

# CRC16 - CRC64 test results on 18.2M dataset, w/program source

## Program & Test Run by Matt Dillon

### 18.2M message-id dataset supplied by Joe Greco

I would like to thank everyone who offered their history files and/or message-id logs to run this test. I wound up using most of them for smaller runs during my construction of the CRC test program, and used an 18.2 million message-id data set supplied by Joe Greco for the final test runs shown below.

Using the program I posted earlier with one minor bug in the placement of ++total corrected, I ran the 18.2 million message-id data set with CRC's ranging from 16 to 64 bits. The number of collisions are shown below. The program is included at the bottom.

The lower numbered CRC's tended on collision rates nearing 100% after a certain number of samples, which is as expected. Once the test got beyond the noise floor, each additional bit of CRC cut the number of collisions down by approximately half. No collisions occurred with the 18.2 million message-id's dataset once we got beyond CRC48, but one can extrapolate a collision rate of one message-id per 2.3 Trillion message-id's with a CRC64 from empirical data. The theoretical collision rate for CRC64 and 18.2 million message-id's is one collision every 2 trillion message-id's so we have good correspondance to theory.

I should have used a real CRC long ago rather than try to do something fancy with prime numbers. The 1.14 diablo release is going to use the CRC64 algorithm included at the end (well, actually CRC63 as I want to reserve one bit for future use). Besides, it's a good deal faster then the old prime-mod algorithm anyway as it only requires shift and xor ops to implement.

-Matt (dillon@backplane.com)

Summary, 18.2 million sample test dataset, number of collisions.

```
output.16 Count 18134464/18200000
output.17 Count 18068928/18200000
output.18 Count 17937856/18200000
output.19 Count 17675712/18200000
output.20 Count 17151424/18200000
output.21 Count 16103198/18200000
output.22 Count 14061250/18200000
output.23 Count 10770169/18200000
output.24 Count 7092360/18200000
output.25 Count 4153742/18200000
output.26 Count 2259269/18200000
output.27 Count 1179721/18200000
output.28 Count 603421/18200000
output.29 Count 305089/18200000
output.30 Count 153722/18200000
output.31 Count 77254/18200000
output.32 Count 38638/18200000
output.33 Count 19232/18200000
output.34 Count 9652/18200000
output.35 Count 4914/18200000
output.36 Count 2343/18200000
output.37 Count 1204/18200000
output.38 Count 637/18200000
output.39 Count 302/18200000
output.40 Count 152/18200000
output.41 Count 75/18200000
output.42 Count 52/18200000
output.43 Count 21/18200000
output.44 Count 13/18200000
output.45 Count 7/18200000
output.46 Count 1/18200000
```

(below noise floor)

```

output.47 Count 1/18200000 (below noise floor)
output.48 Count 1/18200000 (below noise floor)
output.49 Count 0/18200000 (below noise floor)
output.50 Count 0/18200000 (... all remaining entries below noise
output.51 Count 0/18200000 floor)
output.52 Count 0/18200000
output.53 Count 0/18200000
output.54 Count 0/18200000
output.55 Count 0/18200000
output.56 Count 0/18200000
output.57 Count 0/18200000
output.58 Count 0/18200000
output.59 Count 0/18200000
output.60 Count 0/18200000
output.61 Count 0/18200000
output.62 Count 0/18200000
output.63 Count 0/18200000
output.64 Count 0/18200000

```

Raw data, collisions for 18.2 million sample data set in increments of 100,000 samples for CRC16 through CRC64. Note that near the end, CRC16 through CRC20 approach a 100% collision rate. No collisions occurred with the test dataset beyond CRC-48.

