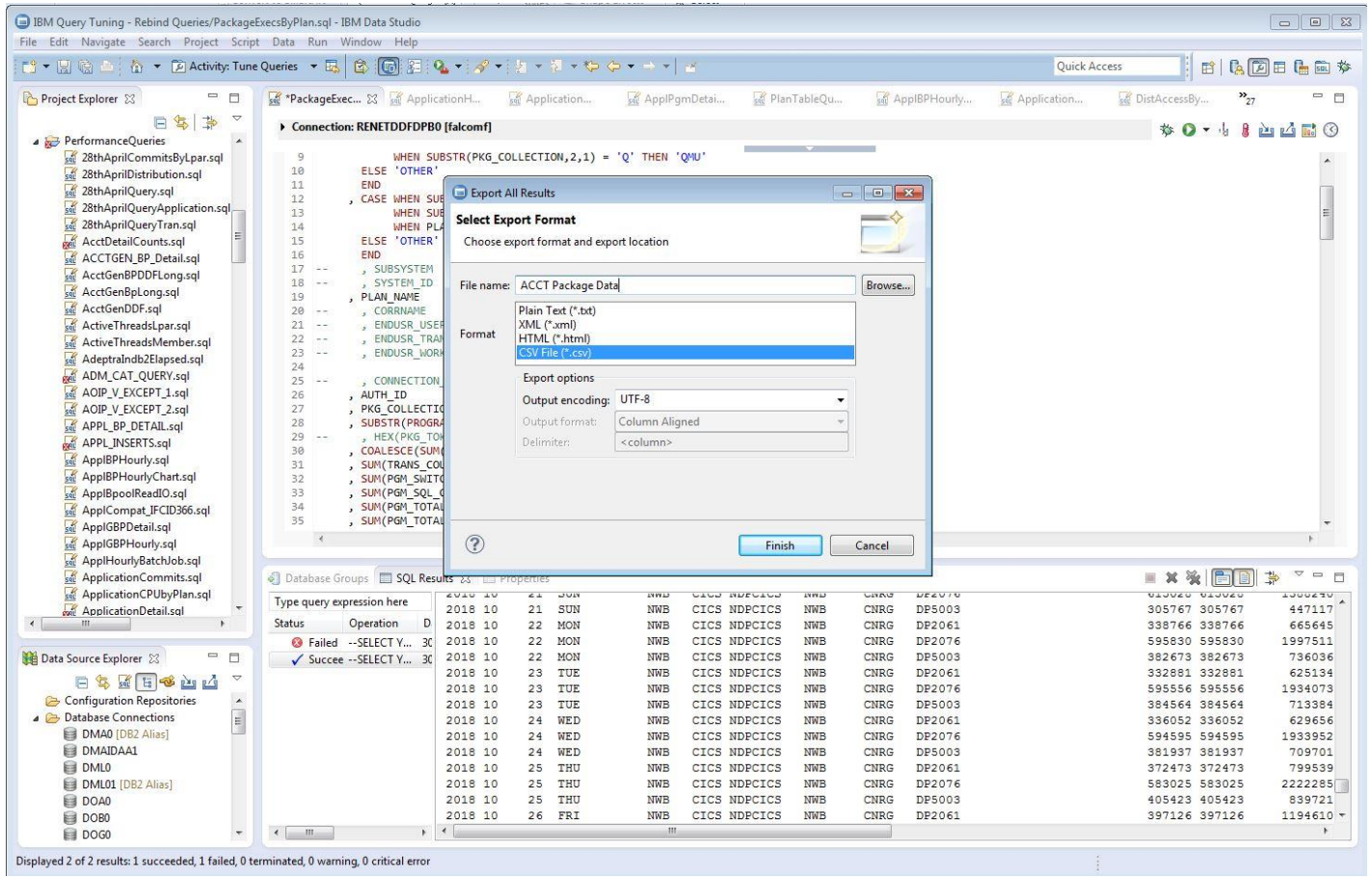
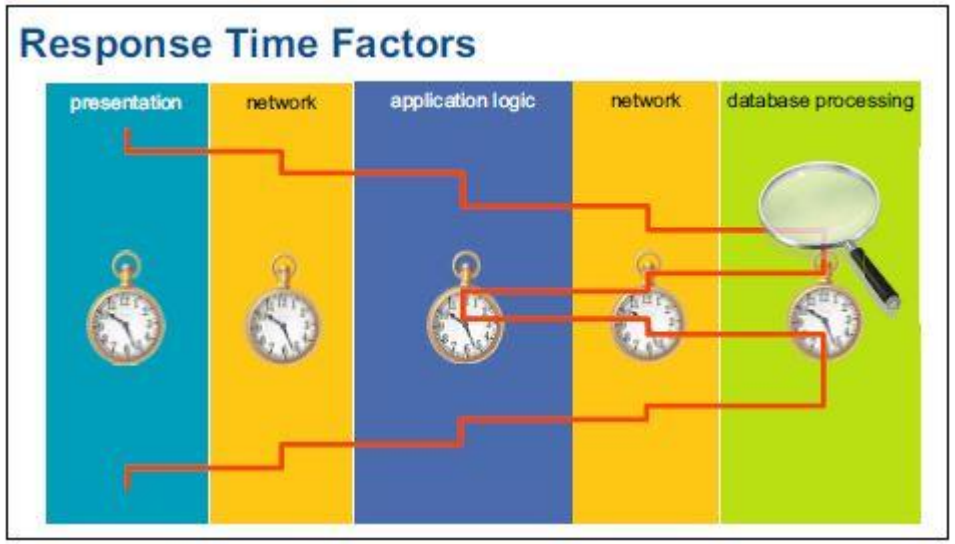


Using the Data

- Top down approach
  - Many application layers in the mix
    - Usually you'll just be proving the issue is not Db2
  - Start looking at the high level stats then drill down
  - For application type issues start with Accounting Class 1,2,3 level data



Using the Data

- Accounting Class Terminology
  - Class 1
    - Application time connect (thread create) to disconnect (thread terminate)
    - Reporting Class 1 elapsed and Class 1 cpu time
  - Class 2
    - Time spent in Db2
    - Reporting Class 2 Elapsed and Class 2 cpu time
  - Class 3
    - Suspensions (I/O wait, locking, service task switch)
  - Class 7
    - Same as Class 2, but at package level
    - Reporting Class 7 Elapsed and Class 7 cpu time
  - Class 8
    - Same as Class 3, but at package level

TIMES/EVENTS	APPL(CL.1)	DB2 (CL.2)
ELAPSED TIME	32.419443	1.752436
NONNESTED	32.419443	1.752436
STORED PROC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
CP CPU TIME	0.003043	0.001556
AGENT	0.003043	0.001556
NONNESTED	0.003043	0.001556
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.000000	0.000000
SE CPU TIME	0.000000	0.000000
NONNESTED	0.000000	0.000000
STORED PROC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.000000	0.000000
SUSPEND TIME	0.000000	1.748431
AGENT	N/A	1.748431
PAR.TASKS	N/A	0.000000
STORED PROC	0.000000	N/A
UDF	0.000000	N/A
NOT ACCOUNT.	N/A	0.002448

CLASS 3 SUSPENSIONS	ELAPSED TIME
LOCK/LATCH(DB2+IRLM)	1.716285
IRLM LOCK+LATCH	0.000000
DB2 LATCH	1.716285
SYNCHRON. I/O	0.015137
DATABASE I/O	0.011434
LOG WRITE I/O	0.003703
OTHER READ I/O	0.000000
OTHER WRTE I/O	0.000000
SER.TASK SWTCH	0.004382
UPDATE COMMIT	0.004382
OPEN/CLOSE	0.000000
SYSLGRNG REC	0.000000
EXT/DEL/DEF	0.000000
OTHER SERVICE	0.000000
ARC.LOG(QUIES)	0.000000
LOG READ	0.000000
DRAIN LOCK	0.000000
CLAIM RELEASE	0.000000
PAGE LATCH	0.011564
NOTIFY MSGS	0.000000
GLOBAL CONTENTION	0.000000
COMMIT PH1 WRITE I/O	0.000000
ASYNCH CF REQUESTS	0.001063
TCP/IP LOB XML	0.000000
ACCELERATOR	0.000000
AUTONOMOUS PROCEDURE	0.000000
PQ SYNCHRONIZATION	0.000000
TOTAL CLASS 3	1.748431

Using the Data

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Using the Data

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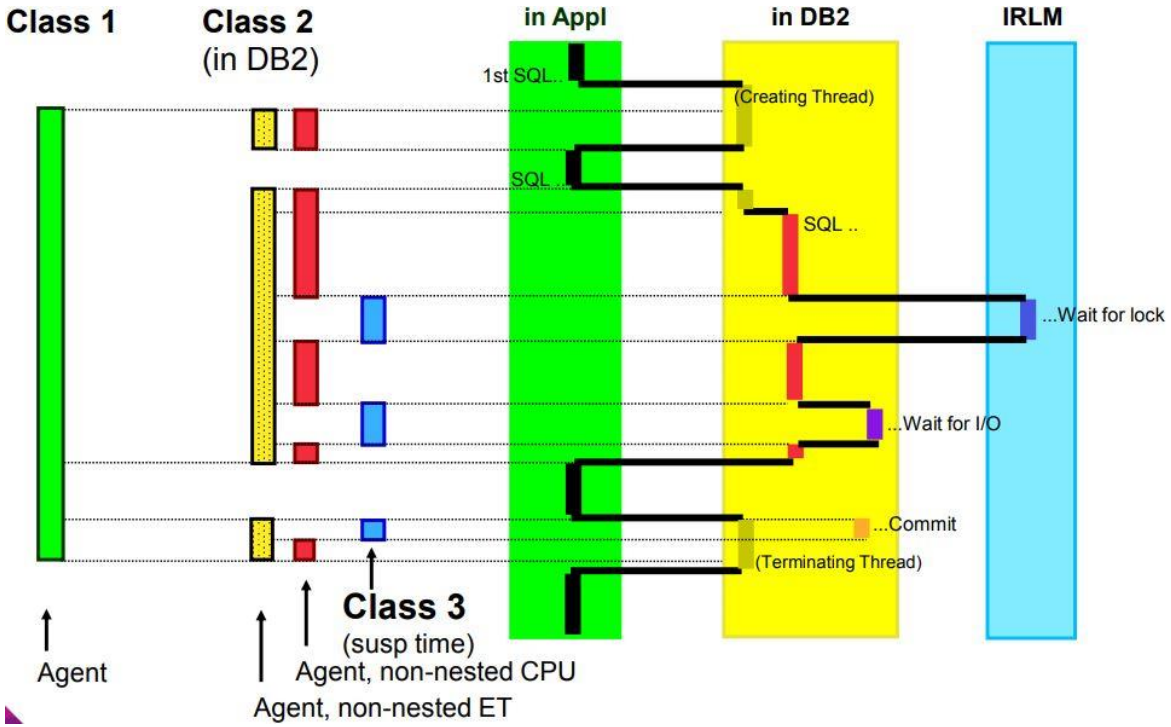

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Using the Data

- Accounting Report Limitations
  - Verbose
  - A LOT of data per transaction, especially if in high volume production situation
  - Difficult to see the big picture in detailed trace reports
  - Summary reports can be too high level
  - Enter EXCEL…
  - Object is to plot out the information in accounting report in visual form
    - Which is all in your performance database, so here we go…

Using the Data

- Take methodical approach
  - Start at a high(ish) level then work down
  - 95% of issues can be diagnosed from data patterns
  - If you have aggregated accounting tables then start there
  - If not, then aggregate results by second, minute or hour in your SQL queries
  - In SQL queries, start by taking the Class 1,2,3 fields
    - Refer to your vendors documentation
  - Have adhoc SMF dump jobs and File extracts ready to run
    - Some sites only externalise the SMF data into their performance databases once a day, usually overnight

