Bantam Version 1.9 Evaluation Guide

Bantam 1.9 Evaluation Guide

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Bantam 1.9 Evaluation Guide

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Who Should Read This Document

This document explains how to evaluate the Bantam 1.9 GDSII Stream Optimization product from Saratoga Data Systems, Inc.

It is imperative that you read this document if you plan to quickly and accurately evaluate the Bantam 1.9 GDSII Stream Optimization software from Saratoga Data Systems, Inc.

Introduction

GDSII Stream is the de facto standard data file format used by the IC design and manufacturing industries for representing IC design layout.

GDSII Stream files are very large and will continue to grow dramatically in size due to the requirements of modern IC fabrication processes. Adding "dummy", or "fill", data for Chemical Mechanical Polishing (CMP) and resolution enhancements such as Optical Proximity Correction (OPC) or Phase Shifted Mask (PSM) to a design can increase the size of a GDSII Stream file by several orders of magnitude. For example, single layer GDSII Stream files can approach 100 GB in size after CMP filling and OPC have been applied.

- You may find it difficult to obtain adequate disk space to store very large GDSII Stream files.
- Very large GDSII Stream files are time consuming to copy, move, archive, or transmit them over a network.
- Very large GDSII Stream files are time consuming to process with downstream applications.
- Downstream applications may not have the capacity to process very large GDSII Stream files.

What is Bantam GDSII Stream Optimization Software?

You use the Bantam GDSII Stream Optimization software to reduce the daunting size of GDSII Stream files.

Bantam is Optimization

Bantam reads a GDSII Stream file. Bantam optimizes the data in the file and writes a functionally equivalent, but much smaller, GDSII Stream file.

> The GDSII Stream file written by Bantam is 100% point-for-point equivalent to its input file.

Bantam reads and writes GDSII Stream version 6.

Your Design Hierarchy

> Bantam GDSII Stream Optimization does not change your original design hierarchy.

Each structure, or cell, in your original input GDSII Stream file exists in the Bantam optimized version of the file. Each of your original structures is 100% point-for-point equivalent to its corresponding structure in the Bantam optimized version of the file.

Hierarchical LVS

> Since Bantam leaves your original design hierarchy intact, using Bantam optimized GDSII Stream files for hierarchical LVS operations will not affect your LVS results.

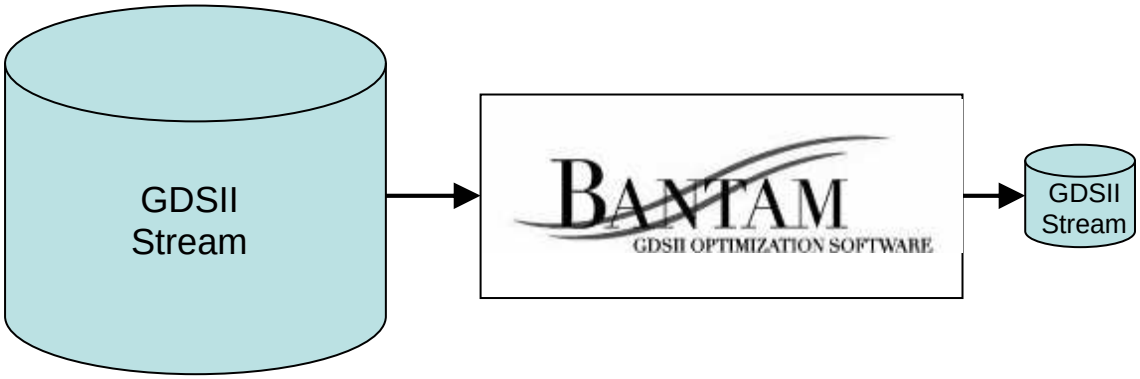


Figure 1: Bantam reads a large GDSII Stream file and writes an equivalent, but much smaller, GDSII Stream file