SAMPLES	CRC16	CRC17	CRC18	CRC19	CRC20	CRC21	CRC22
0.1M	48694	29762	17032	9070	4519	2274	1212
0.2M	137655	97436	60243	34119	17834	9211	4809
0.3M	235174	182198	121457	71883	39173	20303	10626
0.4M	334630	275232	194897	120208	67433	35624	18672
0.5M	434497	371788	277068	177992	102379	55094	28973
0.6M	534472	470260	364505	242833	143019	78184	41394
0.7M	634464	569530	456066	314036	189198	105006	55646
0.8M	734464	669213	550297	389973	240256	135019	72156
0.9M	834464	769050	646412	470339	295794	168415	91007
1.0M	934464	868987	743717	554420	356011	205050	111280
1.1M	1034464	968955	841834	640870	419364	244383	133311
1.2M	1134464	1068940	940621	729741	486134	286809	157443
1.3M	1234464	1168934	1039769	820321	555780	331720	183461
1.4M	1334464	1268929	1139183	912533	628092	379218	210872
1.5M	1434464	1368928	1238758	1006000	702876	429273	239867
1.6M	1534464	1468928	1338453	1100821	779956	481688	270883
1.7M	1634464	1568928	1438273	1196438	859240	536198	303568
1.8M	1734464	1668928	1538141	1292873	940251	592525	337916
1.9M	1834464	1768928	1638059	1389909	1023041	651033	373656
2.0M	1934464	1868928	1737994	1487422	1107333	711244	410826
2.1M	2034464	1968928	1837950	1585341	1193293	773717	449497
2.2M	2134464	2068928	1937912	1683661	1280182	837874	489659
2.3M	2234464	2168928	2037896	1782338	1368569	903329	531092
2.4M	2334464	2268928	2137886	1881219	1457974	970943	574008
2.5M	2434464	2368928	2237876	1980254	1548323	1040150	618300
2.6M	2534464	2468928	2337871	2079431	1639565	1110486	663715
2.7M	2634464	2568928	2437865	2178796	1731494	1182295	710659
2.8M	2734464	2668928	2537864	2278265	1824318	1255416	758787
2.9M	2834464	2768928	2637862	2377821	1917637	1329614	808881
3.0M	2934464	2868928	2737860	2477444	2011671	1404983	859560
3.1M	3034464	2968928	2837860	2577106	2106181	1481548	911427
3.2M	3134464	3068928	2937858	2676871	2201256	1559161	964548
3.3M	3234464	3168928	3037857	2776663	2296730	1637708	1018633
3.4M	3334464	3268928	3137857	2876501	2392603	1717381	1073688
3.5M	3434464	3368928	3237856	2976378	2488787	1797956	1129971
3.6M	3534464	3468928	3337856	3076253	2585461	1879781	1187477
3.7M	3634464	3568928	3437856	3176153	2682289	1962055	1245443
3.8M	3734464	3668928	3537856	3276069	2779522	2045323	1304322
3.9M	3834464	3768928	3637856	3375998	2876899	2129150	1364051
4.0M	3934464	3868928	3737856	3475954	2974533	2213928	1425122
4.1M	4034464	3968928	3837856	3575923	3072335	2299534	1486908
4.2M	4134464	4068928	3937856	3675886	3170396	2385735	1549452
4.3M	4234464	4168928	4037856	3775858	3268655	2472571	1613325
4.4M	4334464	4268928	4137856	3875842	3367088	2559869	1677674