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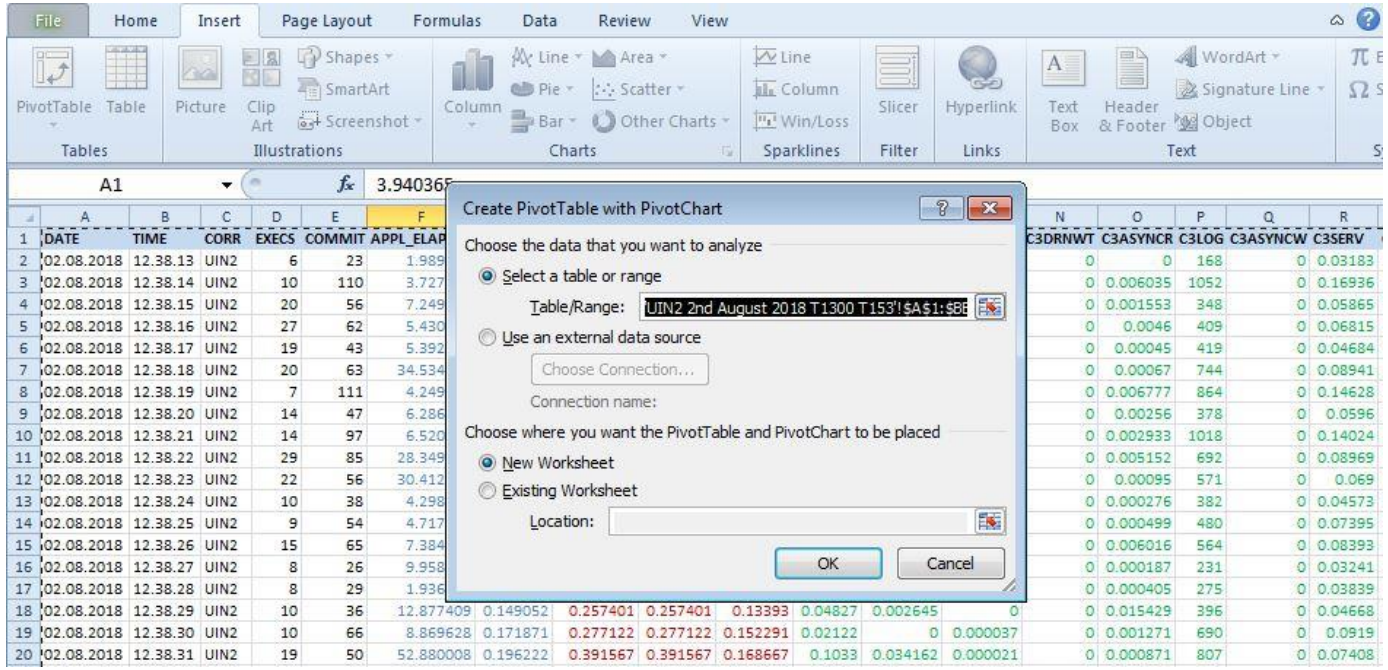
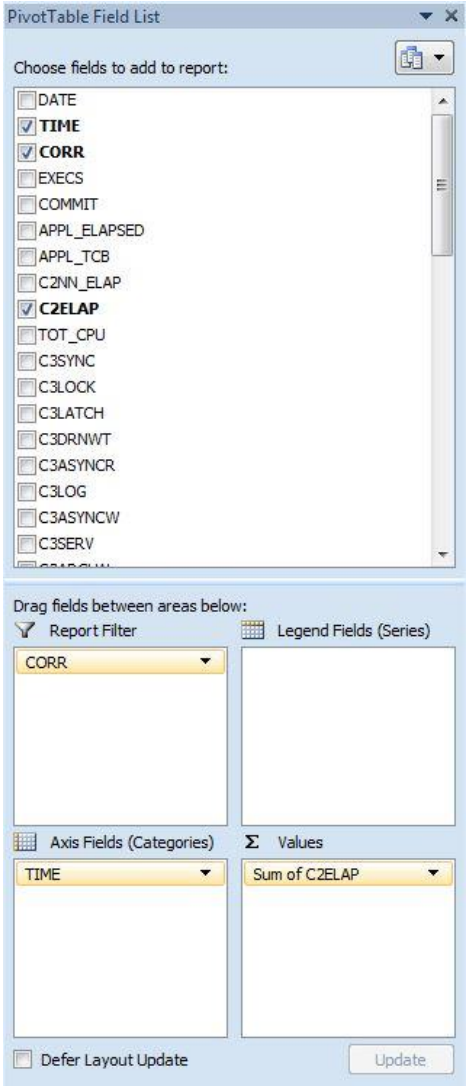
DATE	TIME	CORR	EXECS	COMMIT	APPL_ELAPSED	APPL_TCB	C2NN_ELAP	C2ELAP	TOT_CPU	C3SYNC	C3LOCK	C3LATCH	C3DRNWT	C3ASYNCR	C3LOG	C3ASYNCW	C3SERV	C3ARCLW	C3GLOB	C3PGLTCH	NOT_ACC
02.08.2018	12.38.13	UIN2	6	23	1.989299	0.047251	0.120147	0.120147	0.038275	0.013936	0.031492	0.000029	0	0	168	0	0.031834	0	0.001471	0	0.002991
02.08.2018	12.38.14	UIN2	10	110	3.727015	0.183839	0.40856	0.40856	0.154184	0.067919	0.000011	0	0	0.006035	1052	0	0.169364	0	0	0.000012	0.010362
02.08.2018	12.38.15	UIN2	20	56	7.249691	0.462559	0.587115	0.587115	0.427453	0.034347	0.037014	0.000061	0	0.001553	348	0	0.058649	0	0	0.000049	0.027582
02.08.2018	12.38.16	UIN2	27	62	5.430338	0.389528	0.544152	0.544152	0.355633	0.054534	0.031565	0.00002	0	0.0046	409	0	0.068149	0	0	0.000131	0.028948
02.08.2018	12.38.17	UIN2	19	43	5.392612	0.152976	0.233747	0.233747	0.13039	0.043691	0	0.000029	0	0.00045	419	0	0.046835	0	0.002274	0.000006	0.009808
02.08.2018	12.38.18	UIN2	20	63	34.534644	0.292739	0.427189	0.427189	0.262512	0.046419	0.002863	0.002345	0	0.00067	744	0	0.089411	0	0.002496	0.000038	0.019966
02.08.2018	12.38.19	UIN2	7	111	4.249092	0.095317	0.390115	0.390115	0.071386	0.158361	0.00016	0.000155	0	0.006777	864	0	0.146281	0	0.001209	0.00002	0.002316
02.08.2018	12.38.20	UIN2	14	47	6.286933	0.20877	0.32568	0.32568	0.189183	0.062967	0.000112	0.000028	0	0.00256	378	0	0.0596	0	0	0.000013	0.011057
02.08.2018	12.38.21	UIN2	14	97	6.520175	0.332119	0.541609	0.541609	0.301177	0.077187	0	0.000067	0	0.002933	1018	0	0.140241	0	0	0.000017	0.019469

