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Analysis of Audit timeouts

1 Background

This paper contains the working notes from examination of the timeout events extracted from the Horizon system between December 07 and June 08.

The Riposte message journal is used as one of the sources of diagnostic information concerning activities that take place at the branch.

Whilst in general, applications writing to the Riposte message journal will normally be able to write a record, there are potential cases where a write can fail. It is up to the application software to handle the error and report this to the user.[1]

A recent question has been raised as to whether there may be any circumstances where records might have been lost before being written to the journal.

Riposte has a timeout of 10 seconds on how long it will queue a write request before returning a failure response to the calling application. Examples circumstances where a failure could occur are as follows: An application may chose to take a lock out and write a number of records within a single commit unit; The system may be busy performing other I/O functions and the write cannot be completed within the timeout period.

In cases where a failure occurs, Riposte writes a "Timeout" event to the NT event log. In some cases, the calling application also writes its own "Timeout" event. These events are forwarded via Tivoli to the central Horizon systems management system.

Events are only forwarded by Tivoli to the audit system where they are categorised as "Error". Local filtering can also take place where an event has been categorised as "harmless" to prevent large volumes swamping the central systems.

An extract of the timeout events for a 6 month period has been provided for analysis, and is the subject of the rest of this paper

[1] A separate analysis of the counter application behaviour is being undertaken and is covered by a separate paper.

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2 Event texts and volumes

The events recorded cover the period 31st December 2007 and 30th June 2008. 31st.

These events are filtered to those which include the string "timeout" in the message description. *[There may also be some further filtering – check with Alan Holmes.]*

There were a total of 27993 events recorded, split as shown below

Source	Text	Total
C_HV_POACK	<TMSPOAcknowledge>Error Message: 'RiposteCreateMsgEx' for 'LocalTrigger' fails. Timeout occurred waiting for lock. (0xC1090003) Trigger message could not be processed. Data for msg=<Application:BDC><Data:<TranType:LocalTrigger><GroupId:111111111>><MsgVer	142
C_HV_POSCH	<TMSPOCallSched>Error Message: RiposteCreateMessageEx failed in ReportOfflineMemo Trying to report counter offline memo - Timeout occurred waiting for lock. (0xC1090003)	4
Riposte	A cluster allocation operation failed. Timeout occurred waiting for lock. (0xC1090003).	1
Riposte	An error occurred while attempting to commit a message run. Timeout occurred waiting for lock. (0xC1090003)	249
Riposte	An unexpected error occurred while attempting to insert a message. Timeout occurred waiting for lock. (0xC1090003).	19
Riposte	An unexpected error occurred while attempting to modify an entry in the run map. Timeout occurred waiting for lock. (0xC1090003)	19537
KMRX	KMRX: Riposte Error 3238592515. Timeout occurred waiting for lock. (0xC1090003) RiposteCheckpointMessagePort	8032
KMRX	KMRX: Riposte Error 3238592515. Timeout occurred waiting for lock. (0xC1090003) RiposteGetMessage	2
VBRuntime	The VB Application identified by the event source logged this Application Desktop: Thread ID: 360 ,Logged: Logging user JWI001 off from Riposte failed: Timeout occurred waiting for lock. (0xC1090003) UserLogoff failed. (C1090003)	1
Riposte	Timeout occurred waiting for lock.	6
	Grand Total	**27993**

In the cases where an application rather other Riposte logs the error, there is in general an associated Riposte error event. (There are a two of cases for KMRX, where there is no associated Riposte event – these are the 2 "RiposteGetMessage" events above and relate to reading rather than writing, and hence no Riposte error has been logged for these.)

The KMRX, C_HV_POACK and C_HVPOSCH applications are background applications which monitor the messages received in the counter and generate responses to be returned to the central system. KMRX also uses Riposte to hold checkpoints of message runs. These applications handle the errors and recover from the failure, hence these can be removed from the analysis.

By removing these background applications and the associated Riposte events , these reduce to a total of 11633 events recorded, split as shown below

Riposte Only Events

Source	Text	Total
Riposte	A cluster allocation operation failed. Timeout occurred waiting for lock. (0xC1090003).	1
Riposte	An error occurred while attempting to commit a message run. Timeout occurred waiting for lock. (0xC1090003)	249
Riposte	An unexpected error occurred while attempting to insert a message. Timeout occurred waiting for lock. (0xC1090003).	19
Riposte	An unexpected error occurred while attempting to modify an entry in the run map. Timeout occurred waiting for lock. (0xC1090003)	11358
Riposte	Timeout occurred waiting for lock.	6
	Grand Total	11633

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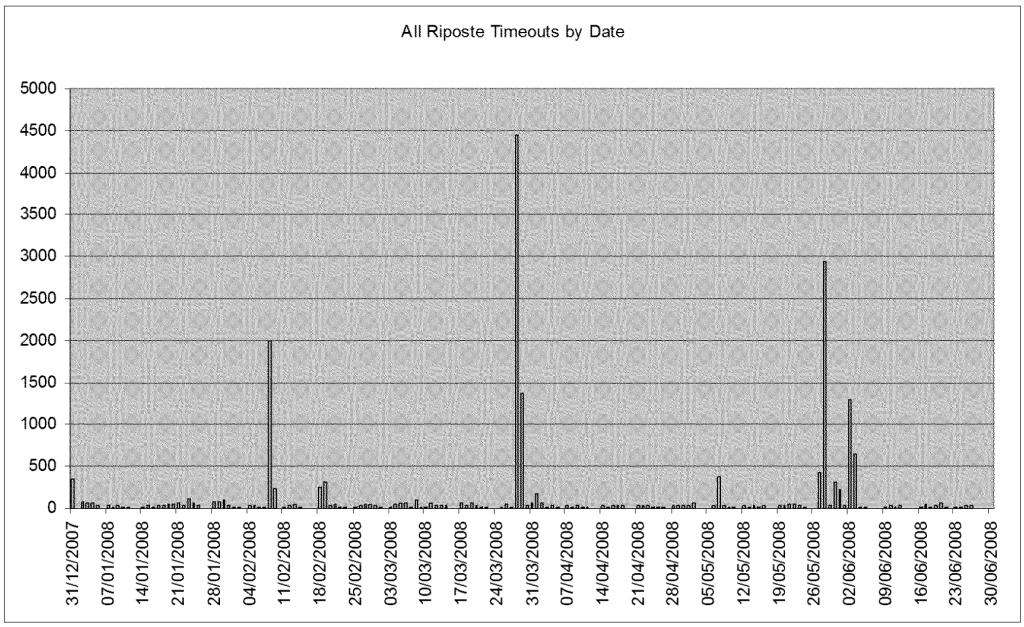
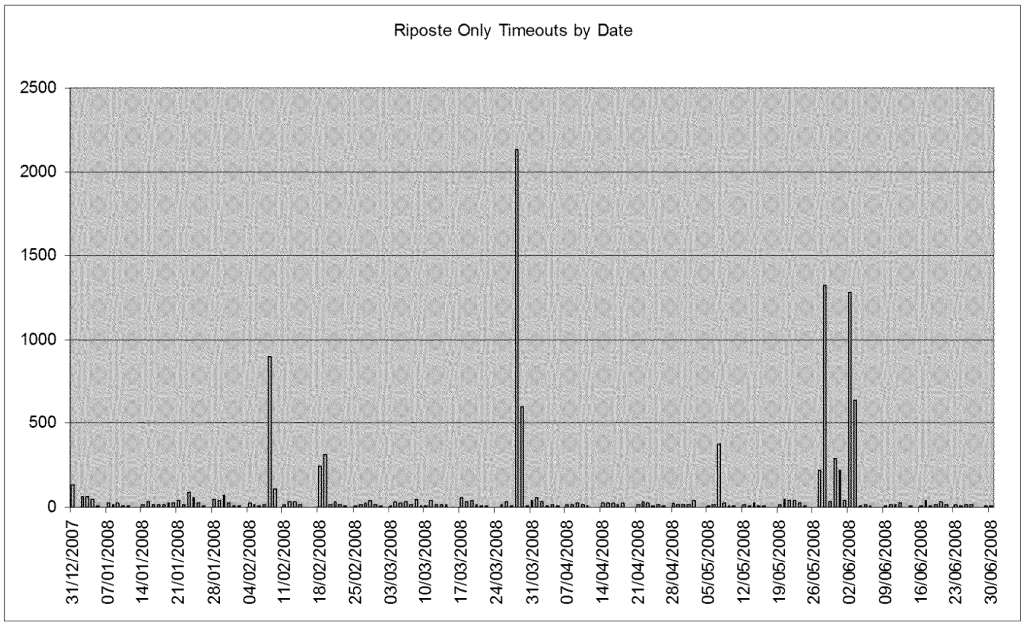
3 Spread of events over the 6 month period

