IntelliMagic Technical Note

Storage Performance Management Note # 1106-2

Understanding SSD Performance with IntelliMagic Vision and IntelliMagic Balance

Solid State Drives (SSDs) can provide much higher random access data rates than traditional disk drives can. At the same time, they use much less power than Fibre channel HDDs. At equal cost per GB, the choice would be clear. Unfortunately, SSDs are still much more expensive than HDDs.

The promise of SSD performance, however, is so significant that many customers are looking at installing at least some Solid State Drives (SSD) in new storage systems. It is important to realize, however, that mainframe disk storage systems have so much cache memory that SSD may not do much to improve **overall** response time. One customer told us that they could not tell the difference after they installed Solid State!

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Because SSD is more than 10 times as expensive as HDDs, and the benefit is entirely workload dependent, it is important to set your objectives before making the investment. These objectives should be defined in the context of application performance, so that you can quantify whether or not the investment will provide significant benefits for your important workloads.

IntelliMagic Vision can help you quantify the benefits of SSD by providing a top-down analysis of the business benefits of SSDs. ***Figure 1: I/O Service Time by Service Class*** illustrates the I/O service time contribution for the top-10 service classes.

Figure 1: I/O Service Time by Service Class

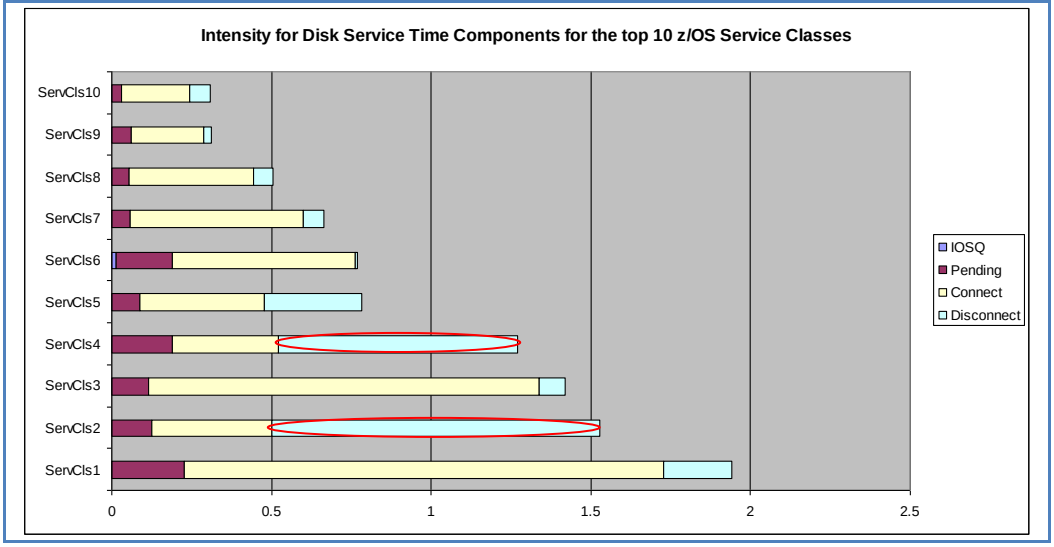


Figure 1: I/O Service Time by Service Class makes it immediately clear that ServCls2 and ServCls4 could benefit from SSD, while ServCls1 and ServCls3 are not likely to see any significant improvement. This is because SSDs improve disconnect time in particular, since they have no seek or latency delays that normally make up most of the disconnect time. Disconnect time is significant for ServCls2 and ServCls4. ServCls1 and ServCls3 would benefit more from better connect time.

If ServCls4 is the most important application, the next step would be to look for the data sets that generate most of the disconnect time during the period that you want to optimize.

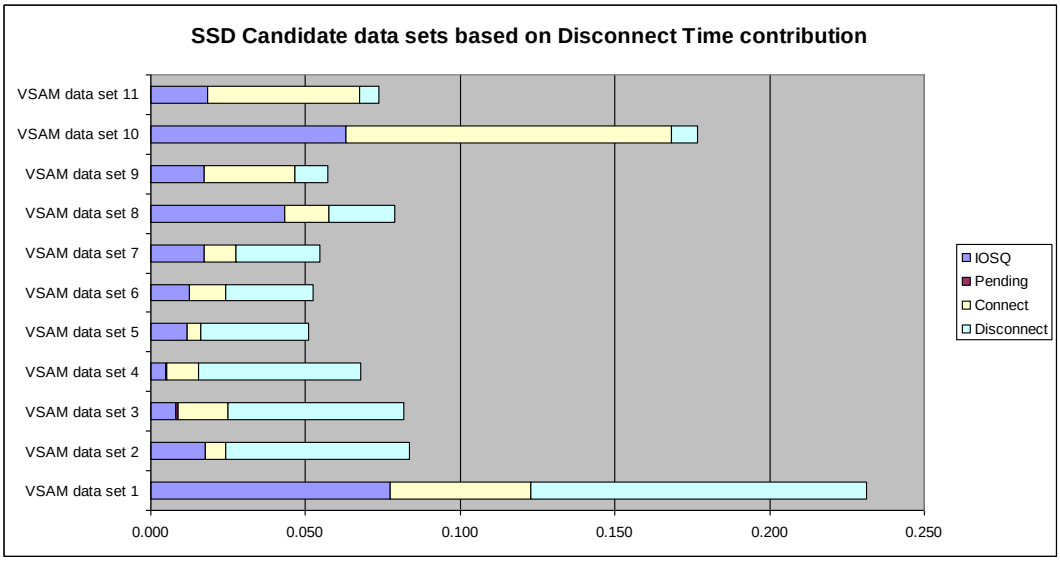
Table 1: Service Class I/O Time by Data Set illustrates the data sets (and volumes) that will give the most significant improvement for the ServCls4 workload. In this particular example, all data sets in the most-active list are VSAM data sets. This is quite common: large DB2 databases tend to show low cache hit rates for random reads, and hence they are good candidates for SSD.