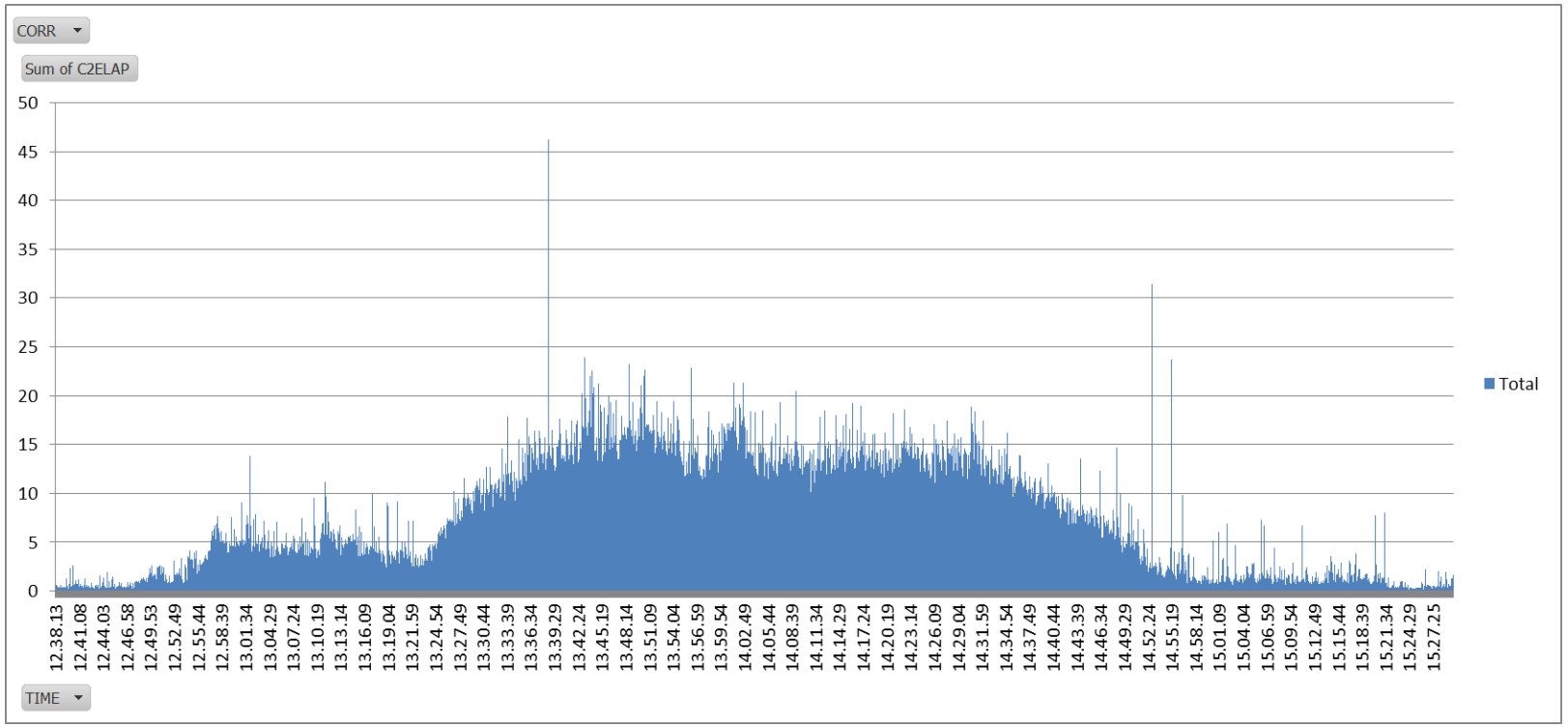
Using the Data

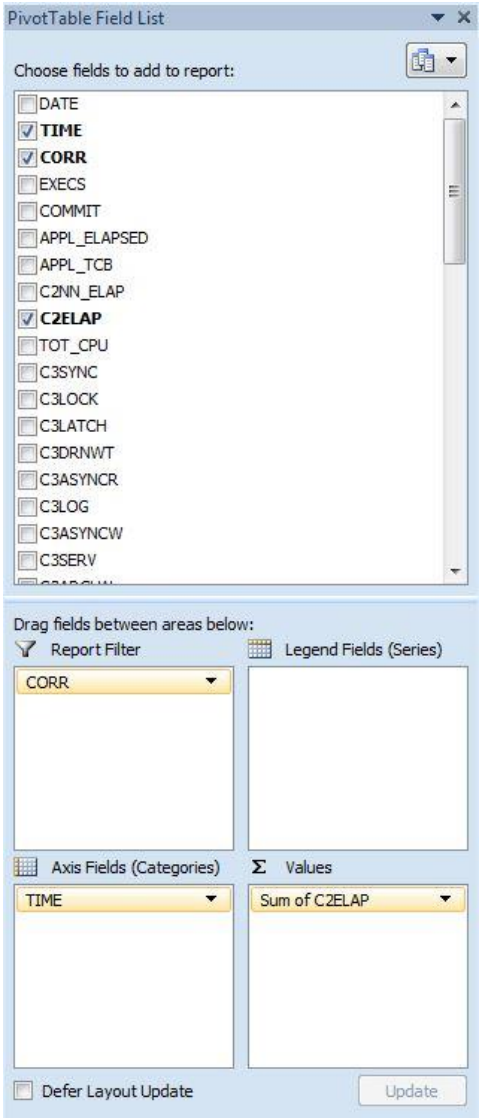
- Create Pivot chart





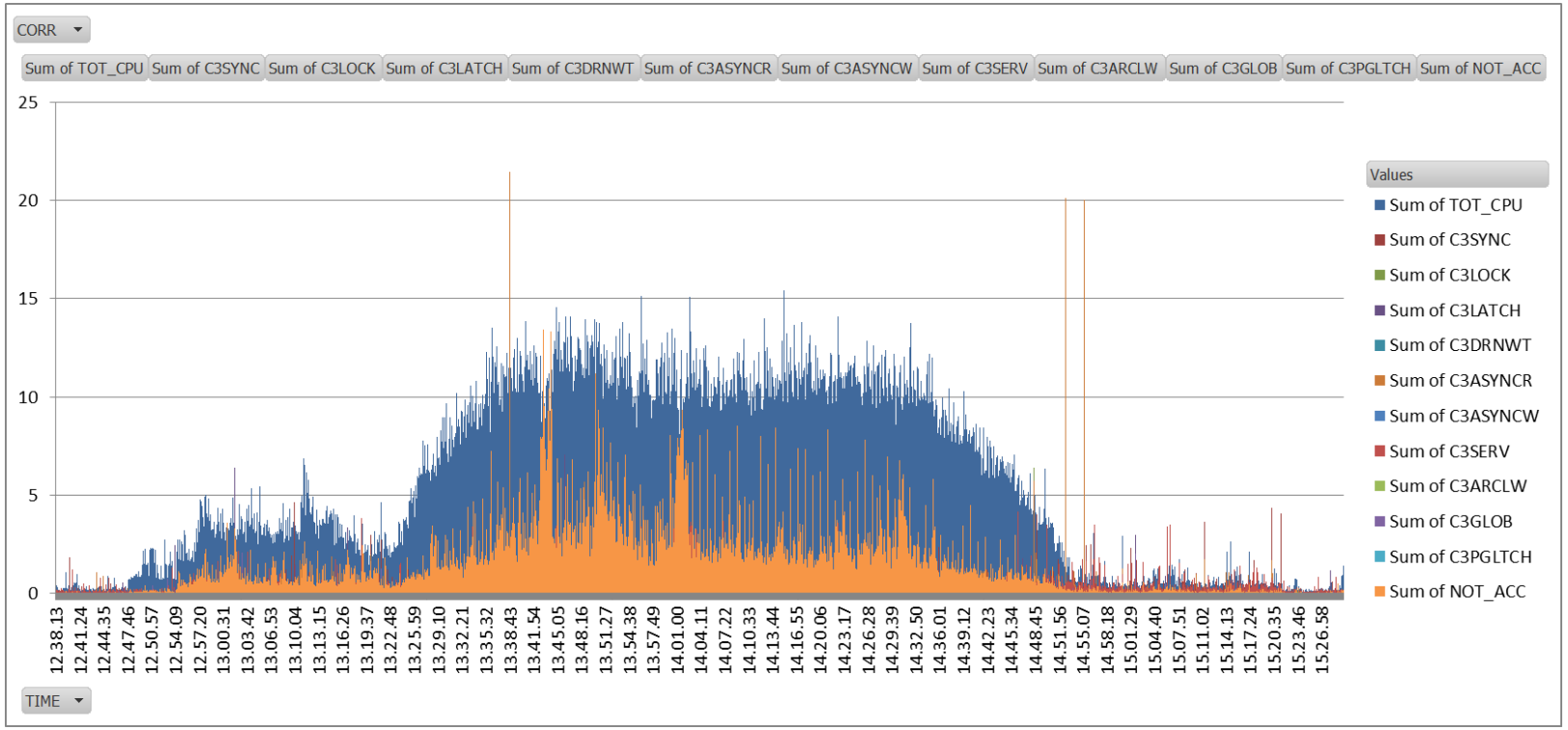
Using the Data

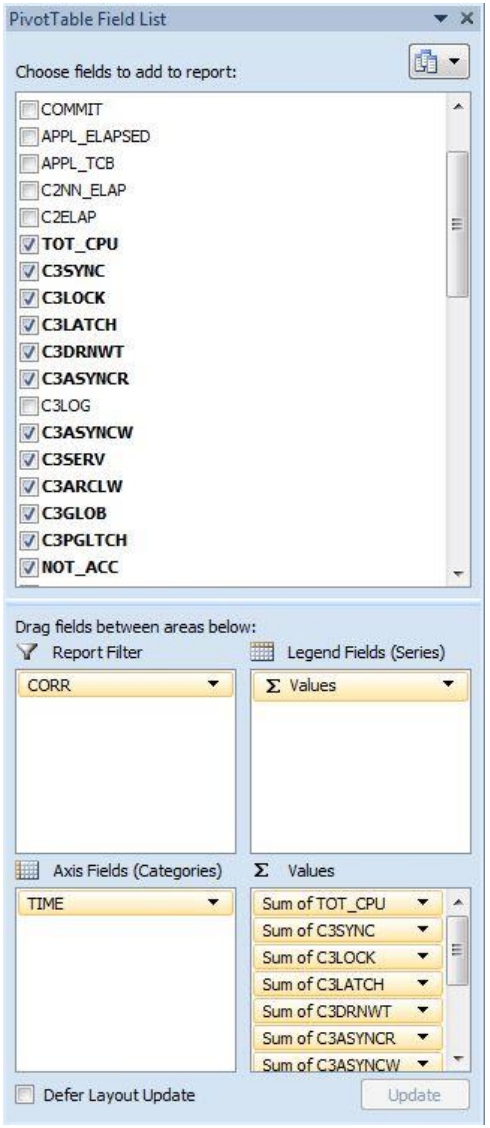




Shows Class 2 Elapsed time only, but we can see what this is made up of…

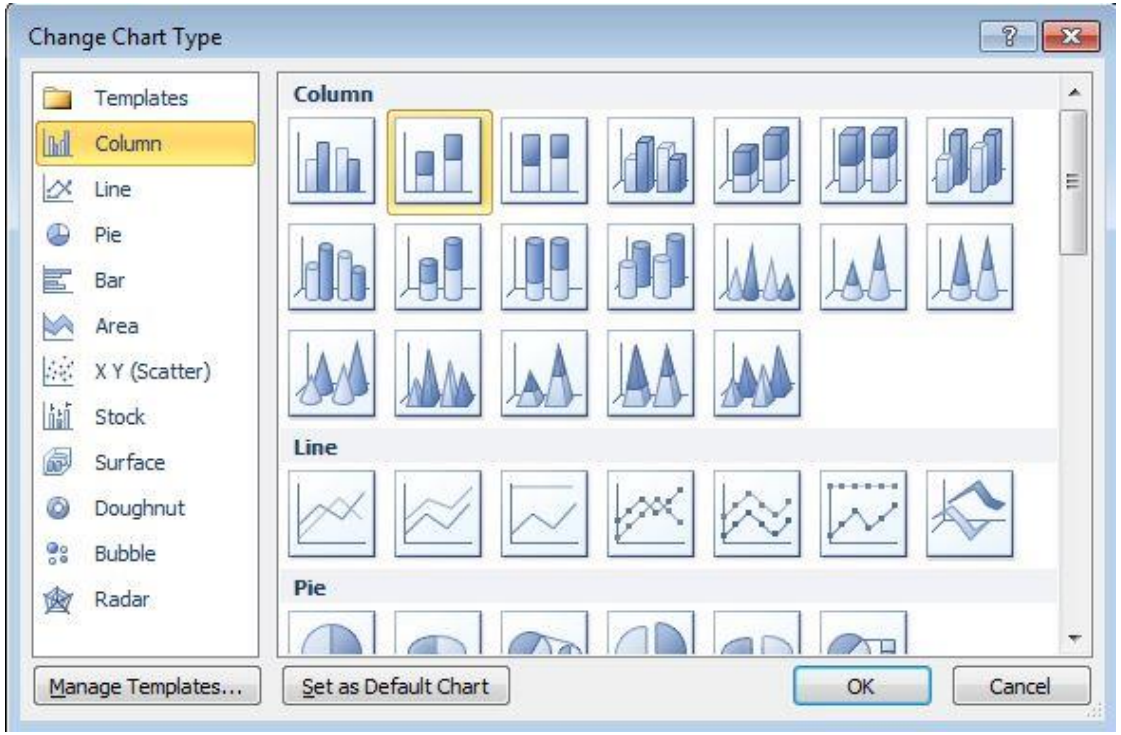
Using the Data





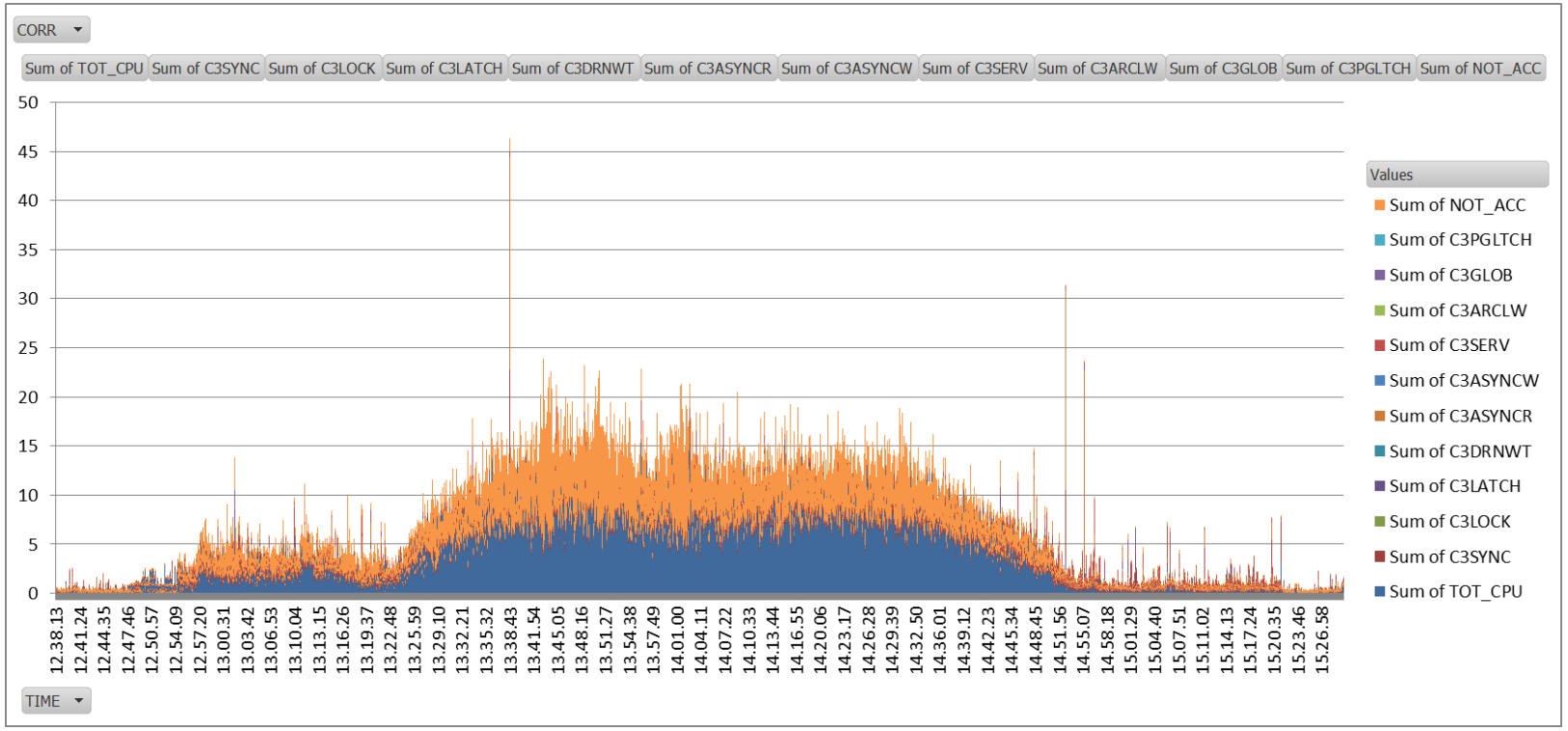
Axis values don’t match Class 2 Elapsed, need to change chart type to stacked…