The spread of events across the 6 month period for All Riposte Timeout events is shown below:



By eliminating the Riposte events where there an associated application timeout event, we restrict these events to the cases where there is a Riposte Only Timeout event as shown below:



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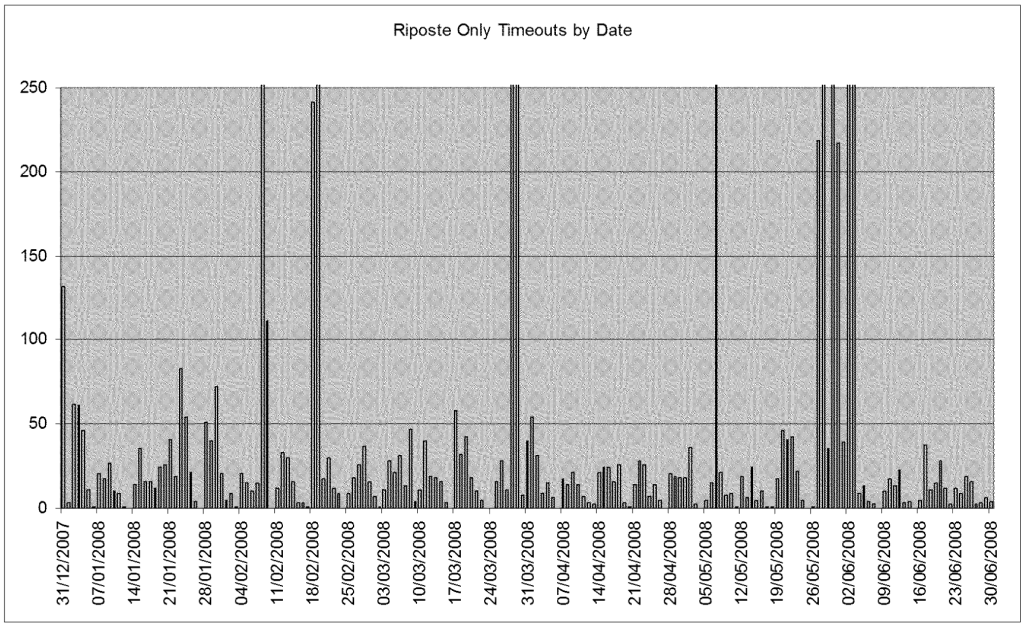
Reducing the scale to show normal activity and ignore the peaks shows:



It can be seen that there are several days where there are significant peaks in the events raised. Specifically there were > 200 events raised on each of the following 12 days:

Date	Number of Events
08/02/2008	894
18/02/2008	241
19/02/2008	312
28/03/2008	2128
29/03/2008	601
07/05/2008	375
27/05/2008	219
28/05/2008	1324
30/05/2008	294
31/05/2008	217
02/06/2008	1280
03/06/2008	636
Total	**8521**

This represents 73% of the Riposte Only Timeout events.

It was conjectured that the peaks may be related to Software Distribution. The attached response from Release Management covers what was released to the counters in this period.

8/Feb/2008

T80_MULTI 41_1 (distributed and committed estate wide 29/01/08)
APS_COUNTER 41_3 (unsure of distribution date but committed estate wide 05/02/08)

29-30/Mar/2008

COUNTER_EPOSS 41_4 (distributed 14/03/08 and committed estate wide 18/03/08)

28/May/2008

APS_COUNTER 42_2 (distributed and committed estate wide 20/05/08)
UK_MAILS 42_2 (distributed 28/05/08, committed 29/05/08, however this was actually regressed in the end from 992 Counters)

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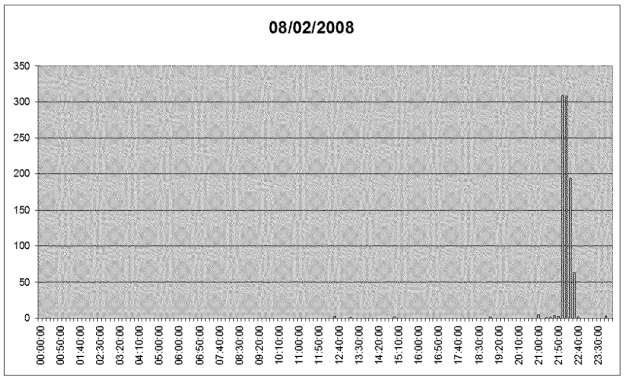
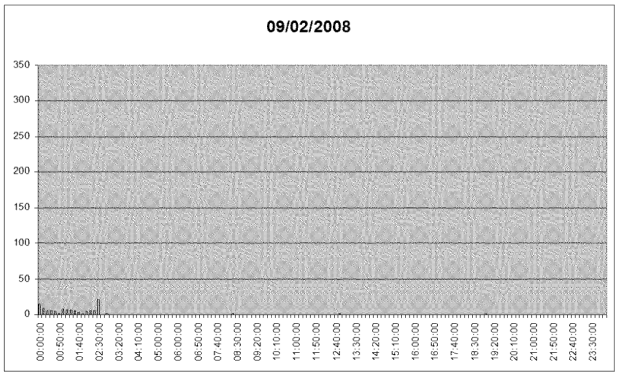
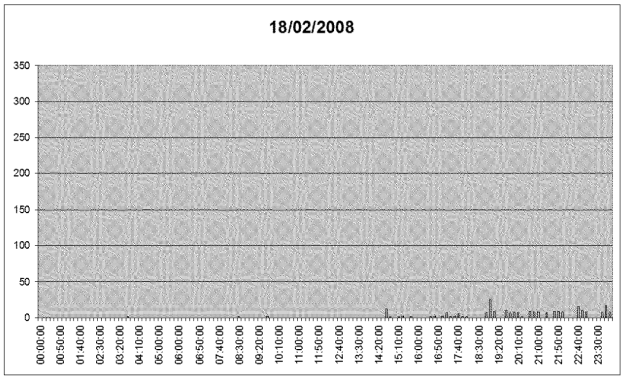
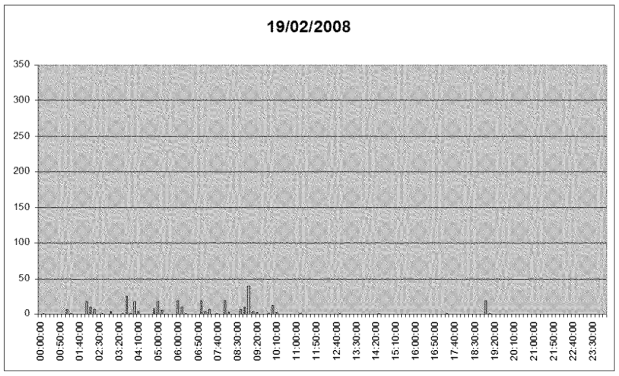
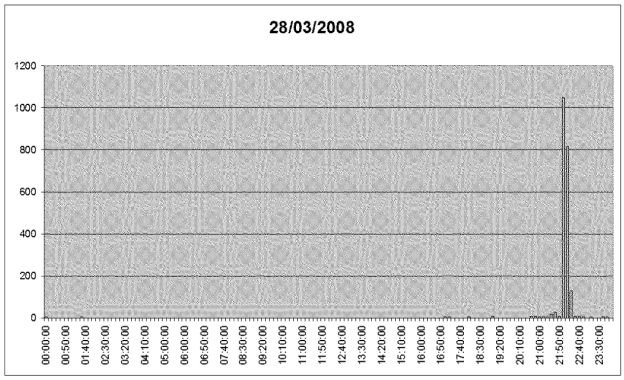
Initial indications are that the above dates are related, but are not a precise match. The times of the events on these dates (plus some adjacent dates) is shown below. Note that scales are different for the 28th – 29th graphs, all other graphs have the same scale.