Bantam is Not Compression

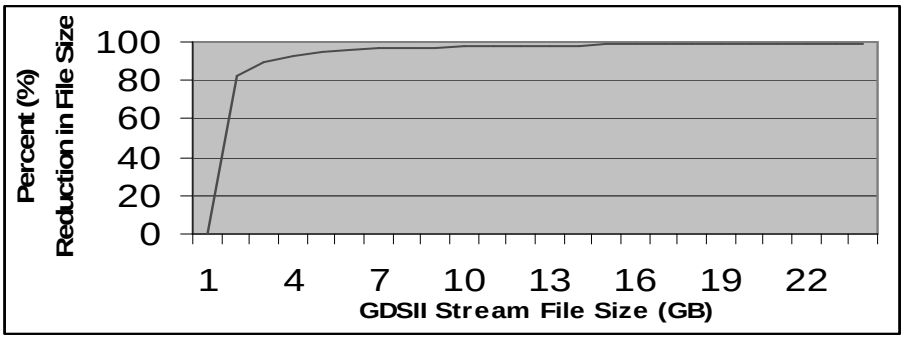
Bantam is **not** compression software. There is no compression technology used in Bantam. You do not need to decompress Bantam output so that downstream applications may read it. Bantam writes GDSII Stream files that

may be read by any downstream application. You do not need to "undo" Bantam optimization to use the GDSII Stream files produced by Bantam.

File Size Reduction Percentage

Bantam reduces the size of any large GDSII Stream file through optimization of the layout data within the file. Your file size reduction percentage depends upon the nature and size of your input GDSII Stream file. Your file sizes may be reduced by 90% or more.

In general, Bantam GDSII Stream Optimization software is more effective as your file sizes increase. The larger the size of your input GDSII Stream file, the greater your file size reduction percentage.



Also, Bantam is most effective on GDSII Stream files that contain "dummy" filling and resolution enhancements such as OPC and PSM.

Appendix A provides data on the relative impact of Bantam on Stream files of various sizes and complexities. If you see different results in your evaluation from those shown in Appendix A, please contact our support group (e-mail: support@saratogadata.com; phone: 408-627-7671) to discuss your results.

Applying Bantam GDSII Stream Optimization Software

Bantam GDSII Stream Optimization may also have a significant positive impact on some downstream GDSII Stream applications. For example, extensive testing has demonstrated that Mask Data Preparation (MDP), or fracture, runtimes are considerably reduced when the input GDSII Stream file has been optimized with Bantam prior to the MDP operation. Bantam GDSII Stream Optimization may improve the throughput and capacity of your MDP flow.

You typically use Bantam in your IC tape-out flow following any GDSII Stream application that creates a significant volume of IC layout or substantively modifies your layout data.

Figure 2 illustrates how many Bantam customers are successfully using Bantam GDSII Stream Optimization in their IC tape-out flow.

As your GDSII Stream file proceeds through the tape-out flow depicted in **Figure 2**, the file drastically increases in size. Since Bantam becomes more effective as your file size increases, Bantam is most effective at the later stages of this tape-out flow.

Many have found that Bantam not only significantly reduces the size of their GDSII Stream files, but also improves the overall throughput of their tape-out flow. Appendix B contains a table of actual Bantam customer MDP runtime improvements for various sizes of GDSII Stream files.

Some Bantam customers have had success optimizing their GDSII Stream files prior to Layout Verification (DRC/LVS). They have found that Bantam not only significantly reduces the size of their GDSII Stream files but also improves the runtime of Layout Verification. However, this is not a universal result, and, since Layout Assembly and Layout Verification are a tight check-and-fix loop, we hesitate to advocate the use of Bantam at this point in your flow.

You may eliminate the very large, un-optimized, GDSII Stream files depicted in **Figure 2** by piping the GDSII Stream output file of a tool directly into Bantam. Refer to the section entitled *Using Compression with Bantam Optimized GDSII Stream File* for examples of how to do this.