Using the Data



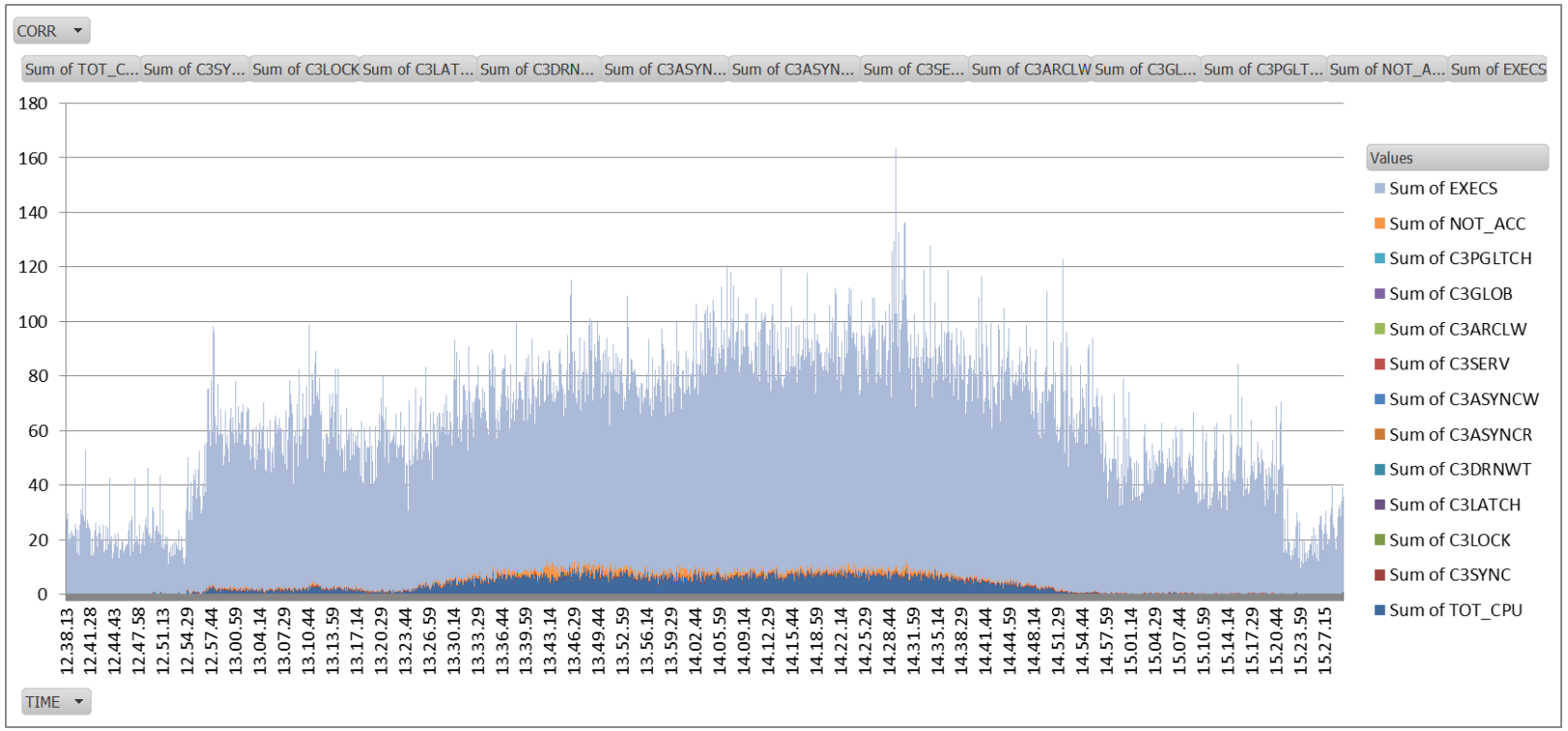
Switch to stacked view

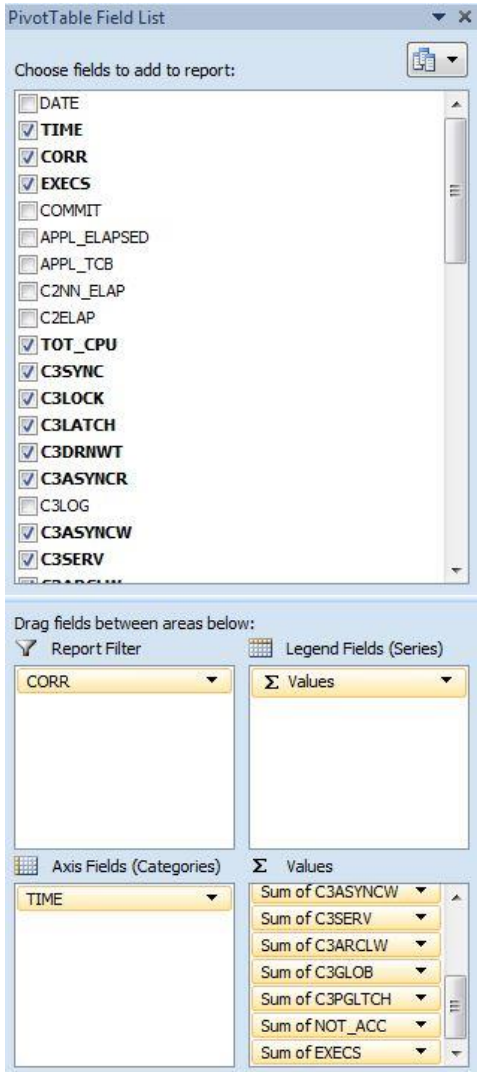
Using the Data



Now have nice view of what application was doing In-Db2 at one second interval. Can now enhance further and add in the transaction volumes…

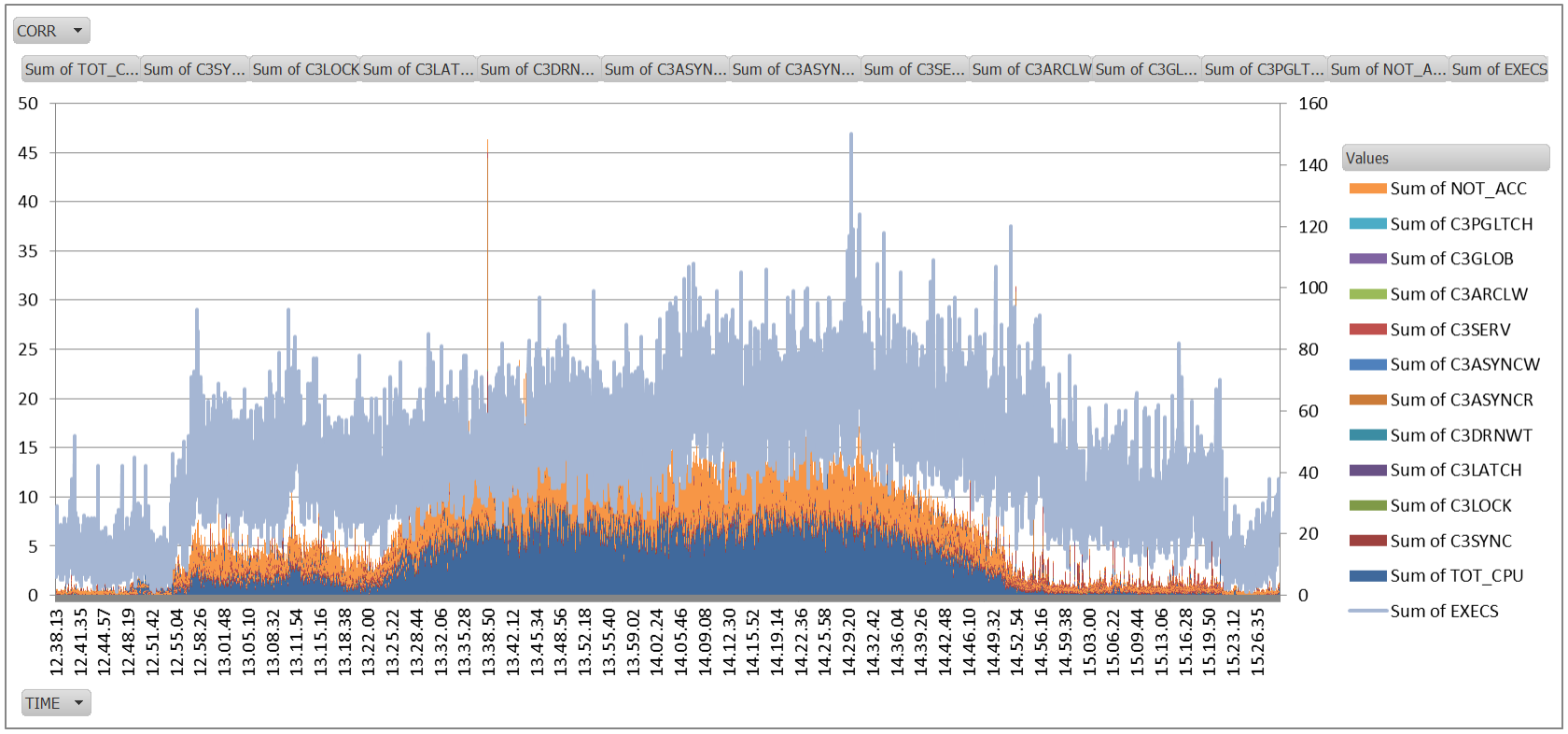
Using the Data

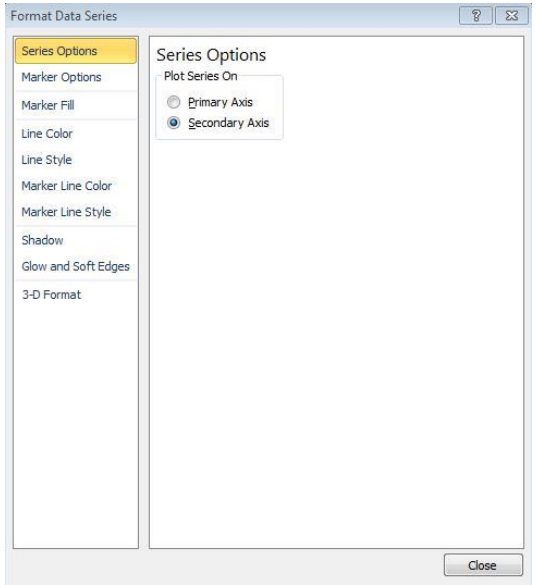


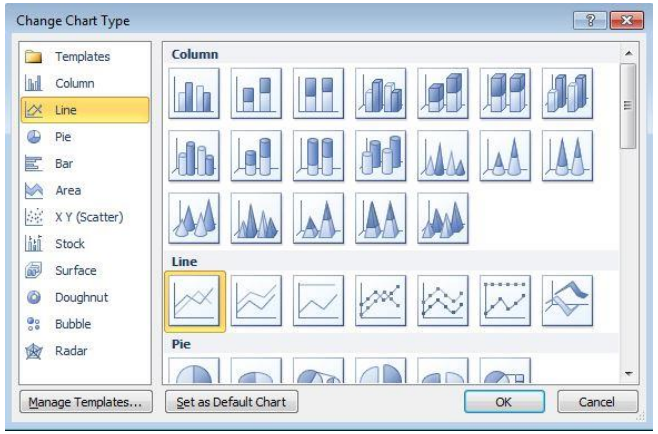


Adding #Execs to chart has obscured the In-Db2 elapsed time, so move #Execs to secondary axis…