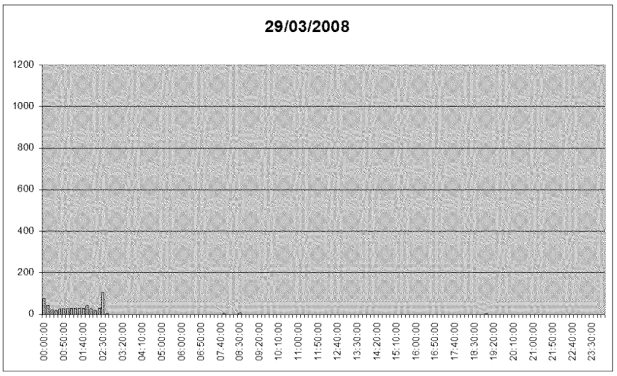


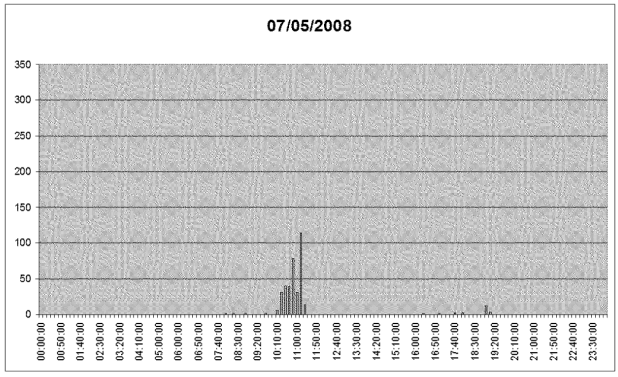


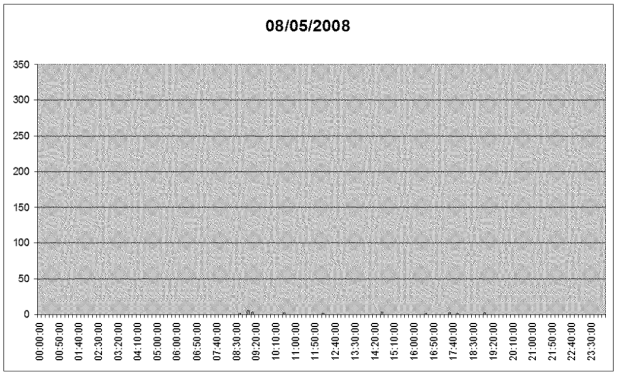












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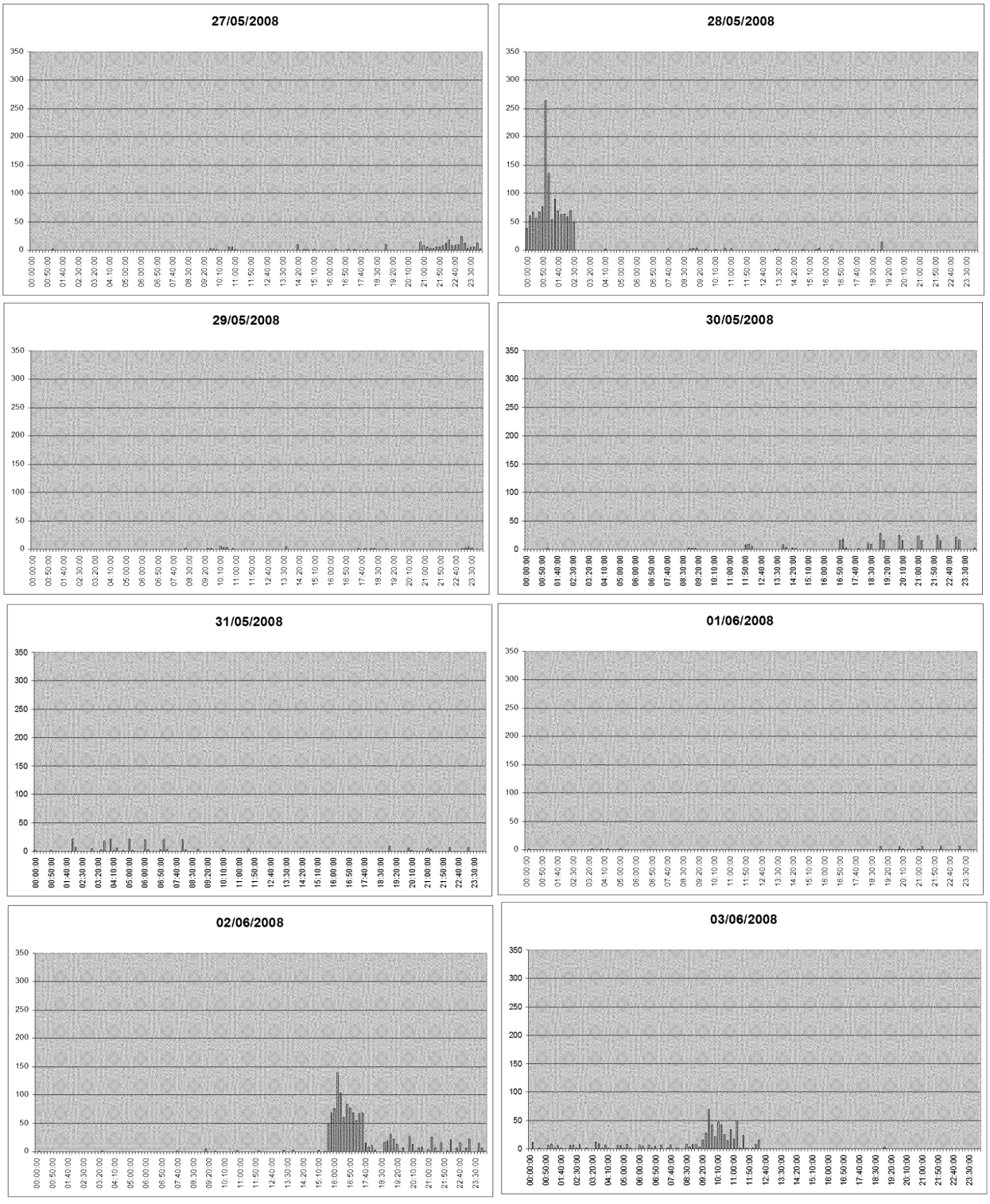
The period from 27th May to 3rd June is shown in full below:



[Further analysis needed to identify the reason for these higher volumes of events on these specific dates.]

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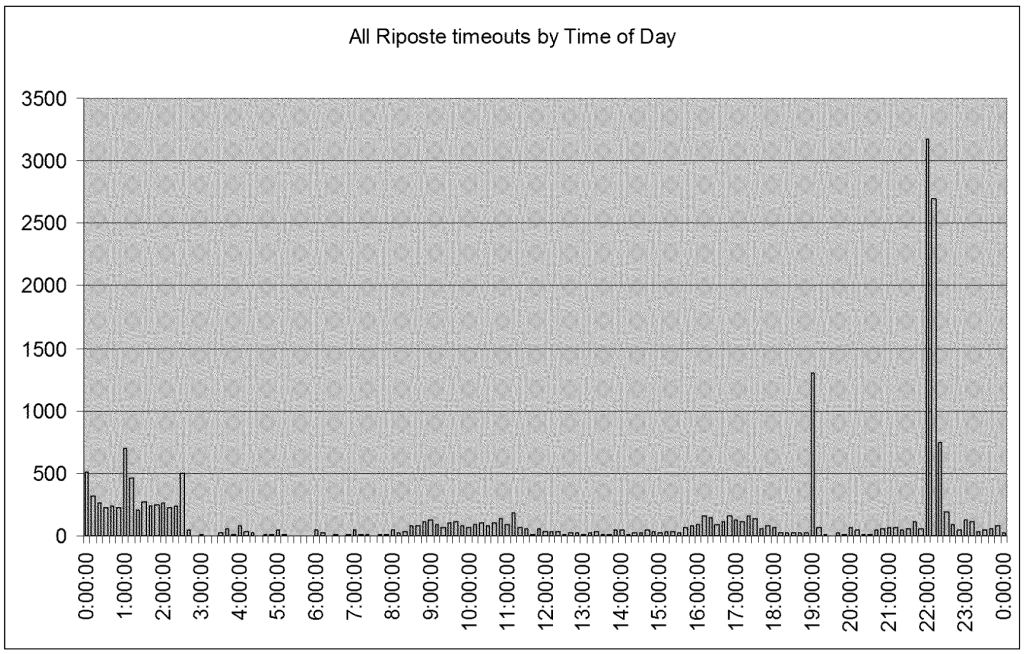
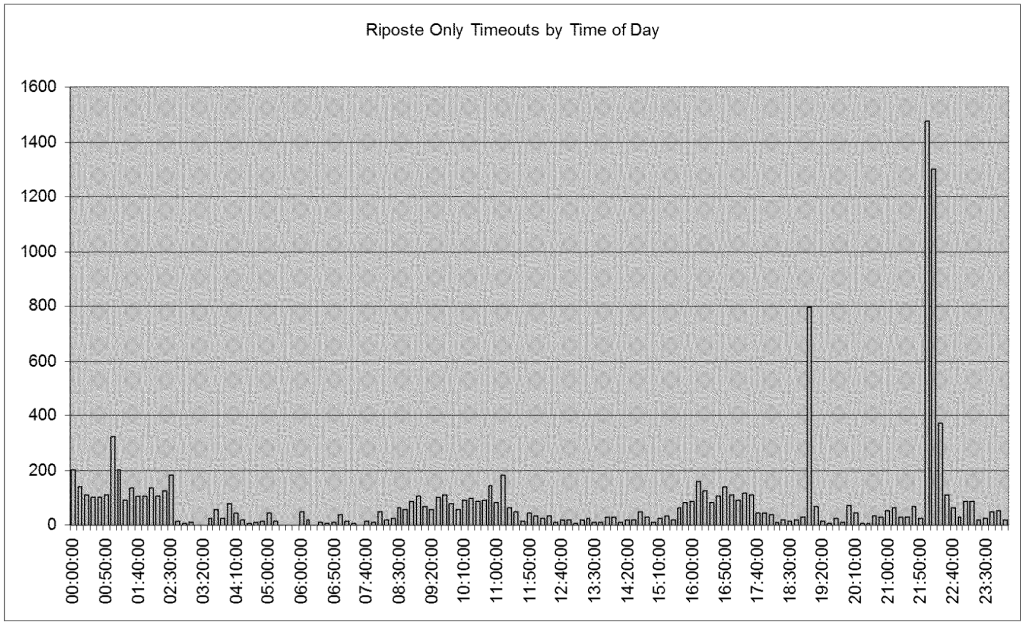
4 Spread of events by time of day