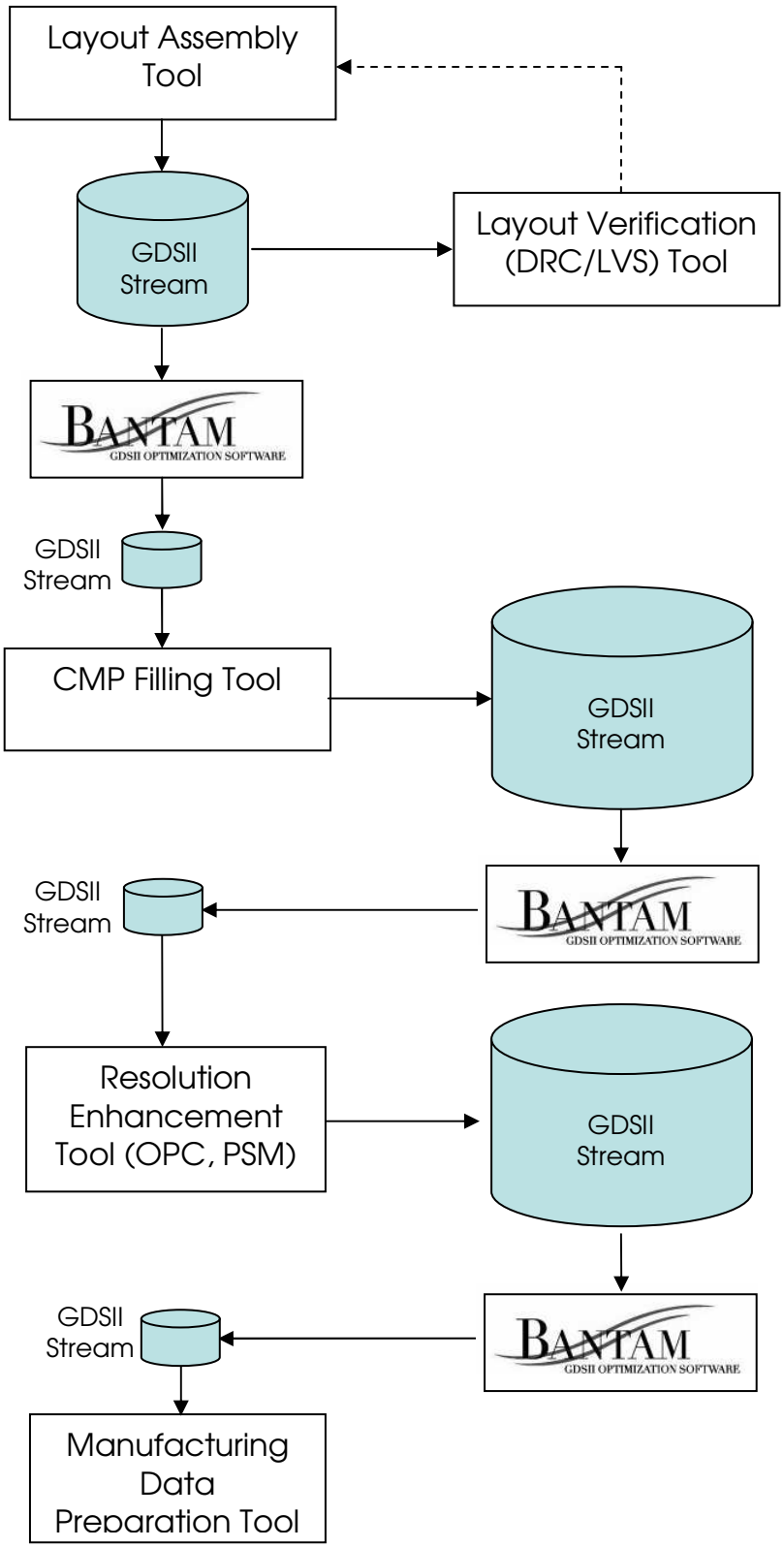


Figure 2: Recommended Application of Bantam GDSII Stream Optimization in a Tape-Out Flow

Evaluating Bantam GDSII Stream Optimization Software

Selecting GDSII Stream Files for Your Evaluation of Bantam

Bantam GDSII Stream Optimization is most effective on very large GDSII Stream files. In order for your evaluation to be most productive, you should ideally run Bantam on files that are tens or hundreds of gigabytes in size. Typically GDSII Stream files of this size have been subjected to some manufacturing required manipulation such as "dummy" filling and OPC or PSM. Sometimes your GDSII Stream files become very large because your physical design hierarchy has been significantly flattened or otherwise disordered by an operation in your flow.

These very large GDSII Stream files may be a minority in your environment but probably consume the majority of your compute resources to process. Please be sure to select an appropriate test set of your largest GDSII Stream files for your Bantam evaluation.

Don't hesitate to contact our support team (e-mail: support@saratogadata.com; phone: (408) 627-7671) for any help that we can provide before or during your evaluation. We are eager to work with you.

In summary, in order to appropriately experience the benefits of Bantam GDSII Stream Optimization, you should select a set of GDSII Stream files that:

- Are very large, at lease 2GB in size, the larger the better, ***or***
- Contain "dummy" filling for CMP, ***or***
- Contain resolution enhancements such as OPC, ***or***
- May have been significantly flattened

Getting a Bantam Evaluation License

You should have received a Bantam evaluation license file with this document. If you do not have a license file, you may request one by sending e-mail to `support@saratogadata.com`.

Downloading Bantam

You may download Bantam using *FTP* over the internet. Bantam is downloaded as a compressed *tar* file. We provide two forms of compression: *gzip* and *compress*.