Using the Data

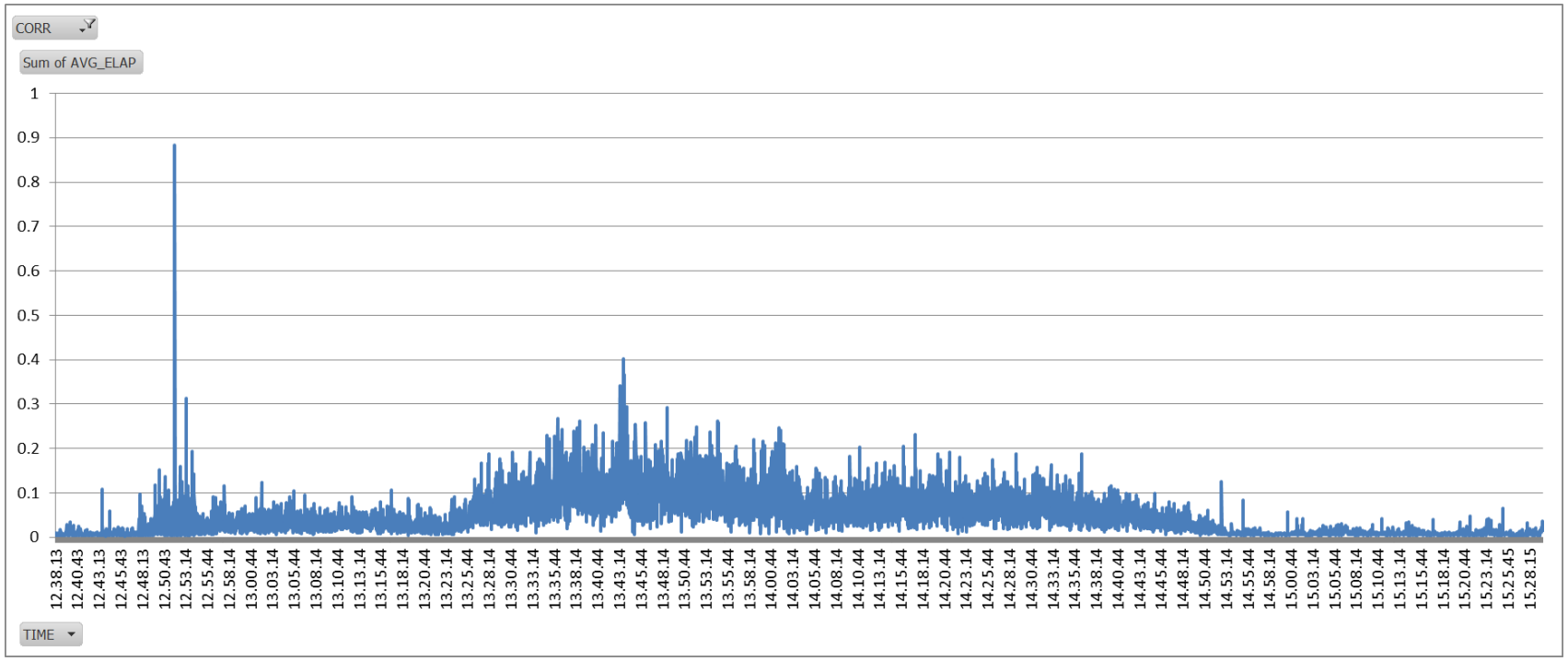


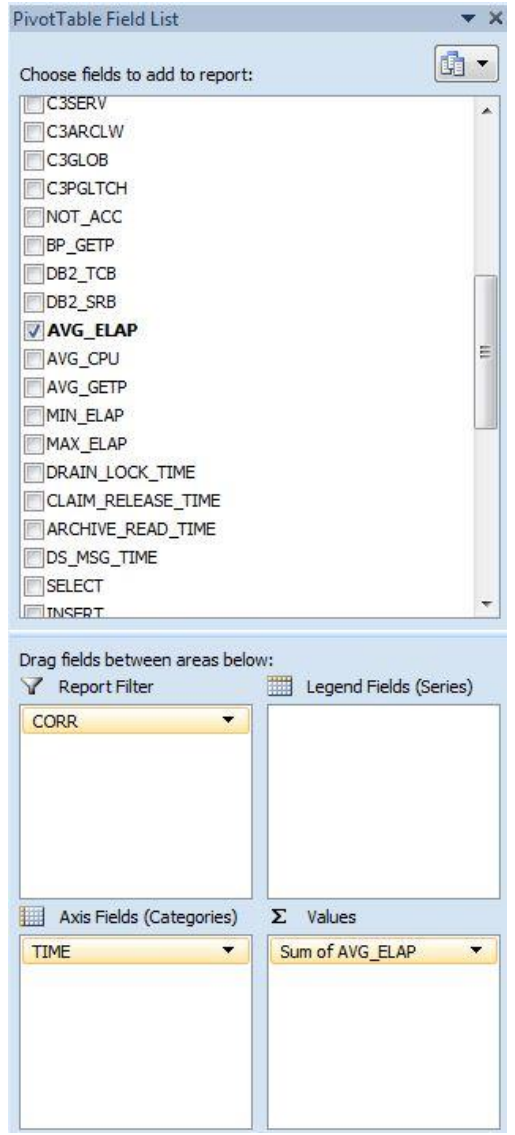




Now have In-Db2 time plotted against transaction throughput

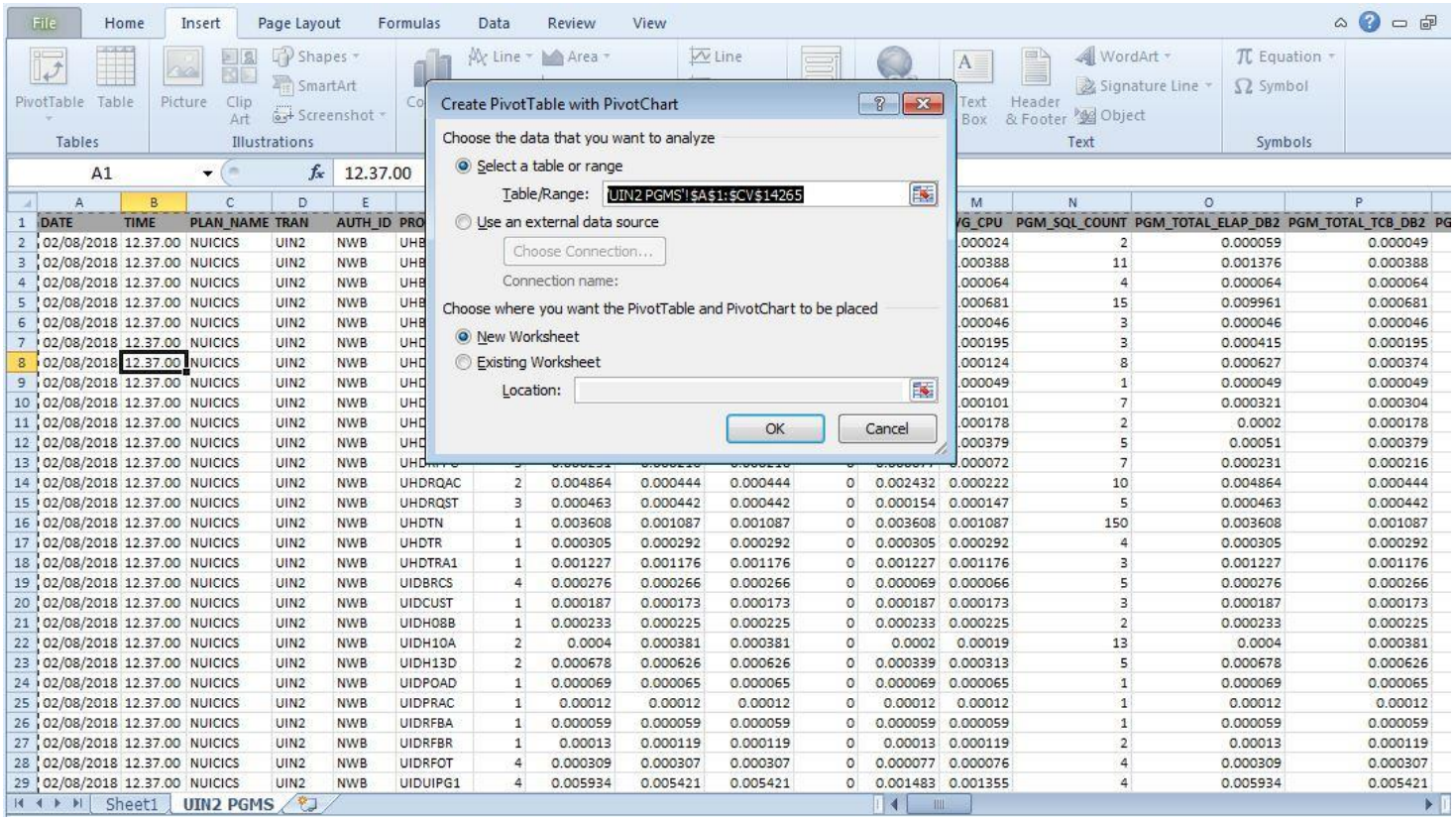
Using the Data

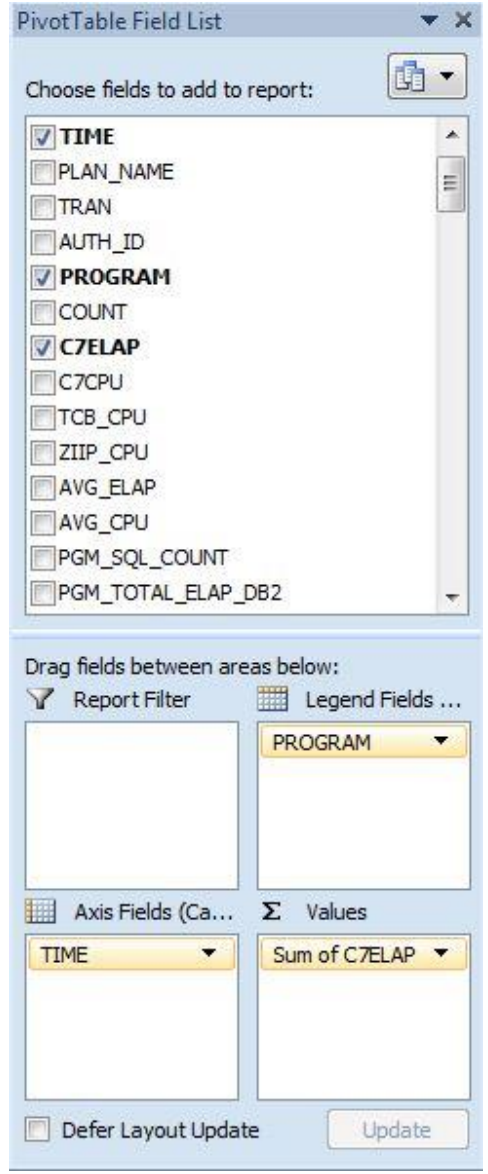




Perhaps you just want to see the average response times for the transaction…

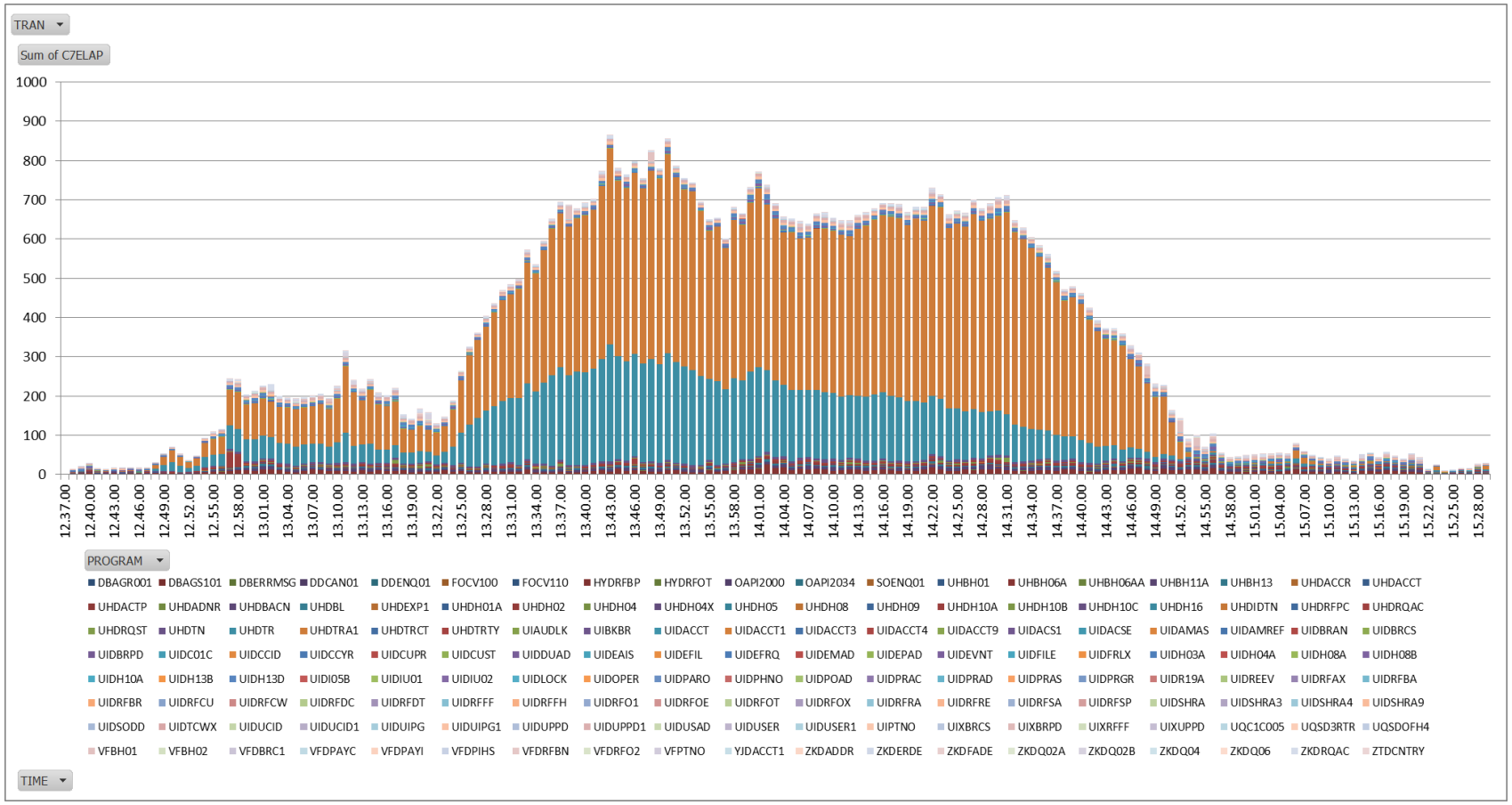
Using the Data

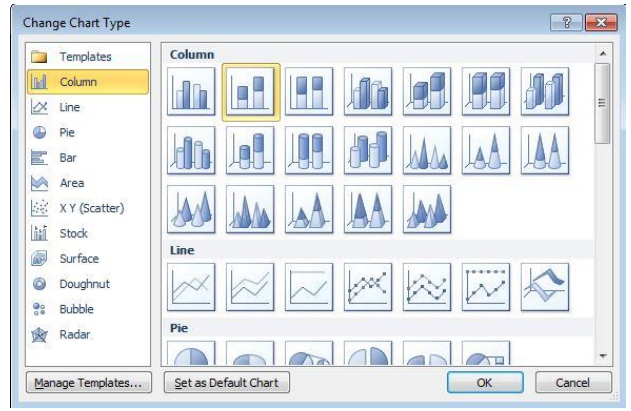




- Say you want to go deeper and look at the Class7 data – Package level
- Create Pivot table with Program now going into Legend Field and Class 7 Elapsed in Values

Using the Data

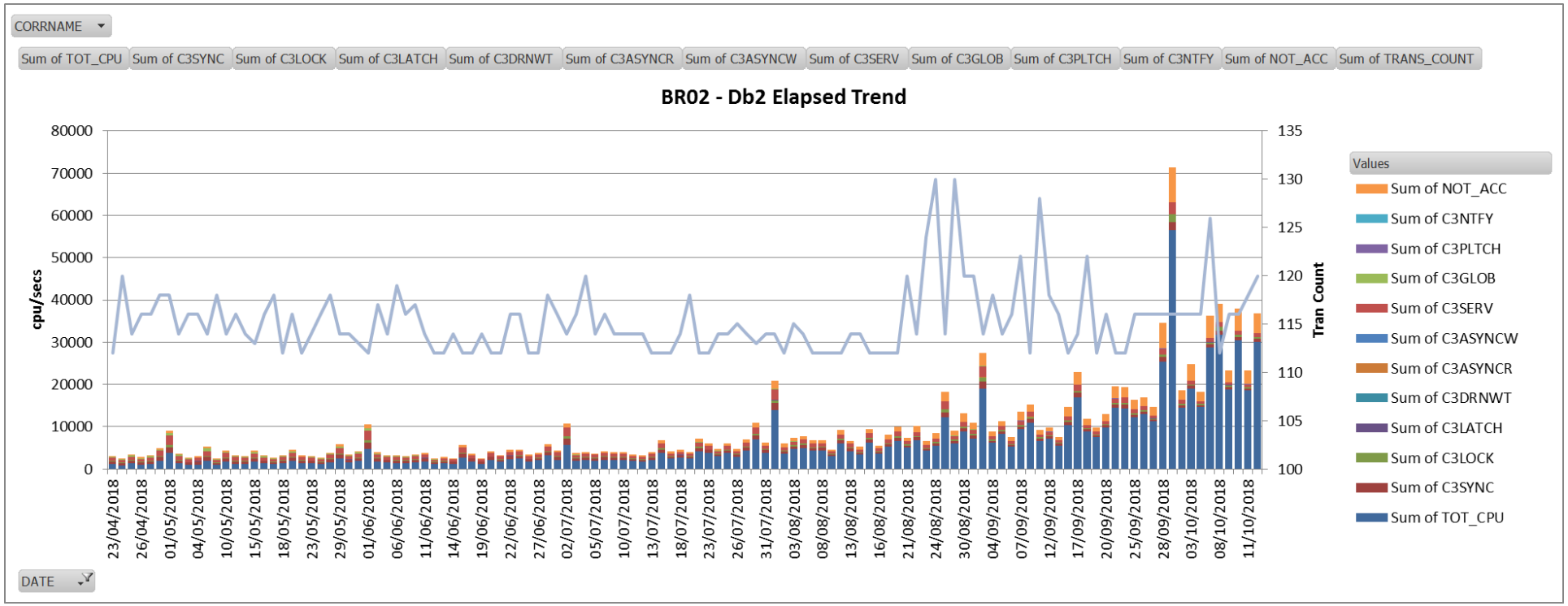