The spread of events by time of day across the 6 month period for All Riposte Timeout events is shown below:



By eliminating the Riposte events where there an associated application timeout event, we restrict these events to the cases where there is a Riposte Only Timeout event is shown below:



Reducing the scale to show normal activity and ignore the peaks shows:

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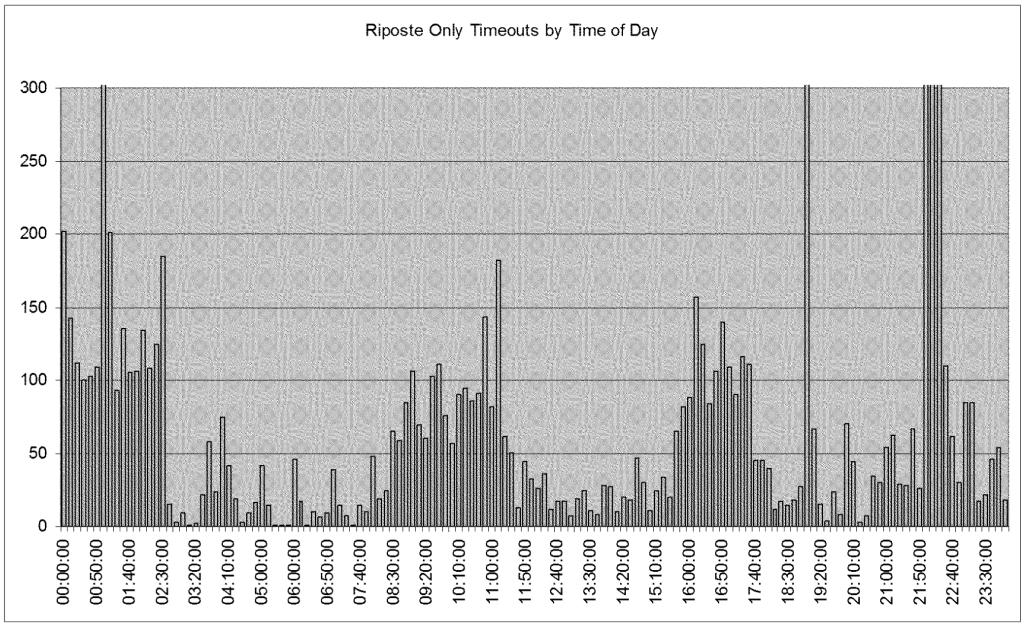
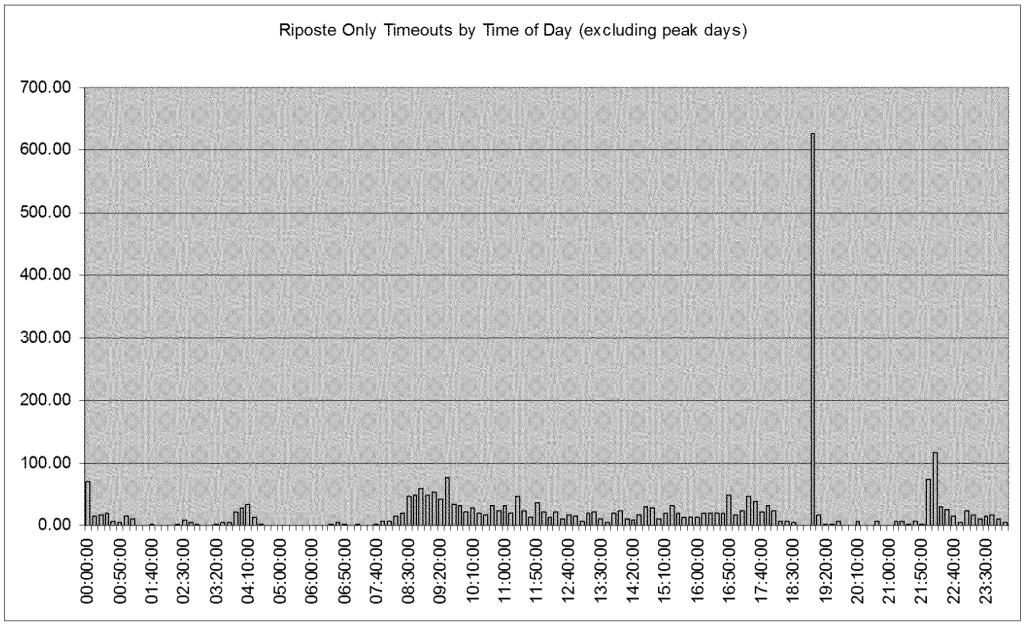


By eliminating the events for the peak days, we see the normal spread of events by time of day as follows:



[This shows that the End of Day peak is significant and generates a significant proportion of the normal daily Riposte Only events once the Peak days have been excluded.]

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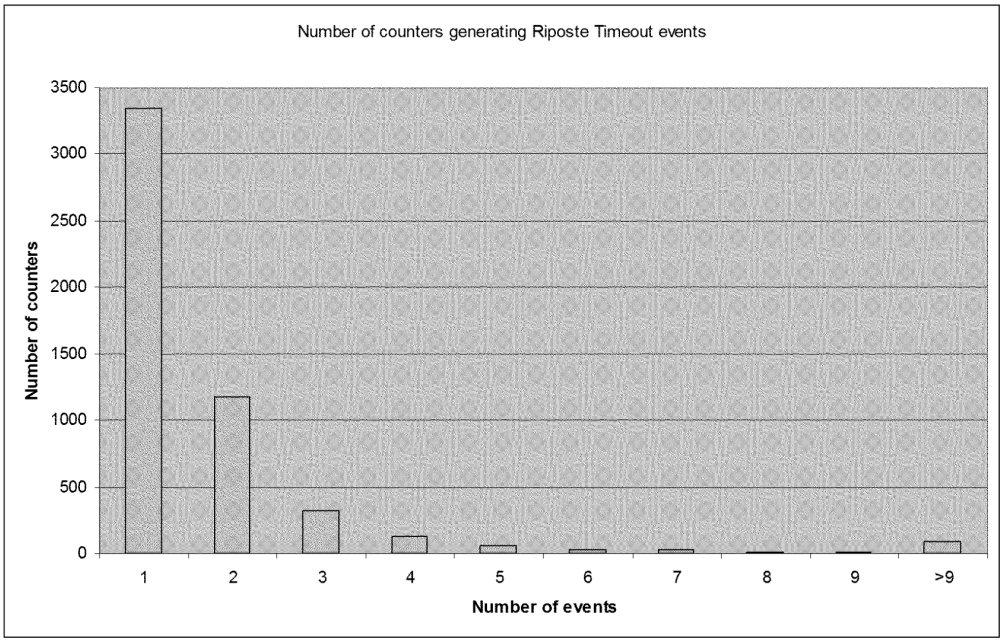
5 Analysis by counter

The Riposte only timeout events for this 6 month period were generated on 5179 separate counters. That means that over 5/6th of the counters had no events in this period.

For each counter the following graph shows the numbers that had 1 or more events.