- The file name of the *gzip* compressed version of the Bantam installation tar file ends with .gz

- The file name of the *compress* compressed version of the Bantam installation tar file ends with .Z
- You may download either version of the Bantam tar file
- You should also download the MD5 signature of the compressed Bantam installation *tar* file in order to confirm that your download was successful

Anonymous FTP

You download the *gzip* compressed version of the Bantam installation *tar* file from `ftp://ftp.saratogadata.com/pub/bantam/bantam-production.tar.gz` using anonymous FTP as follows:

```
Linux> ftp ftp.saratogadata.com
Name (ftp.saratogadata.com:<username>): anonymous
331 Please specify password.
Password: <enter your e-mail address here>
ftp> cd pub/bantam
ftp> binary
ftp> get bantam-1.9-production.tar.gz
ftp> get bantam-1.9-production.md5sum
ftp> quit
Linux>
```

You download the *compress* compressed version of the Bantam installation tar file here: `ftp://ftp.saratogadata.com/pub/bantam/bantam-production.tar.Z` using anonymous FTP as follows:

```
Linux> ftp ftp.saratogadata.com
Name (ftp.saratogadata.com:<username>): anonymous
331 Please specify password.
Password: <enter your e-mail address here>
ftp> cd pub/bantam
ftp> binary
ftp> get bantam-1.9-production.tar.Z
ftp> get bantam-1.9-production.md5sum
ftp> quit
Linux>
```

Verify Download

You now have a local copy of the compressed Bantam installation *tar* file and an *md5sum* file to verify that your download is error free.

You may verify that the compressed Bantam installation *tar* file has downloaded correctly by running the *md5sum* utility as follows:

```
Linux> md5sum –c bantam-1.9-production.md5sum
```

The *md5sum* utility should tell you that the file you downloaded is "OK". If it does not print "OK" next to the name of the compressed Bantam installation *tar* file you downloaded, you should delete the file and download it again.

Installing Bantam

Select a System

We strongly recommend that you install and run Bantam on a high performance Linux system utilizing a 3GHz, or better, Pentium 4, Athlon, Opteron, or similar high performance processor. We also recommend that your test system contain at least 1GB of RAM.

Move the compressed Bantam installation file you just downloaded to the system in which you intend to install Bantam.

Save License File

You probably received a Bantam evaluation license file as an e-mail attachment. Save or copy the attached license file to the system on which you intend to install Bantam.

Uncompress

Next, uncompress the Bantam installation *tar* file:

- If you downloaded the *gzip* compressed installation file, uncompress it as follows:
  ```
  Linux> gzip –d bantam-1.9-production.tar.gz
  ```
- If you downloaded the *compress* compressed installation file, uncompress it as follows:
  ```
  Linux> uncompress bantam-1.9-production.tar.Z
  ```

You now have an uncompressed Bantam installation *tar* file named `bantam-production.tar`.

Extract

Next, extract the Bantam installation *tar* file as follows:

```
Linux> tar -xvf bantam-1.9-production.tar
```

This creates a subdirectory named `bantam-1.9` containing the Bantam installation file hierarchy. Change directory to the `bantam-1.9` subdirectory:

```
Linux> cd bantam-1.9
```

Run the Installation Script

Finally, run the Bantam installation script:

```
Linux> ./install.sh
```

The installation script requires you to read the *Bantam End User License Agreement*, prompts you for the name of a directory in which to install Bantam, and then prompts you for the location of your Bantam license file. We refer to the name of the directory in which you installed Bantam as the <*installation-directory*>.

FLEXlm License

Bantam uses the FLEXlm license management system from Macrovision. Your evaluation license file works standalone (not served) and does not require a FLEXlm server. You may install the Bantam evaluation license as a served license, but, for the purpose of your evaluation, it is an unnecessary complication.

Running Bantam

Bantam Executable

The Bantam executable file is <*installation-directory*>/bin/bantam. To run Bantam:

- You may add <*installation-directory*>/bin/bantam to your Unix path variable and run it by typing *bantam*, or
- You may simply type the full pathname of the executable

Bantam requires only one command line argument: the name of a GDSII file you wish to optimize with Bantam. For example,

```
Linux> <installation-directory>/bin/bantam myVeryLarge.gds
```

Bantam will read the GDSII Stream file myVeryLarge.gds and write the optimized data to a GDSII Stream file named myVeryLarge.bos. The *.bos* file name extension is an acronym for Bantam Optimized Stream.