- Use Stacked Option on chart type
- Can use drop down boxes to focus on individual packages or txns

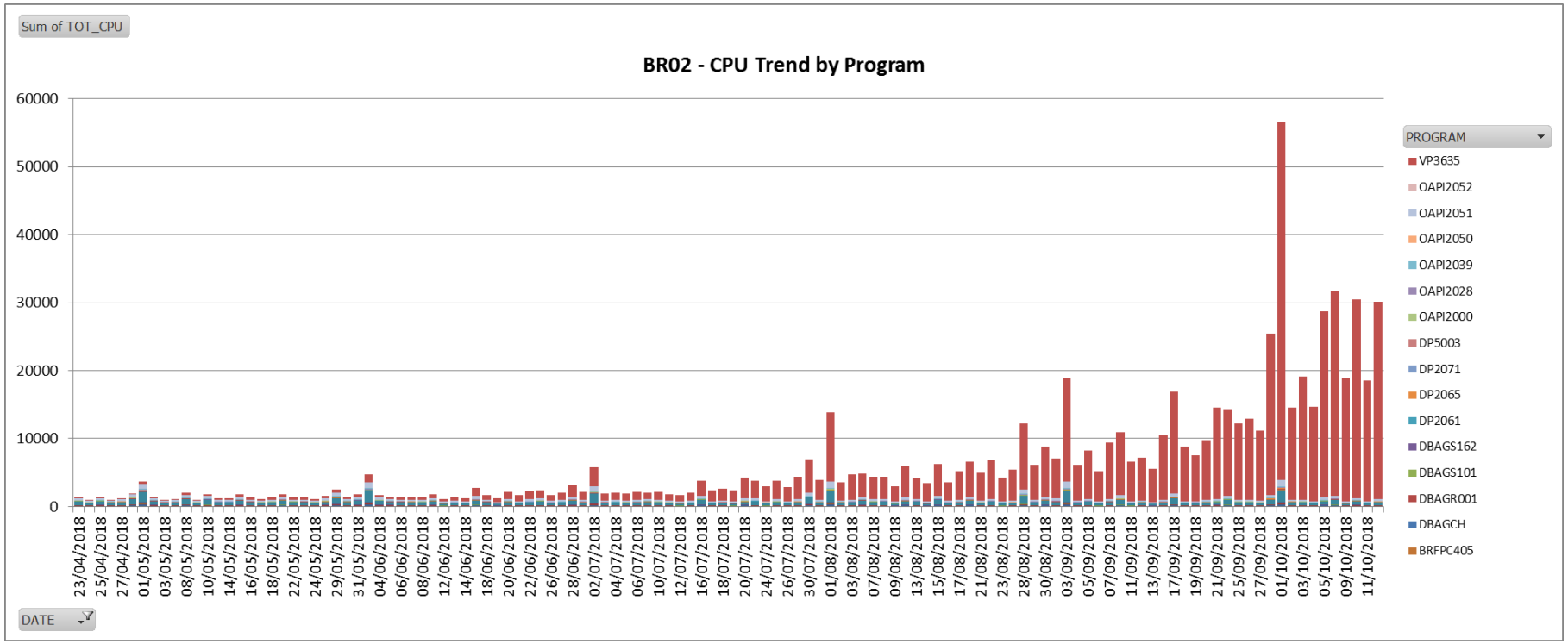
Using the Data

- Case Study 1 – Capacity team spot high CPU usage from CICS region running BR02 transaction
  - Plot accounting class 2,3 times going back to start of historical data
  - Very clear CPU burn started to rise sometime in July, but no increase in txn counts



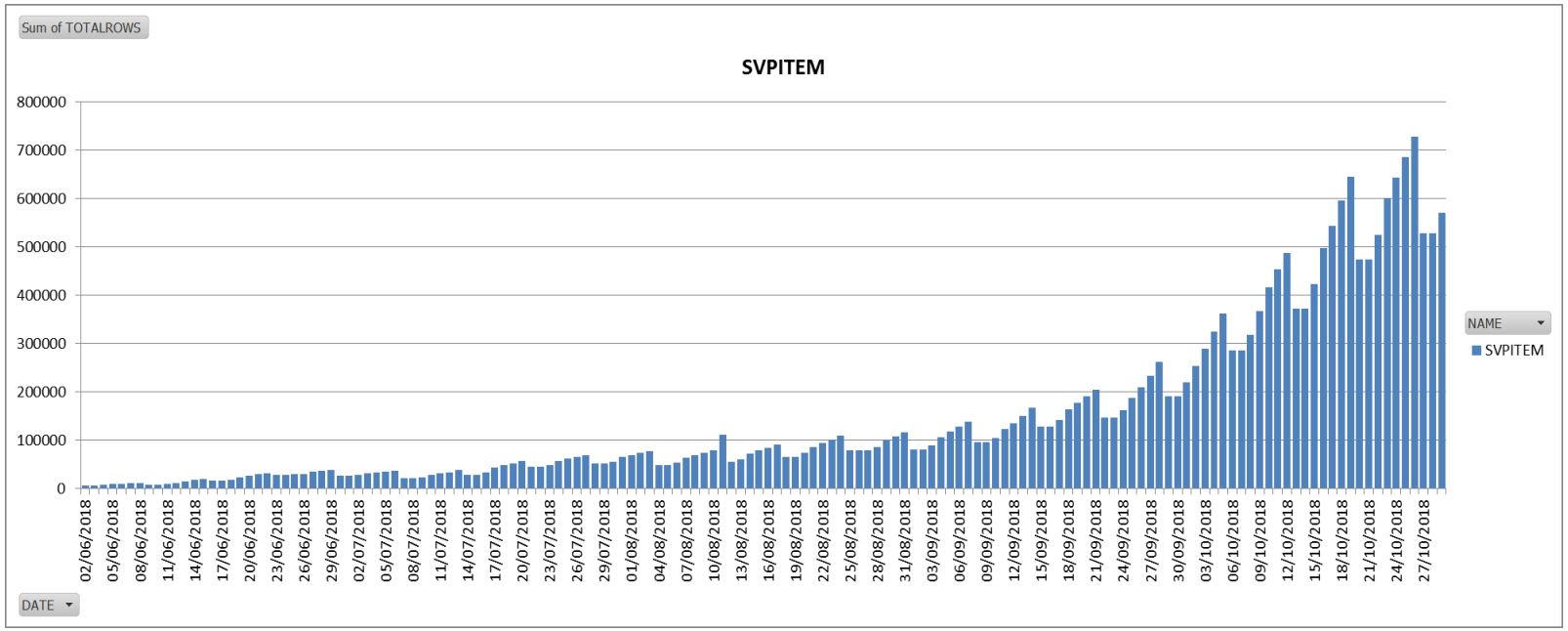
Using the Data

- Case Study 1 (Cont)
  - Plot accounting class 7 time by package going back to start of historical data
  - Very clear CPU burn started to rise sometime in July in package VP3635



