TDF Facts & Figures

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(1) INTRODUCTION

This document provides facts and figures about the performance of the TDF system compared with other compilers. It is based upon the Dhrystone 2.1 and SPEC 1.2B benchtests. TDF is an intermediate format for distributing software applications; it was developed by the United Kingdom's Defence Research Agency at RSRE, Malvern. TDF is designed to support a range of languages, but this document is concerned with C only. The document is split into three sections: the first section gives a summary of the performance figures; the second section gives a more detailed breakdown of the figures on each platform; the third section gives an explanation of how the figures were generated.

The figures in this document are up to date as of Thu Nov 5 16:56:10 GMT 1992. The table below shows the hardware, operating systems and compilers which were used for the tests:

Hardware	Operating System	Compilers
MIPS (DECSystem 5100)	Ultrix 4.2A	Ultrix 4.2A CC
80X86 (Dell 486)	SCO UNIX	GCC 1.37.1
80X86 (Kamco 486/50)	UNIX SVR4.2	SVR4.2 CC
SPARC (SPARCStation 2)	SUNOS 4.1.1	SUNOS 4.1.1 CC
680X0 (HP 9000/425T + 68040)	HP-UX 7.05	HP-UX 7.05 CC

The next table compares the performance of the TDF compiler against the native compiler on each platform. The first three figures indicate run time performance; the last column indicates compile time performance. For an exact description of what the figures mean, see section 3. The figures are ratios, where values greater than one indicate better performance from the TDF software, and values less than one indicate better performance from the native software.

Platform	dry2	dry2reg	SPEC	SPEC compile time
MIPS/Ultrix	1.00	1.00	0.98	1.28
80X86/SCO	1.29	1.29	1.02	0.78
80X86/SVR4.2	0.98	0.98	1.03	1.17
SPARC/SUNOS	1.07	1.07	1.11	1.23
680X0/HP-UX	1.05	1.06	1.07	0.86

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CAVEAT

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(2) MIPS/Ultrix performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	29688.3	29629.6	tcc	cc -O2
dry2reg	1000000	29703.0	29673.6	tcc	cc -O2

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	83.7	80.7	tcc	cc -O2
espresso	164.7	159.8	tcc	cc -O2
gcc	89.1	86.9	tcc	cc -O2
xlisp	351.6	360.4	tcc	cc -O2

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	4.7	8.8	13.5	16.8
espresso	49.7	58.3	107.9	117.3
gcc	129.0	206.1	335.2	570.9
xlisp	10.7	16.1	26.8	31.2

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	44555	94692	96588	72430
stripped	N/A	57344	57344	N/A
espresso	322000	309456	300572	381537
stripped	N/A	225280	208896	N/A
gcc	1374278	1357112	1282628	2747036
stripped	N/A	1003520	917504	N/A
xlisp	106771	183640	177556	170454
stripped	N/A	102400	94208	N/A

(2) MIPS/Ultrix (multi file optimisations) performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	30627.9	30643.5	tcc -M	cc -O3
dry2reg	1000000	30181.1	30927.8	tcc -M	cc -O3

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	83.5	72.9	tcc -M	cc -O3
espresso	166.1	155.8	tcc -M	cc -O3
gcc	89.1	86.9	tcc	cc -O2
xlisp	361.2	362.8	tcc -M	cc -O3

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	4.9	7.0	11.9	17.7
espresso	50.7	142.1	192.7	124.7
gcc	129.0	206.1	335.2	570.9
xlisp	10.8	16.3	27.0	41.0

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	44555	92252	87860	72430
stripped	N/A	57344	49152	N/A
espresso	322000	321492	298288	381537
stripped	N/A	241664	196608	N/A
gcc	1374278	1357112	1282628	2747036
stripped	N/A	1003520	917504	N/A
xlisp	106771	202096	190264	170454
stripped	N/A	122880	102400	N/A

(2) 80X86/SCO performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	29955.1	23264.8	tcc	gcc -O
dry2reg	1000000	30060.1	23319.1	tcc	gcc -O

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	78.0	78.3	tcc	gcc -O
espresso	144.8	153.2	tcc	gcc -O
gcc	73.9	69.3	tcc	gcc -O
xlisp	295.7	318.5	tcc	gcc -O

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	4.2	11.4	15.6	11.1
espresso	41.2	82.0	123.2	91.7
gcc	126.9	254.7	381.6	370.2
xlisp	9.1	25.9	35.0	25.1

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	44555	52713	53573	72430
stripped	N/A	36276	33672	N/A
espresso	322000	185653	168080	381537
stripped	N/A	158380	133556	N/A
gcc	1374661	796643	700931	2747229
stripped	N/A	698412	574960	N/A
xlisp	106771	95214	91174	170454
stripped	N/A	70068	61864	N/A

(2) 80X86/SVR4.2 performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	54377.4	55371.0	tcc	cc -O
dry2reg	1000000	54377.4	55309.7	tcc	cc -O

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	56.2	62.4	tcc	cc -O
espresso	101.9	99.7	tcc	cc -O
gcc	57.6	60.1	tcc	cc -O
xlisp	204.8	203.5	tcc	cc -O

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	3.8	7.0	10.8	11.7
espresso	41.4	44.7	86.1	83.6
gcc	101.1	157.0	258.1	378.5
xlisp	8.4	13.0	21.4	26.1

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	44555	30804	32436	72430
stripped	N/A	26772	27356	N/A
espresso	322000	158868	159776	381537
stripped	N/A	147164	145124	N/A
gcc	1374661	720044	696600	2747229
stripped	N/A	665716	620020	N/A
xlisp	106771	73984	76672	170454
stripped	N/A	62852	63476	N/A