Viewed another way,

Number of events	Number of counters	Total events	Percentage of events
1 event	3346	3346	29
2 events	1174	2348	20
3 events	316	948	8
4 events	122	488	4
5+ events	221	4503	39
Total	5179	11633	100

Hence approximately 40% of the events were generated from 221 counters, and over 50% of the events were generated from 659 counters (221+122+316).

There were 19 counters (in separate branches) which experienced 40 or more events in this period. The events recorded by these counters accounted for over 20% of the events raised.

Counter hostname	Number of events	Percentage of events
h17402600101	492	4.23
h40020700101	349	3.00
h16530900103	220	1.89
h15082400103	167	1.44
h05500300102	161	1.38
h59161400102	134	1.15
h40032900104	111	0.95
h10593700103	105	0.90
h25252300102	80	0.69
h34551100101	67	0.58
h14092500101	61	0.52
h25442400103	59	0.51

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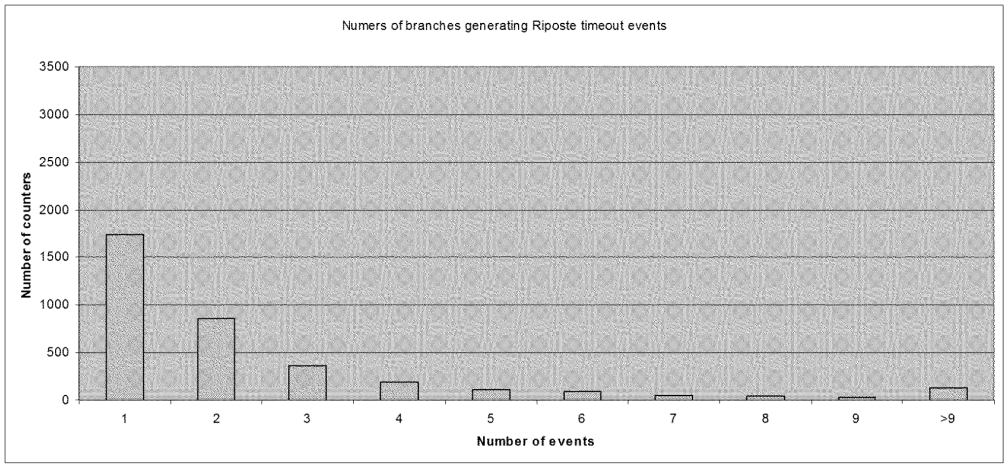
h03042000103	53	0.46
h10002500101	53	0.46
h23521700103	52	0.45
h30661100101	51	0.44
h39432900102	50	0.43
h27320800109	43	0.37
h09002600102	40	0.34
Number of counters	**19**	
Total Events	**2348**	
Percentage events	**20**	

The final 2 characters of the hostname are the counter position, and this shows that these are spread across different counter positions (e.g. not all gateway PCs).

6 Analysis by Branch

The Riposte only timeout events for this 6 month period were generated on 3583 separate branches. That means that approx 75% of the branches had no events in this period.

For each branch the following graph shows the numbers that had 1 or more events.



Viewed another way,

Number of events	Number of branches	Total events	Percentage of events
1 event	1738	1738	15
2 events	860	1720	15
3 events	362	1086	9
4 events	190	760	7
5+ events	433	6329	54
Total	3583	11633	100

Hence over 50% of the events were generated from 433branches.

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There were 20 branches which experienced 40 or more events in this period. The events recorded by these branches accounted for over 22% of the events raised.

Branch	Number of events	Percentage of events
h174026	494	4.58
h400207	349	3.23
h165309	220	2.04
h055003	203	1.88
h150824	167	1.55
h591614	134	1.24
h400329	111	1.03
h105937	105	0.97
h252523	81	0.75
h345511	67	0.62
h140925	61	0.57
h235217	61	0.57
h030420	60	0.56
h254424	59	0.55
h100025	54	0.50
h306611	51	0.47
h394329	51	0.47
h273208	45	0.42
h090026	42	0.39
h126137	40	0.37
Number of branches	**20**	
Total Events	**2455**	
Percentage events	**23**	

It can be seen that the top 3 branches accounted for 10% of the events raised in this period

There is some correlation between the Branch top 20 list and the counter top 20 list, but there are a few differences.

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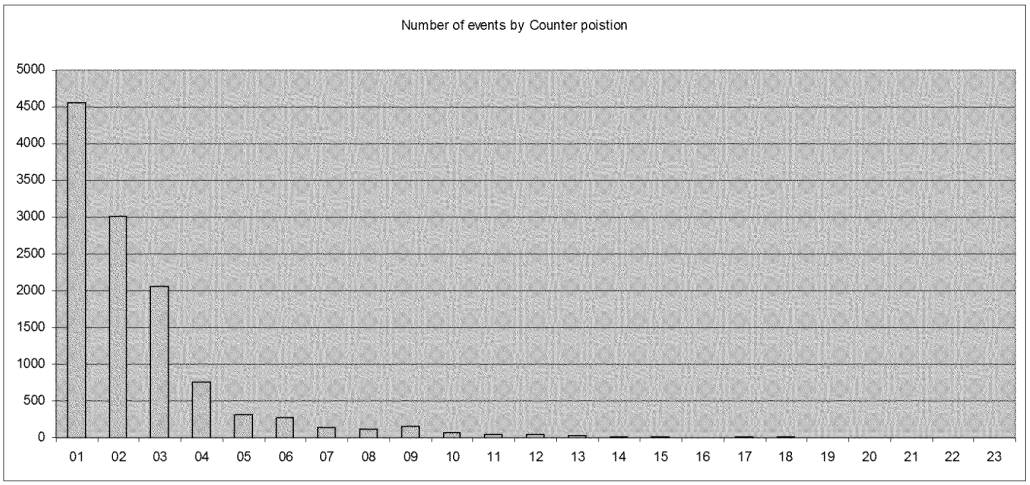
7 Analysis by Counter position

The spread by counter position is shown in the following graph.



The data and percentages for this are as follows:

Counter position	Number of events	Percentage of events
01	4550	39.11
02	3008	25.86
03	2055	17.67
04	754	6.48
05	318	2.73
06	270	2.32
07	149	1.28
08	114	0.98
09	153	1.32
10	78	0.67
11	44	0.38
12	37	0.32
13	22	0.19
14	13	0.11
15	9	0.08
16	3	0.03
17	18	0.15
18	21	0.18
19	7	0.06
20	5	0.04
21	2	0.02
22	2	0.02
23	1	0.01
Total	**11633**	**100.00**

The distribution is not far off the distribution of the number of counters within the live estate, and no specific conclusions can be reached from this aspect.

8 Events during the day

Reducing the analysis to events raised between 08:00 and 20:00, shows that in total, there were 4768 events. This is the period when users are most likely to be logged on.