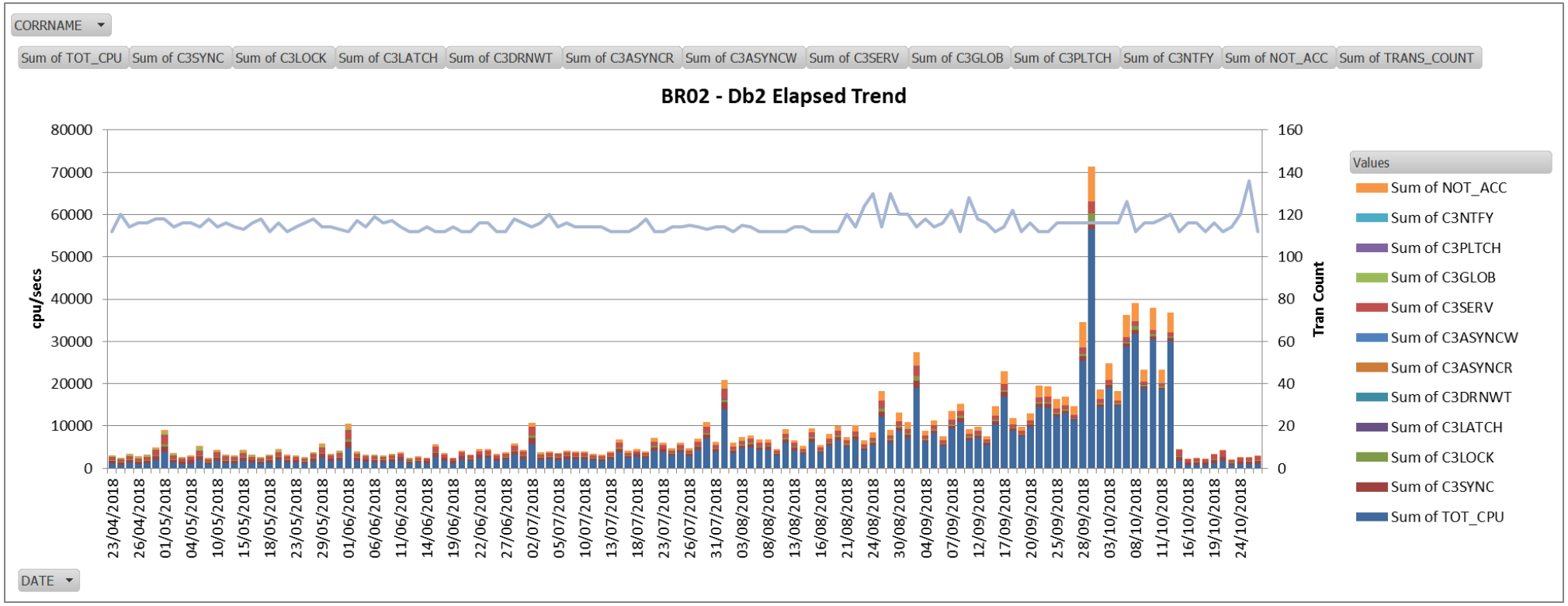
Using the Data

- Case Study 1 (Cont)
  - Package had not been rebound recently, so no access path changes
  - Then checking RTS showed that tables being accessed had corollary in table volume increases
  - Access path was inefficient, with a number of TS scans against these tables



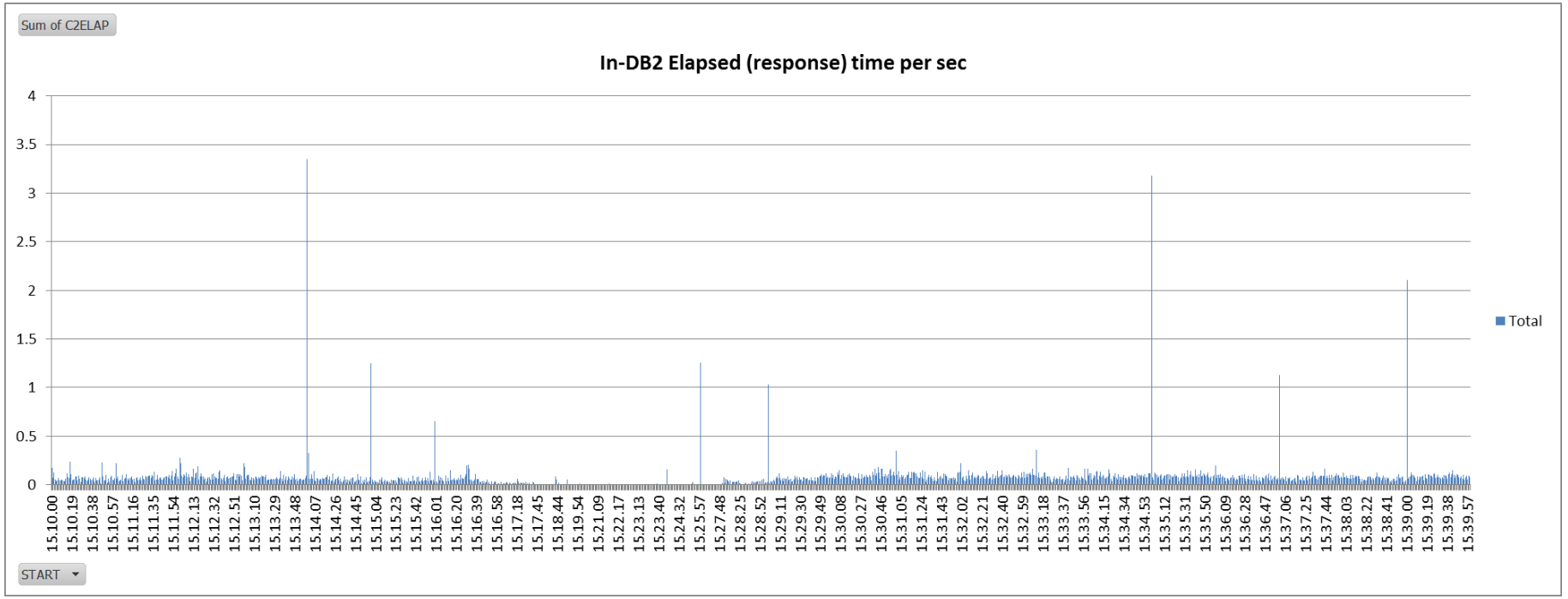
Using the Data

- Case Study 1 (Cont)
  - New Index added to fix access path problem



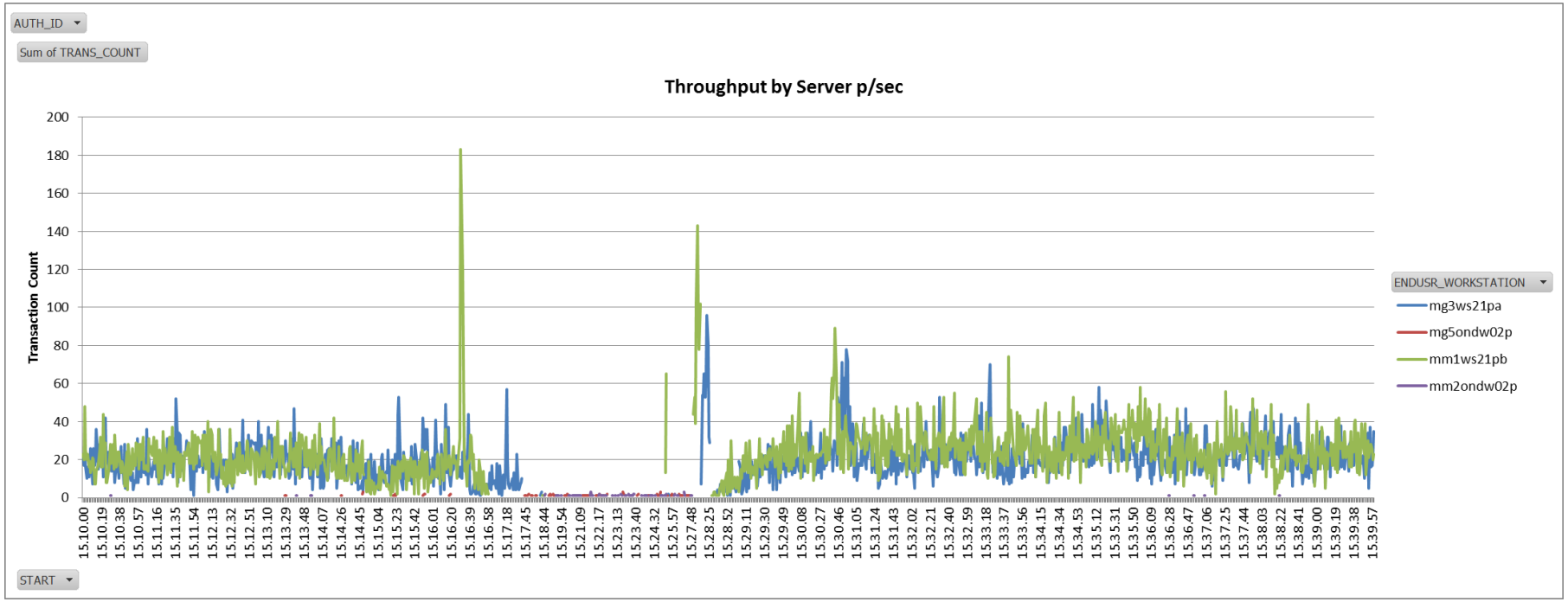
Using the Data

- Case Study 2
  - Issue with offhost Branch diary application, JVM thread pools filling up and monitoring tools point at long response times (60 sec+) from Db2 on mainframe
  - Initial look at response times in Db2 do not support this



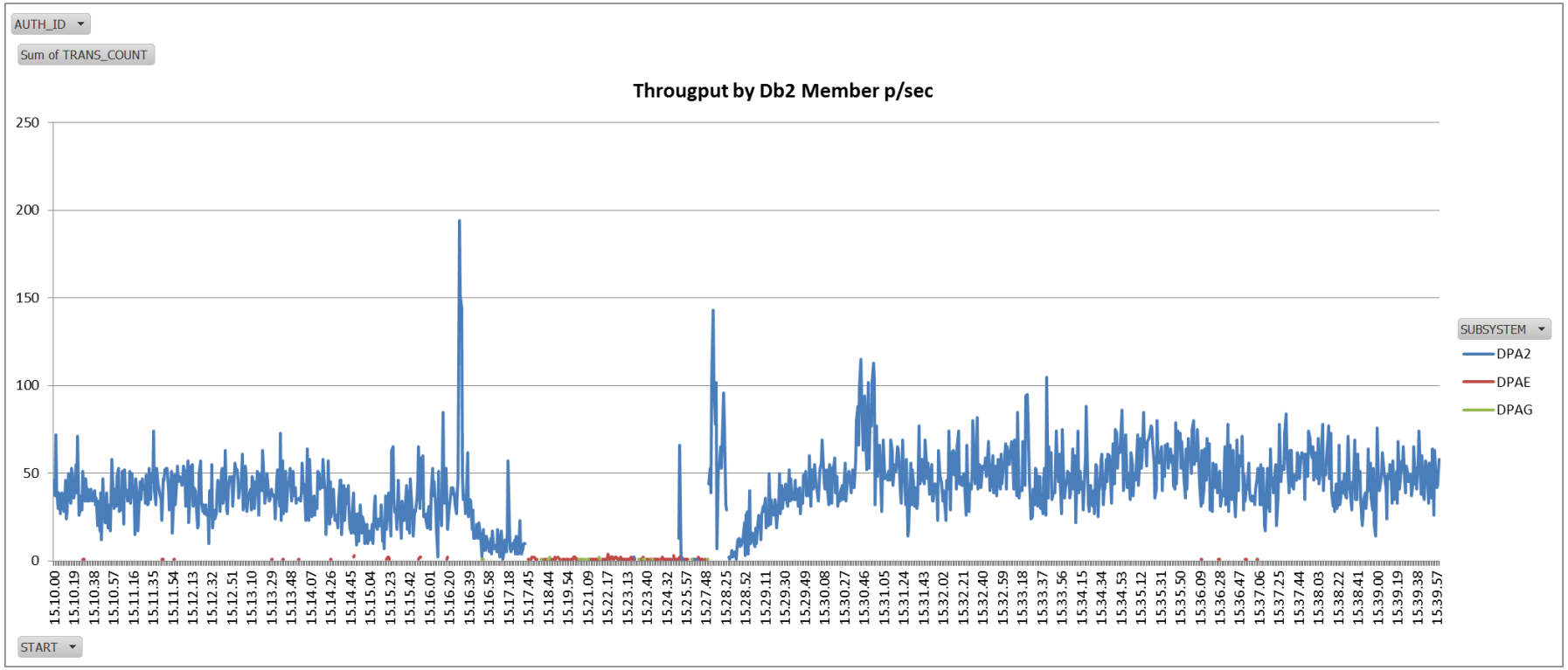
Using the Data

- Case Study 2 (Cont)
  - Time to check what is NOT there, as opposed to what is
  - Instead plotting distributed connection counts by server shows different picture
  - No issues with max DBATs, no error messages in logs, issue still appears to be outside DB2