Quick Mode

During optimization Bantam creates new GDSII Stream structures in the output GDSII Stream file. By default Bantam ensures that the names of the new structures it creates do not collide with the names of existing structures. However, this requires that Bantam read your input GDSII Stream file twice.

You may speed Bantam processing by about 40% if you instruct Bantam to read your input GDSII Stream file only once by using "quick" mode. However, quick mode requires that you specify a structure name prefix that will ensure that Bantam will not create structures with names that already

exists in your input GDSII Stream file. You should select a structure name prefix that is as short as possible. A single character, for example "_", "$", or "?", works well.

If, for example, you wish to run Bantam in quick mode using "_" (under bar) as the structure name prefix, you type:

```
Linux> <installation-directory>/bin/bantam –q '_' myVeryLarge.gds
```

Most Bantam customers use quick mode, we recommend you also use quick mode for your evaluation.

Bantam En Masse

The Bantam installation hierarchy contains a utility named *bantam_em* which allows you to run Bantam on many GDSII Stream files in sequence and automatically generate a table of results.

Create a subdirectory to contain all of your evaluation GDSII Stream files. Then move (mv), copy (cp), or link (ln –s) all of your GDSII Stream files into that subdirectory. Then run Bantam in quick mode on all of your evaluation GDSII Stream files. For example,

```
Linux> mkdir test_bantam
Linux> cd test_bantam
Linux> ln -s ../design1/opc.gds .
Linux> ln -s ../design2/opc.gds .
Linux> ln -s /home/engineer2/design3/filled.gds .
Linux> ln -s /home/engineer2/design4/bigOpc.gds .
Linux> <installation-directory>/bin/bantam_em –s sum.txt -q '_' -- *.gds
```

In the above example you are instructing *bantam_em* to run Bantam, in quick mode, on all files in the current directory with the file name extension *.gds* and write a summary table of the result of all runs to a file named `sum.txt`.

Local Files

Like any tool that reads very large files, Bantam's performance is slowed if the input file is read over a network. For best performance, you must have the input GDSII Stream files available locally.

Bantam User Manual

Bantam has several options in addition to those mentioned here that may interest you. Please refer to the Bantam User Manual (`<installation-directory>/doc/Bantam_User_Manual.pdf`) for details.

Using Compression with Bantam Optimized GDSII Stream Files

Many GDSII Stream users keep their GDSII Stream files compressed, typically with *gzip*, to save disk space. Bantam Optimized GDSII Stream files may also be compressed.

If you typically keep your GDSII Stream files compressed, you should compress your Bantam optimized GDSII Stream files before you make size comparisons to compressed input GDSII Stream files.

For example:

```
Linux> gzip *.bos
```

Reading and Writing Compressed Files

Many tools read compressed GDSII Stream. You may read and write compressed GDSII Stream files with Bantam by using the Unix *mkfifo* command. For example:

```
Linux> mkfifo bantam_in
Linux> gzip -d < my.gds.gz > bantam_in &
Linux> <installation-directory>/bin/bantam –q '_' bantam_in my.bos
```

Similarly, you may write compressed GDSII Stream files with Bantam. For example:

```
Linux> mkfifo bantam_out
Linux> gzip < bantam_out > my.bos.gz &
Linux> <installation-directory>/bin/bantam –q '_' my.gds bantam_out
```

And, you may read and write compressed GDSII Stream files with Bantam. For example:

```
Linux> mkfifo bantam_in
Linux> mkfifo bantam_out
Linux> gzip -d < my.gds.gz > bantam_in &
Linux> gzip < bantam_out > my.bos.gz &
Linux> <installation-directory>/bin/bantam –q '_' bantam_in bantam_out
```

Please note, you may only use this technique with Bantam's quick mode (-q command line option). Bantam's default two-pass mode will not work with fifo input files.

Verifying Accuracy

Layout XOR

Bantam customers have rigorously verified the accuracy of their Bantam optimized GDSII Stream files against their original files using a variety of

commercially available layout XOR tools, for example: Calibre, Hercules, Assura, Dracula, and CATS.

You may verify the accuracy of Bantam using any layout XOR tool. You will find no difference in the layout contained in your original GDSII Stream file versus the Bantam optimized version of the same GDSII Stream file.

Design Hierarchy

While Bantam creates new structures in optimizing your GDSII Stream file, it does not change your existing design hierarchy. Every structure in your original GDSII Stream file still exists in the Bantam optimized file. Each structure in your original GDSII Stream file will XOR cleanly against the same structure in the Bantam version of the same GDSII Stream file.