(2) SPARC/SUNOS performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	46948.4	43699.9	tcc -Bstatic -TJ	cc -O4 -Bstatic
dry2reg	1000000	46948.4	43795.6	tcc -Bstatic -TJ	cc -O4 -Bstatic

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	48.9	56.8	tcc -Bstatic -TJ	cc -O4 -Bstatic
espresso	118.0	123.1	tcc -Bstatic -TJ	cc -O4 -Bstatic
gcc	62.5	62.6	tcc -Bstatic -TJ	cc -O2 -Bstatic
xlisp	272.2	336.2	tcc -Bstatic -TJ	cc -O3 -Bstatic

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	3.6	15.6	19.2	25.2
espresso	43.0	92.7	135.7	186.5
gcc	130.5	414.4	544.8	549.6
xlisp	9.0	27.3	36.3	45.5

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	38667	131072	139264	72430
stripped	N/A	122880	122880	N/A
espresso	283939	303104	311296	381537
stripped	N/A	286720	286720	N/A
gcc	1236797	1196032	1171456	2752411
stripped	N/A	1122304	1064960	N/A
xlisp	90398	212992	212992	170454
stripped	N/A	196608	188416	N/A

(2) 680X0/HP-UX performance breakdown

Runtime figures for Dhrystone2.1.

benchmark	iterations	tcc dhrystones/sec	native dhrystones/sec	tcc options	native compiler
dry2	1000000	34944.7	33204.2	tcc	cc -O
dry2reg	1000000	35087.7	33149.2	tcc	cc -O

Runtime figures for SPEC 1.2B

benchmark	tcc time (s)	native time (s)	tcc options	native compiler
eqntott	103.1	128.6	tcc	cc -O
espresso	207.3	192.2	tcc	cc -O
gcc	115.4	131.7	tcc	cc -O
xlisp	424.2	414.4	tcc	cc -O

Compile time figures for SPEC 1.2B

benchmark	tcc produce time (s)	tcc install time (s)	tcc total time (s)	native time (s)
eqntott	8.8	18.4	27.2	19.0
espresso	89.7	127.5	217.3	160.3
gcc	242.5	391.8	634.2	827.8
xlisp	19.6	38.1	57.7	46.6

Size figures for SPEC 1.2B

benchmark	TDF size (bytes)	tcc binary size (bytes)	native binary size (bytes)	source size (bytes)
eqntott	45241	53677	49778	72430
stripped	N/A	48184	44248	N/A
espresso	322000	195934	175454	381537
stripped	N/A	184320	163840	N/A
gcc	1379433	807228	770378	2751127
stripped	N/A	754572	717720	N/A
xlisp	107547	108626	104499	170454
stripped	N/A	98304	94208	N/A

(3) TEST DESCRIPTION

This section gives a description of the meaning of the figures given within the rest of this document. On all platforms apart from the MIPS, the highest available optimisation level that worked was used for the native compiler. The TDF software was invoked normally. On the MIPS, the -O2 optimisation level was used; the -O3 optimisation level performs multi file optimisations, so the figures generated by this optimisation level were put in the MIPS multi file optimisation section, along with the figures generated by the TDF compiler in multi file mode. In the multi file mode, the native C compiler compiled the GCC benchmark, but the program failed to execute correctly, so the -O2 optimisation level was used again. On the same benchmark, the TDF compiler ran out of memory trying to install the program, so the normal invocation was used again.

Dhrystone

The results from the Dhrystone tests, are figures in Dhrystones per second - the higher the figure, the better the performance. There are two versions of the Dhrystone 2.1 benchmark: dry2 (without register declarations), and dry2reg (with register declarations). The table in each platform entry shows the actual number of dhrystones per second generated. On the front cover, the dhrystone figures are just the ratio:

number of dhrystones per second from the TDF compiled code
to
number of dhrystones per second from the native compiled code

In each case, the dhrystone program was run for one million iterations.

SPEC

Slightly more figures are given for the SPEC tests. The run times are given in seconds (the smaller the better), as are compile times; also, the sizes of source, TDF, and binary (stripped and unstripped) files are given in bytes. All times are measured as user times - system times are ignored. In each case, the source sizes given are the sizes of the files used in the production of the TDF distributable. In the case of GCC, it is impossible to compile GCC in a target independent manner, without modifications; this means that the TDF distributable is unlikely to be portable between platforms; it also means that the source and TDF distributable sizes may vary across platforms, because slightly different configuration files were used. The size figures for GCC TDF and binaries is the sum of the individual sizes of the GCC, CPP and CC1 components of GCC.

In the entry for each platform, the times given are the total run times for the reference input files for the test. The options columns give the compiler and optimisation flags used in the compilation. The produce time column is the time taken to produce a piece of TDF that can be distributed, and the install time column is the time taken to install the TDF (in the case of GCC, three pieces of TDF are produced - one for each binary); the total time is the sum of the produce and install times, and the native compiler time is the time for the native compiler to produce a binary directly. The sizes have already been described.

The summary figures in the first section, are the geometric means of the individual ratios of each test. The individual test ratios are:

run time of native compiled software, or compile time of native compiler
to
run time of TDF compiled software, or compile time of TDF compiler

This is the opposite way round from Dhrystone, because in Dhrystone higher numbers are better, and in SPEC lower numbers are better. This means that the ratios are always greater than one when the TDF software performs better, and less than one when the native compiler performs better.