Table 1: Service Class I/O Time by Data Set

Service Class	Data Set Name	Volume	IOSQ	Pending	Connect	Disconnect
ServCls4	VSAM data set 1	DBX632	0.078	0.000	0.045	0.109
ServCls4	VSAM data set 2	DBX724	0.018	0.000	0.007	0.059
ServCls4	VSAM data set 3	DBX613	0.008	0.001	0.016	0.057
ServCls4	VSAM data set 4	DBX613	0.005	0.000	0.010	0.052
ServCls4	VSAM data set 5	DBX666	0.012	0.000	0.004	0.035
ServCls4	VSAM data set 6	DBX704	0.012	0.000	0.012	0.028
ServCls4	VSAM data set 7	DBX724	0.017	0.000	0.010	0.027
ServCls4	VSAM data set 8	DBZ631	0.043	0.000	0.015	0.021
ServCls4	VSAM data set 9	DBX672	0.017	0.000	0.029	0.011
ServCls4	VSAM data set 10	DBX600	0.063	0.000	0.105	0.008
ServCls4	VSAM data set 11	DBX608	0.018	0.000	0.049	0.006

Figure 2: SSD Candidate Data Sets - Disconnect Time provides a graphical representation of the same data. It is clear that not every data set will benefit to the same level.

Figure 2: SSD Candidate Data Sets - Disconnect Time



While the analysis illustrated above is not trivial as it involves identifying and moving individual data sets, it will allow you to get the most out SSD storage. Moving the candidate data sets to solid state, and keeping them there, does require changes to the DFSMS definitions as well.

The IntelliMagic Balance product supports a higher level analysis approach, where you specify how many SSD and HDD RAID groups you would like to use, and IntelliMagic Balance will determine the most appropriate tier for each storage groups.

This is best illustrated with an example. A target configuration uses 64 SSD drives (146 Gbyte each), and 256 HDD drives (450 Gbyte each). This means that less than 10% of the data will be on SSD. As compared to a 146 Gbyte HDD only configuration, the drive reduction is more than 60%! IntelliMagic Balance will take the current configuration and performance characteristics of the workloads and provide an optimized target configuration based on the most suitable candidates for SSD. ***Table 2: Tier by Storage Group*** illustrates the output of IntelliMagic Balance.

Table 2: Tier by Storage Group

RunID	TargetName	StorageGroup	Total #cylinders	Total #volumes
TIER	SSD	PRODDB	3485916	348
TIER	SSD	QRYDB2	230391	23
TIER	SSD	RULES	150255	15
TIER	SSD	IMSLOGS	100170	10
TIER	SSD	DATA	931581	93
TIER	SSD	SYSW	80136	8
TIER	SSD	SYSZ	1061802	106
TIER	SSD	Non SMS Volumes	1946645	205
TIER	FC450	LOGSDB2	250425	25
TIER	FC450	POLICY	2604420	260
TIER	FC450	POLICY2	4507650	450
TIER	FC450	GROUP1	7202223	719
TIER	FC450	GROUP2	3265542	326
TIER	FC450	GROUP3	12461148	1244
TIER	FC450	IMSPROD	1081836	108
TIER	FC450	QAVOLS	310527	31
TIER	FC450	QAVOLSB	170289	17
TIER	FC450	DBA	150255	15
TIER	FC450	Non SMS Volumes	40208230	4384

This load distribution is chosen such that the SSD volumes handle many more I/Os per physical drive, as shown in the charts below. ***Figure 3: SSD I/Os per Drive*** illustrates that the SSD drives peak at 800 I/Os per second. ***Figure 4: FC450 I/Os per Drive*** illustrates that the HDDs process only 200 I/Os per second. The algorithms in IntelliMagic Balance are designed to favor SSD for active volumes with a relatively low sequential content. During the online period, when response times are most important, even the 450 Gbyte drives are not very busy.