Hierarchical LVS

Since Bantam leaves your original design hierarchy intact, using Bantam optimized GDSII Stream files for hierarchical LVS operations will not affect your LVS results.

Evaluating Downstream Tools

In addition to dramatically reduced file sizes, most Bantam customers also enjoy improved runtimes of their downstream GDSII Stream processing tools. For example, Bantam customers typically see dramatic runtime improvement in the operation of the Synopsys CATS tool when they optimized the very large input GDSII Stream file with Bantam.

Again, Appendix B provides some example CATS MDP results. If your results differ considerably from the table in Appendix B, please contact our support group (e-mail: support@saratogadata.com; phone: (408) 627-7671) to discuss the result. On occasion, the configuration of CATS conceals a substantial runtime improvement. In particular, you must appropriately set the value of the CATS COMPACT parameter.

Support

Visit our web-site, www.saratogadata.com, for additional documentation and application notes.

Send your questions, comments, and problems regarding bantam to: support@saratogadata.com or call us at (408) 627-7671.

Appendix A – Example Bantam File Size Reduction

The following table summarizes Bantam GDSII Stream Optimization file size reduction reported by Bantam users, including a foundry, an independent device manufacturer (IDM), and an IC mask maker.

File Size (MB) Original GDSII Stream File	*File Size (MB) Bantam Optimized GDSII Stream File*	*Percent File Size Reduction*
2.2	0.2	92%
2.2	0.2	91%
2.7	1.2	56%
2.8	1.8	36%
2.9	1.9	32%
2.9	1.9	32%
4.1	1.0	76%
4.5	2.5	45%
4.8	0.4	91%
6.1	2.6	57%
6.8	1.9	71%
7.3	1.8	76%
7.7	2.3	70%
14.2	1.3	91%
22.8	2.1	91%
22.8	2.3	90%
28.4	2.7	90%
41.3	2.3	94%
43.9	0.7	98%
47.4	0.3	99%
70.2	13.3	81%
94.2	0.1	99%
104.9	1.6	98%
107.6	14.4	87%
112.5	12.3	89%
127.0	0.3	99%
143.0	0.1	99%
147.4	0.2	99%
252.6	12.9	95%
353.6	8.6	98%
791.0	12.0	98%
1110.0	33.0	97%
1194.7	278.9	77%
1819.9	315.8	83%
1819.9	316.2	83%
2119.2	56.9	97%
2122.0	153.0	93%
2974.0	328.0	89%
3183.0	871.0	73%
3365.9	626.0	81%
3907.6	659.9	83%
4877.0	26.0	99%
5008.0	27.0	99%
7046.1	2285.0	68%
7397.6	101.1	99%
14039.0	99.0	99%
16999.4	875.8	95%
68368.3	607.6	99%

Appendix B – Example Downstream Tool Runtime Improvement

The following table summarizes example MDP runtime improvements, as reported by Bantam customers, resulting from Bantam optimization of the input GDSII Stream file.

File Size (bytes) Original GDSII Stream File	*MDP Runtime (CPU seconds) Original GDSII Stream File*	*MDP Runtime (CPU seconds) Bantam Optimized File*	*Improvement Factor MDP Runtime*
458,029,056	114	86	1.3
677,967,872	121	94	1.3
1,317,781,504	274	186	1.5
7,046,074,368	1,834	1548	1.2
16,049,420,288	3,556	2343	1.5
16,999,444,480	8,363	1729	4.8
68,368,273,408	15,975	917	17.4

The following table summarizes example Synopsys CATS XOR operation runtime improvements, as reported by a Bantam user, resulting from the optimization of the input GDSII Stream file.

Runtime (CPU hours) CATS XOR Original GDSII Stream File	*Runtime (CPU hours) CATS XOR Bantam Optimized GDSII Stream File*	*Runtime (CPU hours) CATS XOR Improvement*	*Improvement Factor CATS XOR*
26.2	14.7	11.5	1.8
34.6	28.2	6.4	1.2

The following table summarizes an example Synopsys Proteus runtime improvement, as reported by a Bantam customer, resulting from the optimization of the input GDSII Stream file.

File Size (bytes) Original GDSII Stream File	*Proteus Outrigger Runtime (seconds) Original GDSII Stream File*	*File Size (bytes) Bantam Optimized GDSII File*	*Proteus Outrigger Runtime (seconds) Bantam Optimized GDSII Stream File*	*Improvement Factor Proteus Outrigger Runtime*
60,391,424	66,012	462,848	682	96.8

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