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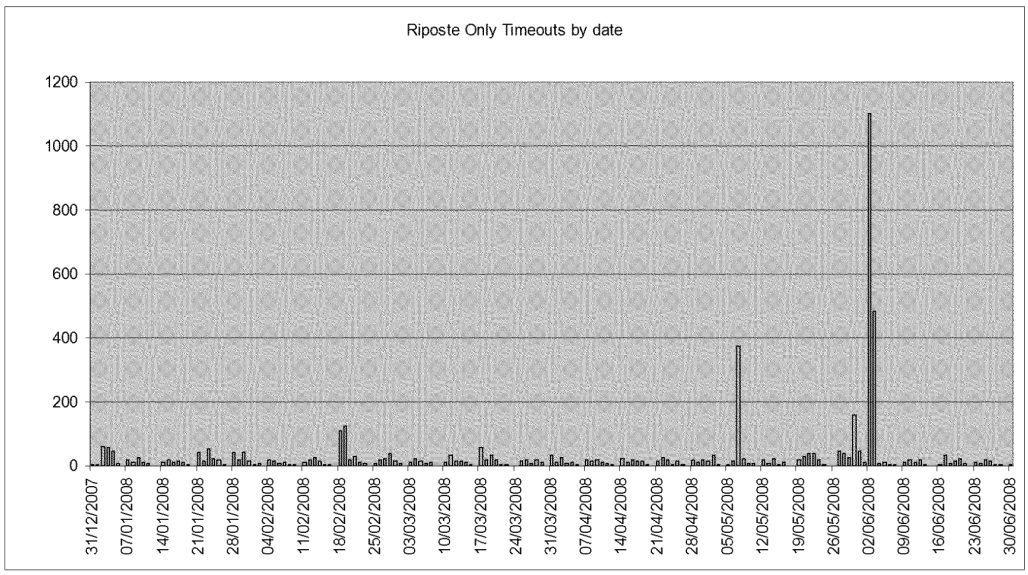
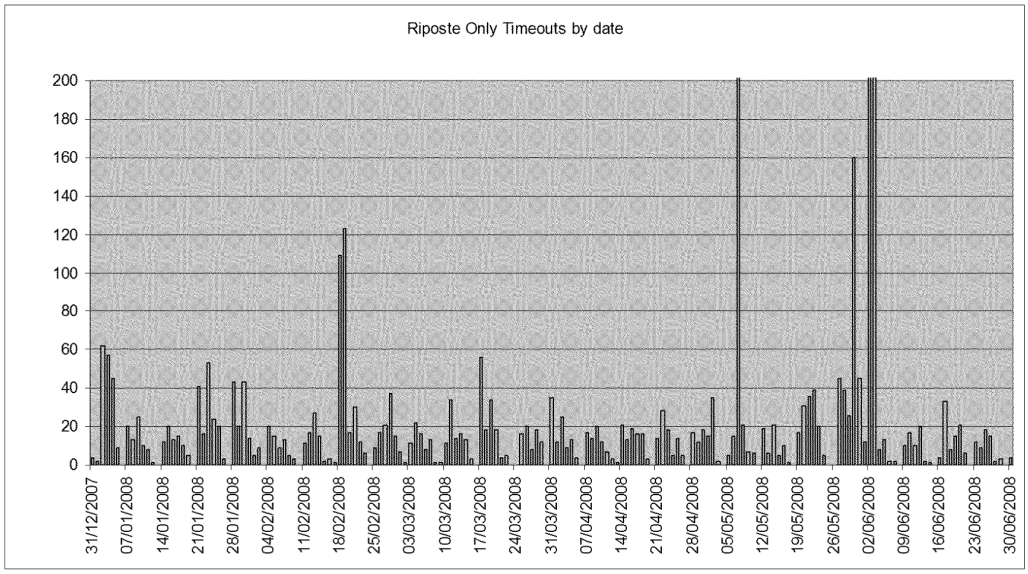
The distribution across the 6 month period showed the following:



Reducing the scale to show normal activity and ignore the peaks shows:



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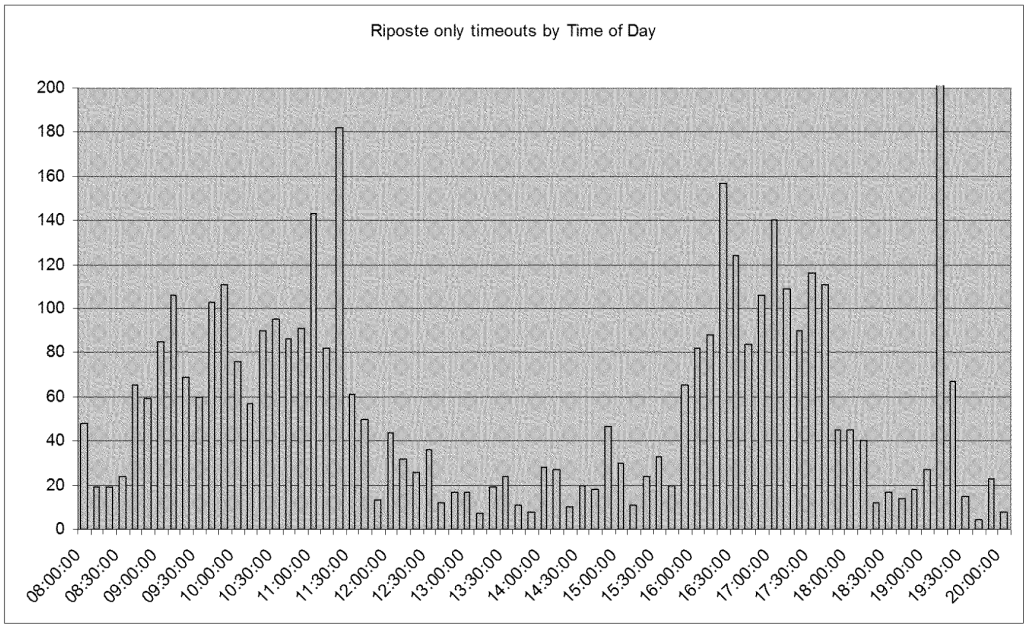
Looking at these by time of day (truncating the 1900 peak) shows:



There were a total of 1201 counters that generated these Riposte timeout events.

Number of events	Number of counters	Total events	Percentage of events
1 event	654	654	14
2 events	220	440	9
3 events	99	297	6
4 events	56	224	5
5+ events	172	3153	66
Total	1201	4768	100

In this case 66 counters are responsible for 50% of the events. *[Details available on request]*.

These were spread across 980 branches as follows:

Number of events	Number of branches	Total events	Percentage of events
1 event	436	436	9
2 events	210	420	9
3 events	97	291	6
4 events	42	168	4
5+ events	195	3453	72
Total	980	4768	100

The top 20 counter are responsible for 29% of the events:

Counter hostname	Number of events	Percentage of events
h17402600101	172	3.61
h16530900103	115	2.41
h10593700103	105	2.20
h40020700101	98	2.06
h05500300102	86	1.80
h25252300102	80	1.68
h34551100101	67	1.41
h15082400103	63	1.32

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h14092500101	61	1.28
h25442400103	59	1.24
h10002500101	53	1.11
h40032900104	52	1.09
h23521700103	52	1.09
h03042000103	52	1.09
h30661100101	51	1.07
h27320800109	43	0.90
h59161400102	41	0.86
h09002600102	40	0.84
h12613700103	38	0.80
h38064100101	35	0.73
Number of counters	**20**	
Total Events	**1363**	
Percentage events	**29**	

The top 20 branches are responsible for 30% of the events.

Branch	Number of events	Percentage of events
h174026	172	3.61
h055003	127	2.66
h165309	115	2.41
h105937	105	2.20
h400207	98	2.06
h252523	81	1.70
h345511	67	1.41
h150824	63	1.32
h140925	61	1.28
h254424	59	1.24
h030420	53	1.11
h100025	53	1.11
h235217	53	1.11
h400329	52	1.09
h306611	51	1.07
h273208	43	0.90
h591614	41	0.86
h090026	40	0.84
h006009	38	0.80
h126137	38	0.80
Number of branches	**20**	
Total Events	**1410**	
Percentage events	**30**	

However, the branch list is slightly different (by 3) to the top 20 counter list.

Looking at the split across counter positions we see:

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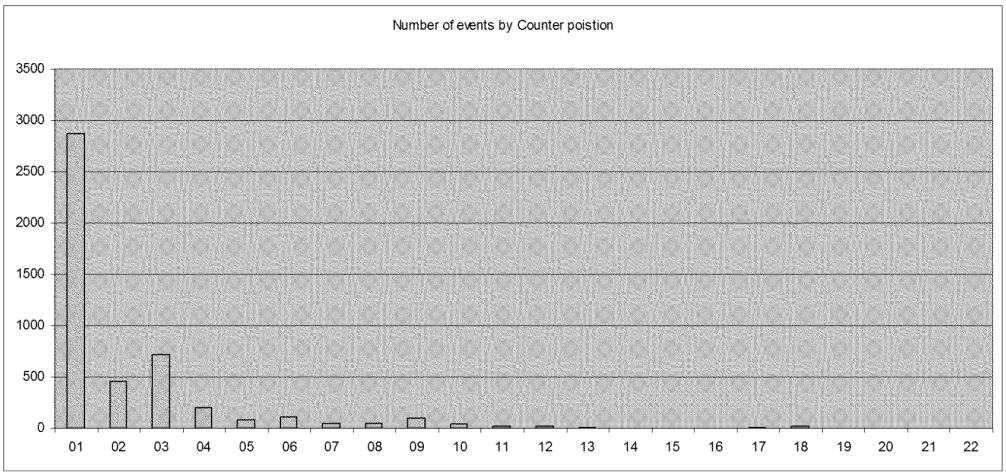

Counter position	Number of events	Percentage of events
01	2873	60.26
02	457	9.58
03	723	15.16
04	200	4.19
05	76	1.59
06	115	2.41
07	47	0.99
08	48	1.01
09	103	2.16
10	36	0.76
11	19	0.40
12	17	0.36
13	6	0.13
14	2	0.04
15	4	0.08
16	2	0.04
17	10	0.21
18	21	0.44
19	4	0.08
20	3	0.06
21	1	0.02
22	1	0.02
Total	4768	

This shows a much greater percentage related to the gateway PC, but only covers approximately 60% of the events generated. *[It may be useful to eliminate the SCO branches to obtain a more accurate picture.]*