Figure 3: SSD I/Os per Drive

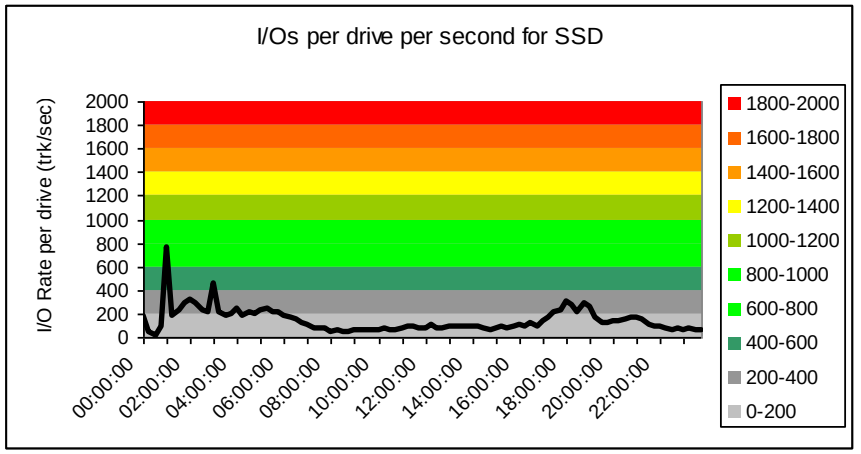
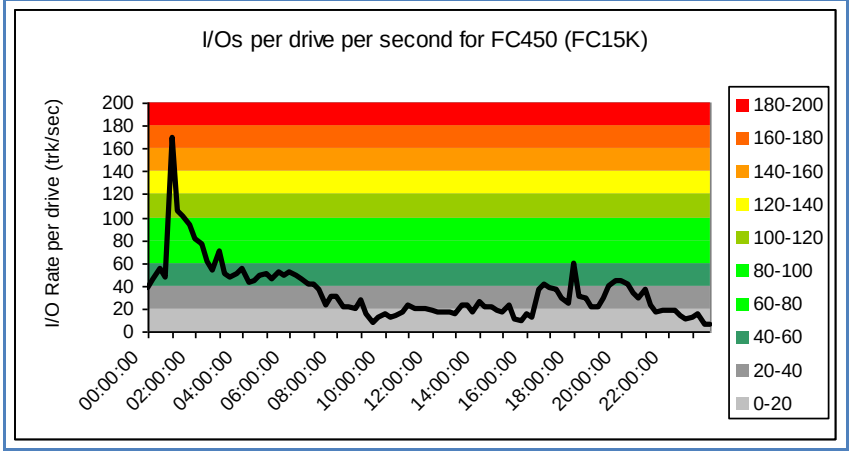
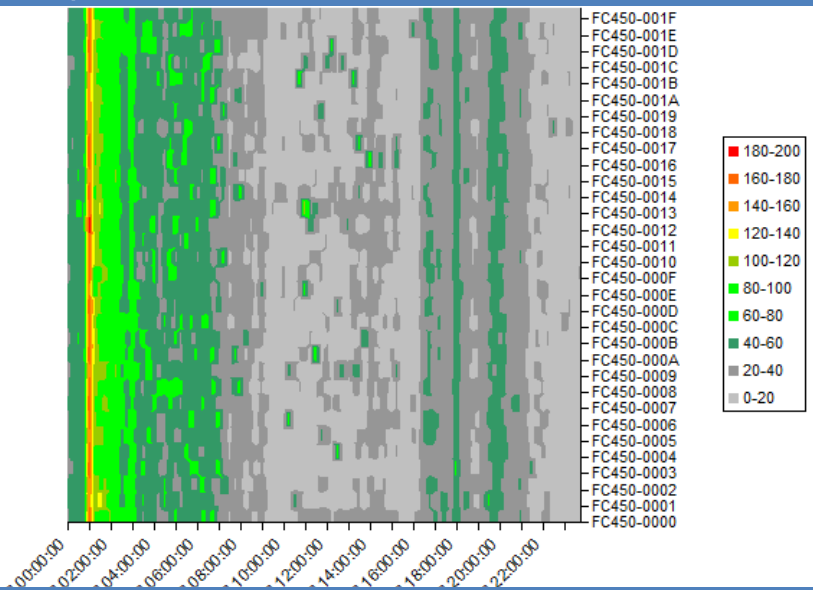


Figure 4: FC450 I/Os per Drive



IntelliMagic Balance will also create a specific layout for this configuration, showing a target array group (extent pool) for each logical volume in the configuration. If you follow these recommendations, the workload will be evenly spread in the newly created configuration. IntelliMagic Balance creates a heatmap to show this balance graphically as illustrated in ***Figure 5: Heatmap***.

Figure 5: Heatmap



In this configuration, you can see that the only time when the configuration is really busy is for a brief period during the batch window. In this particular environment, the batch window has no performance constraints, so a brief busy period is quite acceptable.

In addition to providing software for end users to perform this type of analysis, we can perform the SSD analysis as a contracted service for your installation. It will give you a good understanding on the investment choices that you have.

For more information about the IntelliMagic Vision product, please visit www.intellimagic.net or contact sales@intellimagic.net.