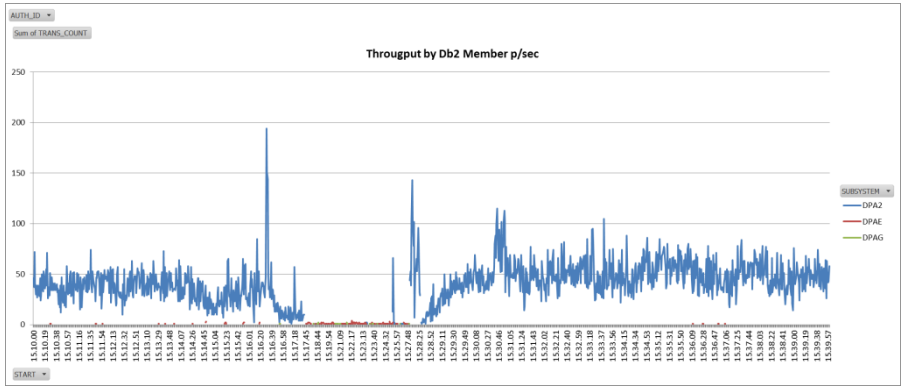
Using the Data

- Case Study 2 (Cont)
  - Time to look at data another way
  - Look at connections by Db2 member instead, which showed a pronounced skew towards DPA2 member, with only a few connections on the other two members



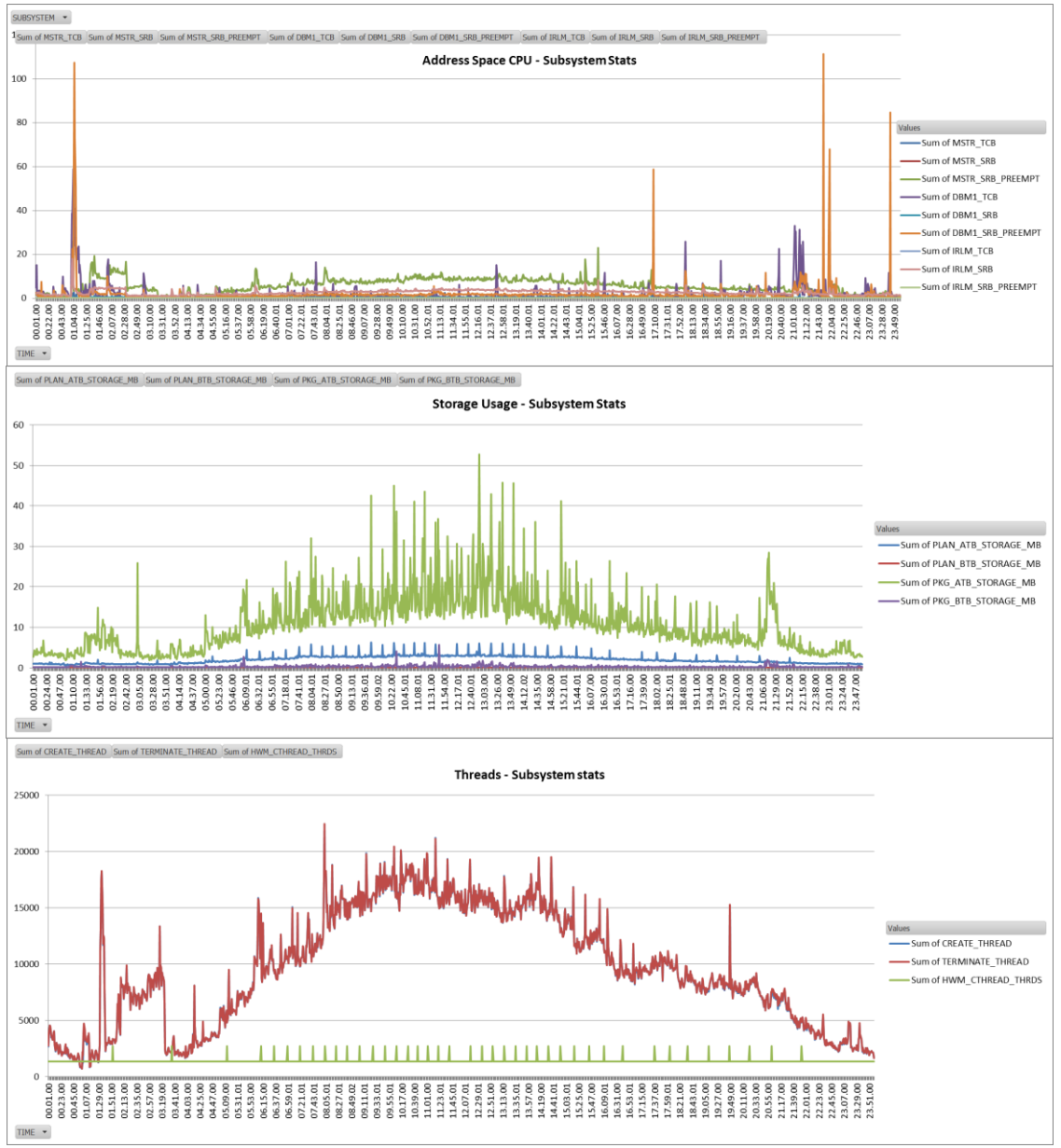
Using the Data

- Case Study 2 (Cont)
  - Sysplex Distributer issue?
  - Firewall?
    - On checking it was discovered that the IP addresses of DPAE and DPAG were not in the firewall rules
    - Application connection via group DVIPA and was directed to DPAE/DPAG on first connection they were successful
    - Subsequent connections direct to the member DVIPA's did not
    - Firewall rule change resolved issue, but resolution would have taken considerably longer had data patterns not pointed that direction



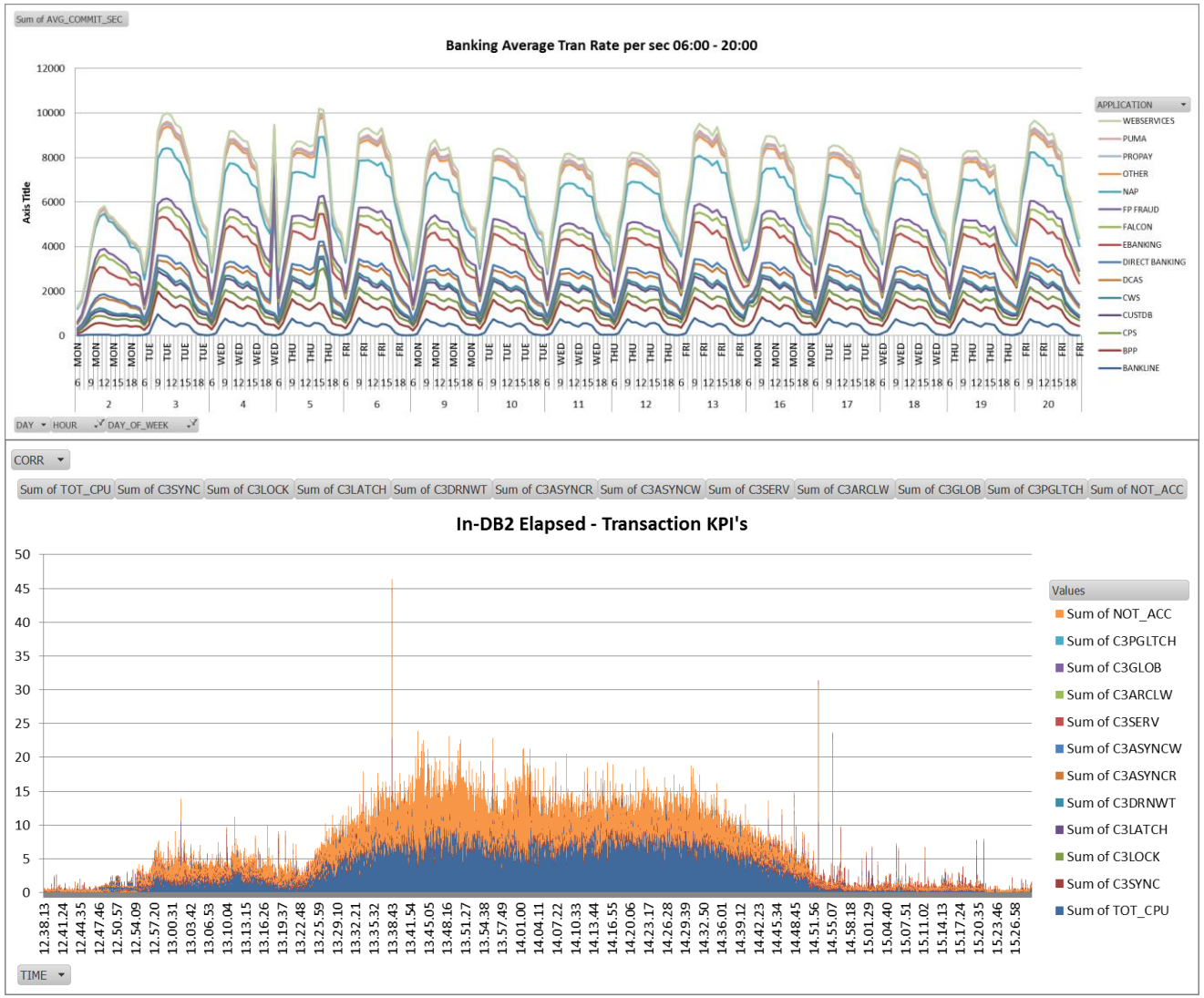
Using the Data

- KPI Examples
  - Subsystem
    - Subsystem Address Space CPU
      - DBM1
      - IRLM
      - MSTR
    - Storage Usage
      - Active/Queued threads
      - Plan/Package above & below bar
      - Dataset open/close activity



Using the Data

- KPI Examples
  - Transaction
    - Throughput rates
    - CL2 Elapsed Total
    - CL2 CPU
    - CL3 Suspensions



The End Game

- Currently reactive
  - Reports produced some time after the fact
- Real time and eventually predictive is the goal!
  - Real time SMF streaming
    - Splunk
      - CDP - Common Data Provider (IBM)
      - Ironstream (Syncsort)
- Machine Learning on Z (MLz)
  - Applying machine learning and data science techniques to SMF data
  - Provide real-time operational insight
  - Near time predictive KPI trends

We want your feedback!

- Please submit your feedback online at ….
  - http://conferences.gse.org.uk/2018/feedback/IG

- Paper feedback forms are also available from the Chair person

- This session is IG