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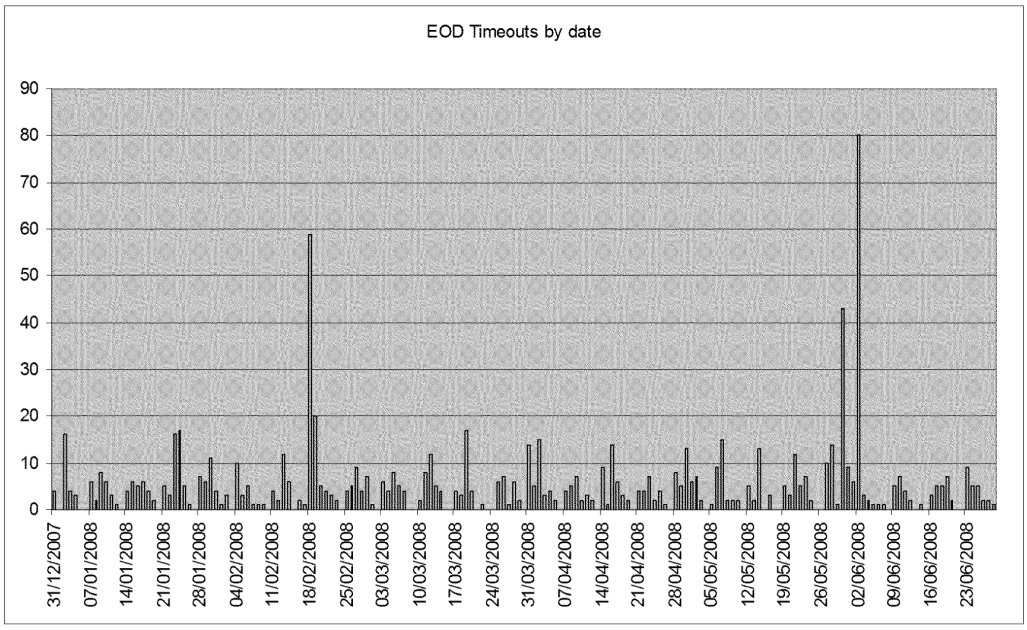
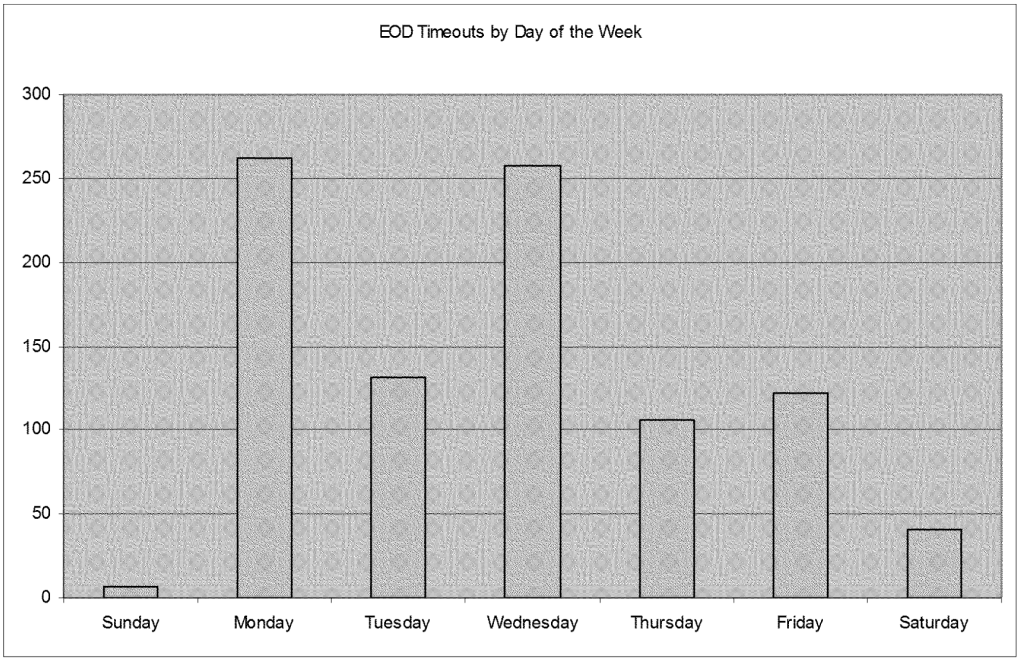
9 The 1900 EOD period

There were 927 events in the EOD (1900 – 2000) period. Split by date these show:



Split by day of the week:



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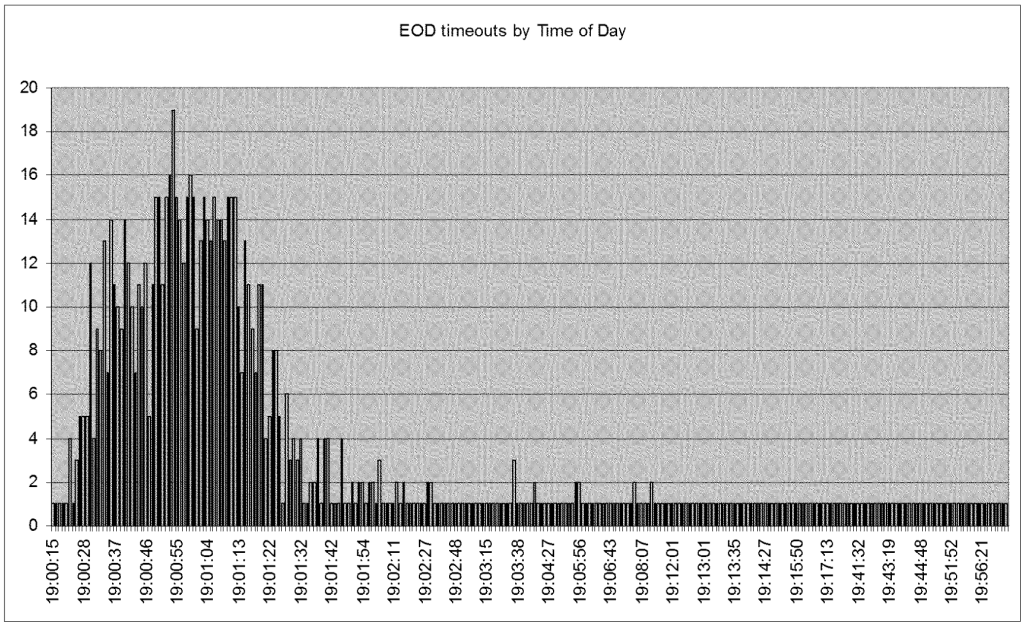
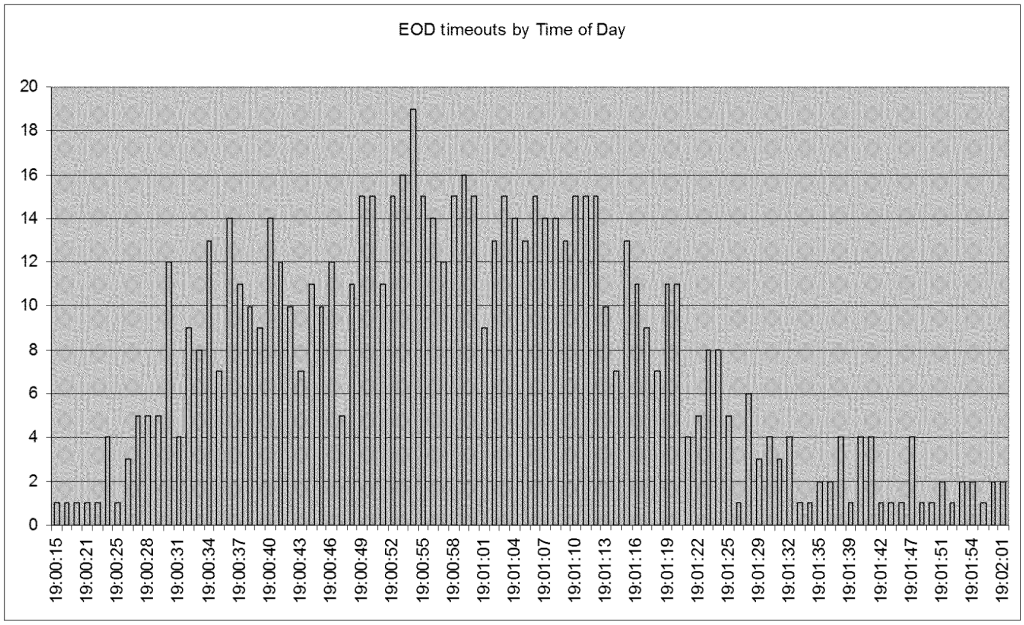
Split by time in the period from 19:00 to 20:00.



By time, for the critical 2 minute period just after 1900, these show:



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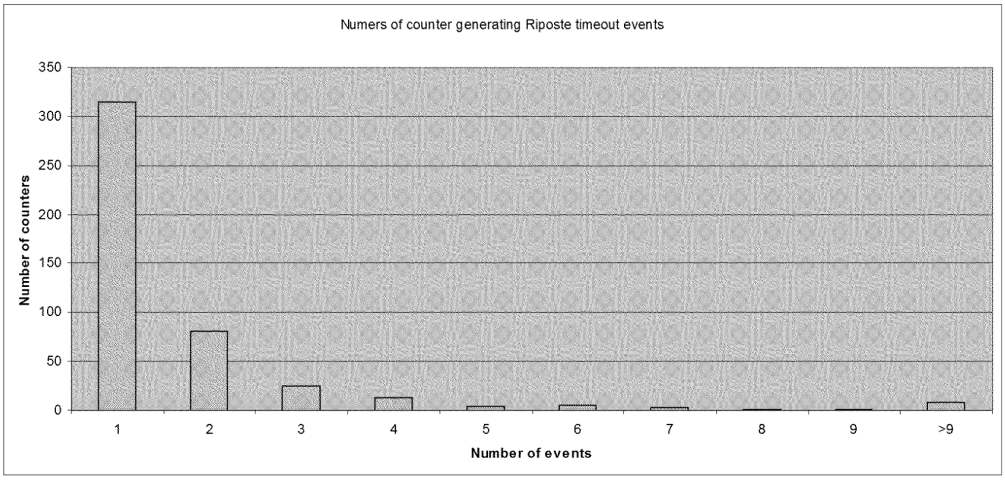
These are spread across 456 counters.



Number of events	Number of counters	Total events	Percentage of events
1 event	315	315	17
2 events	81	162	9
3 events	25	75	4
4 events	13	52	3
5+ events	22	1250	67
Total	456	1854	100

The top 20 counters cover 17% of these events.

Counter hostname	Number of events	Percentage of events
h17402600101	51	2.75
h16530900103	41	2.21
h05500300102	35	1.89
h40020700101	31	1.67
h40032900104	28	1.51
h15082400103	21	1.13
h05500300108	19	1.02
h02000500101	18	0.97
h11102600101	8	0.43
h20042000101	7	0.38
h27131100101	7	0.38
h59161400102	7	0.38
h00534300101	6	0.32
h00901300101	6	0.32
h00910900101	6	0.32
h01501000101	6	0.32
h39432900102	6	0.32
h00342200101	5	0.27
h23354600101	5	0.27
h41722700101	5	0.27
Number of counters	**20**	
Total Events	**318**	
Percentage events	**17**	

Note that not all of these are Gateway PCs as shown in bold. *[Is this expected?]*

Analysis by counter position shows that over 80% of these are from the Gateway PC.

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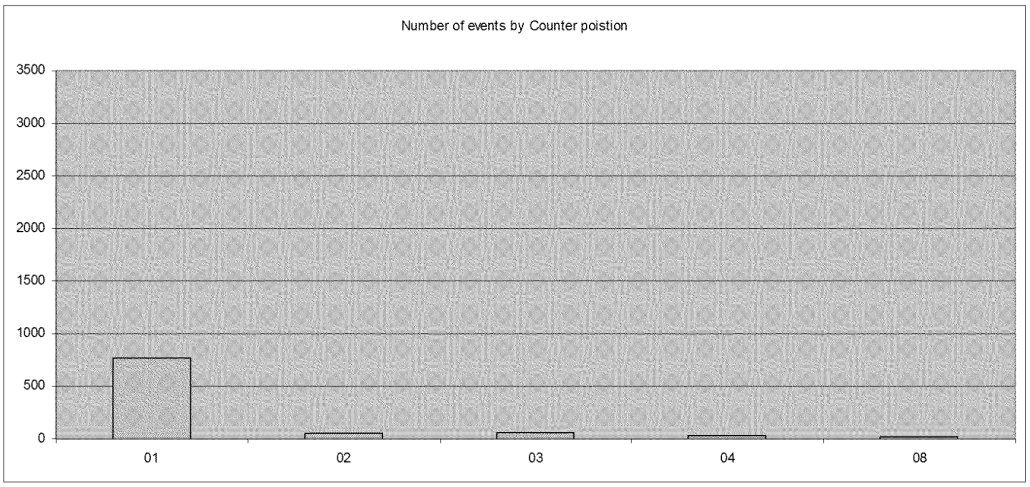

Counter position	Number of events	Percentage of events
01	768	82.85
02	50	5.39
03	62	6.69
04	28	3.02
08	19	2.05
Grand Total	927	100.00

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10 Conclusion & Recommendations

This analysis work has shown the following:

- The Riposte Timeouts can occur at any point and impact any application that is running on the counter.
    - Some Counter Applications handle the failure response in an appropriate way and indicate the error has occurred via their own event message.
        - Over this period we have been able to eliminate as a problem well over half of the Timeout events (down to 11633 from 27993)
    - Where other Counter Applications generate an event, it does not include the word "Timeout" within the event text.
        - *We need to include the results from the further analysis that has been request from Live monitoring of these events by the SSC.*
- The Riposte timeout events can occur at any times of the day or night
    - There are some significant peaks on certain dates, indeed this represents 73% of the Riposte Only Timeout events over the 6 month period!
        - *Further analysis needed to identify the reason for these higher volumes of events on these specific dates, but it is unlikely that we will be able to eliminate these.*
    - Even after elimination of the peak days, the profile of events is still spread across the whole 24 hours, but more closely follows the working day.
        - *Hence it is likely that EPOSS transactions are being impacted and this area needs further investigation.*
    - The events are seen across all counter positions, not just the Gateway PC.
        - The distribution is roughly in line with the distribution of the number of counters within the live estate.
        - However, when looking purely at the events between 08:00 and 20:00, there may be a higher impact on the Gateway PC.
- This analysis shows that the End of Day peak is significant and generates a major proportion of the normal daily Riposte Only events once the Peak days have been excluded.
    - The main impact is within 2 minutes of 19:00.
    - The number of events varies with the day of the week, both Monday and Wednesday being of similar proportions.
    - Over 80% of these are on the gateway PC.
        - *This links to the known case where the EOD process on the gateway PC can lock other applications out for a short period from writing messages to the Riposte journal.*
- An event is always generated by Riposte when the timeout occurs

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- There may be some events which are discarded during "event storms" – and these conditions need to be tracked manually – unless some other event can be detected that relates to this situation.
- The Audit query process must examine the event log to see what events have been generated at the branch in the period covered by the ARQ. This applies to all events, but the Riposte timeout events must be reviewed in detail.

- There are some apparent "hot spots" in individual counters and branches:
  - 19 counters accounted for over 20% of the events.
  - The top 20 branches accounted for 30% of the events
  - Between 08:00 and 20:00, the top 20 counter are responsible for 29% of the events.
  - Between 08:00 and 20:00, the top 20 branches are responsible for 30% of the events – but the branch list is slightly different from the top 20 counter list.
  - At end of day, the top 20 counters cover 17% of the events – though these were not all gateway PCs.

However, this picture needs to be put into perspective!

- Even though a large number of these events are being generated, they only affect a small percentage of the branch estate.
  - For example, assuming that there are 13,000 branches and 30,000 counters, we can calculate the potential impact on an individual branch or counter over a 6 month period as follows:
    - After elimination of known other application timeout events:

Percentage for	Branches	Counters
No Events	72.4	82.7
Up to 1 Event	85.8	93.9
Up to 2 Events	92.4	97.8
Up to 3 Events	95.2	98.9
Up to 4 Events	96.7	99.3
5 or more Events	3.3	0.7

    - During the hours 0f 08:00 to 20:00, the percentages are:

Percentage for	Branches	Counters
No Events	92.5	96.0
Up to 1 Event	95.8	98.2
Up to 2 Events	97.4	98.9
Up to 3 Events	98.2	99.2
Up to 4 Events	98.5	99.4
5 or more Events	1.5	0.6

The analysis work, though comprehensive, is not yet complete.

- A number of areas for further investigation still need to be considered.
- A number of questions in italics within this document need to be followed up.

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- The set of conclusions needs to be reviewed, and potential follow up actions needs to be produced.
- The resources needed to complete this exercise need to be estimated and a plan agreed.