4.5M	4434464	4368928	4237856	3975821	3465615	2648049	1742853
4.6M	4534464	4468928	4337856	4075795	3564349	2736602	1809114
4.7M	4634464	4568928	4437856	4175777	3663217	2825783	1876105
4.8M	4734464	4668928	4537856	4275764	3762136	2915383	1943892
4.9M	4834464	4768928	4637856	4375759	3861176	3005392	2012783
5.0M	4934464	4868928	4737856	4475750	3960320	3095984	2081668
5.1M	5034464	4968928	4837856	4575741	4059520	3187080	2151865
5.2M	5134464	5068928	4937856	4675736	4158805	3278589	2222601
5.3M	5234464	5168928	5037856	4775732	4258124	3370362	2294052
5.4M	5334464	5268928	5137856	4875729	4357467	3462417	2366046
5.5M	5434464	5368928	5237856	4975724	4456955	3555133	2439316
5.6M	5534464	5468928	5337856	5075718	4556432	3647988	2512981
5.7M	5634464	5568928	5437856	5175717	4655960	3741135	2586722
5.8M	5734464	5668928	5537856	5275716	4755527	3834632	2661206
5.9M	5834464	5768928	5637856	5375716	4855124	3928457	2736335
6.0M	5934464	5868928	5737856	5475716	4954791	4022609	2812198
6.1M	6034464	5968928	5837856	5575716	5054480	4116952	2888493
6.2M	6134464	6068928	5937856	5675715	5154207	4211638	2965405
6.3M	6234464	6168928	6037856	5775713	5253974	4306725	3042750
6.4M	6334464	6268928	6137856	5875713	5353726	4401850	3120827
6.5M	6434464	6368928	6237856	5975713	5453499	4497092	3199416
6.6M	6534464	6468928	6337856	6075713	5553283	4592770	3278557
6.7M	6634464	6568928	6437856	6175712	5653122	4688523	3357916
6.8M	6734464	6668928	6537856	6275712	5752959	4784520	3437768
6.9M	6834464	6768928	6637856	6375712	5852821	4880693	3518173
7.0M	6934464	6868928	6737856	6475712	5952687	4977178	3599520
7.1M	7034464	6968928	6837856	6575712	6052594	5073701	3680754
7.2M	7134464	7068928	6937856	6675712	6152491	5170430	3762707
7.3M	7234464	7168928	7037856	6775712	6252398	5267324	3844797
7.4M	7334464	7268928	7137856	6875712	6352304	5364342	3927360
7.5M	7434464	7368928	7237856	6975712	6452219	5461484	4010446
7.6M	7534464	7468928	7337856	7075712	6552148	5558762	4093846
7.7M	7634464	7568928	7437856	7175712	6652078	5656120	4177539
7.8M	7734464	7668928	7537856	7275712	6752016	5753645	4261754
7.9M	7834464	7768928	7637856	7375712	6851972	5851322	4346179
8.0M	7934464	7868928	7737856	7475712	6951923	5949090	4431051
8.1M	8034464	7968928	7837856	7575712	7051873	6047013	4516301
8.2M	8134464	8068928	7937856	7675712	7151834	6145045	4602179
8.3M	8234464	8168928	8037856	7775712	7251795	6243049	4688051
8.4M	8334464	8268928	8137856	7875712	7351768	6341112	4774326
8.5M	8434464	8368928	8237856	7975712	7451730	6439315	4860966
8.6M	8534464	8468928	8337856	8075712	7551700	6537656	4947710
8.7M	8634464	8568928	8437856	8175712	7651675	6636098	5035000
8.8M	8734464	8668928	8537856	8275712	7751661	6734537	5122377
8.9M	8834464	8768928	8637856	8375712	7851639	6833018	5210463
9.0M	8934464	8868928	8737856	8475712	7951624	6931591	5298611
9.1M	9034464	8968928	8837856	8575712	8051609	7030228	5387026
9.2M	9134464	9068928	8937856	8675712	8151591	7128959	5475625
9.3M	9234464	9168928	9037856	8775712	8251571	7227687	5564631
9.4M	9334464	9268928	9137856	8875712	8351554	7326511	5653851
9.5M	9434464	9368928	9237856	8975712	8451536	7425413	5743199
9.6M	9534464	9468928	9337856	9075712	8551525	7524363	5832806
9.7M	9634464	9568928	9437856	9175712	8651512	7623334	5922809
9.8M	9734464	9668928	9537856	9275712	8751506	7722378	6012870
9.9M	9834464	9768928	9637856	9375712	8851498	7821467	6103347
10.0M	9934464	9868928	9737856	9475712	8951490	7920572	6193916
10.1M	10034464	9968928	9837856	9575712	9051482	8019780	6284966
10.2M	10134464	10068928	9937856	9675712	9151477	8118999	6376112
10.3M	10234464	10168928	10037856	9775712	9251476	8218282	6467503
10.4M	10334464	10268928	10137856	9875712	9351467	8317547	6558992
10.5M	10434464	10368928	10237856	9975712	9451464	8416839	6650539
10.6M	10534464	10468928	10337856	10075712	9551457	8516198	6742411
10.7M	10634464	10568928	10437856	10175712	9651456	8615549	6834358
10.8M	10734464	10668928	10537856	10275712	9751453	8714980	6926671
10.9M	10834464	10768928	10637856	10375712	9851450	8814399	7019247
11.0M	10934464	10868928	10737856	10475712	9951450	8913863	7111788
11.1M	11034464	10968928	10837856	10575712	10051446	9013352	7204576
11.2M	11134464	11068928	10937856	10675712	10151441	9112830	7297627
11.3M	11234464	11168928	11037856	10775712	10251439	9212377	7390677

11.4M	11334464	11268928	11137856	10875712	10351438	9311932	7484095
11.5M	11434464	11368928	11237856	10975712	10451438	9411486	7577501
11.6M	11534464	11468928	11337856	11075712	10551437	9511091	7671099
11.7M	11634464	11568928	11437856	11175712	10651437	9610721	7764779
11.8M	11734464	11668928	11537856	11275712	10751437	9710338	7858777
11.9M	11834464	11768928	11637856	11375712	10851437	9809986	7952825
12.0M	11934464	11868928	11737856	11475712	10951437	9909670	8046961
12.1M	12034464	11968928	11837856	11575712	11051435	10009330	8141240
12.2M	12134464	12068928	11937856	11675712	11151435	10109004	8235736
12.3M	12234464	12168928	12037856	11775712	11251434	10208737	8330319
12.4M	12334464	12268928	12137856	11875712	11351433	10308453	8425059
12.5M	12434464	12368928	12237856	11975712	11451433	10408196	8519955
12.6M	12534464	12468928	12337856	12075712	11551432	10507935	8614938
12.7M	12634464	12568928	12437856	12175712	11651432	10607685	8709879
12.8M	12734464	12668928	12537856	12275712	11751430	10707493	8804977
12.9M	12834464	12768928	12637856	12375712	11851429	10807250	8900269
13.0M	12934464	12868928	12737856	12475712	11951427	10907058	8995654
13.1M	13034464	12968928	12837856	12575712	12051427	11006869	9091102
13.2M	13134464	13068928	12937856	12675712	12151427	11106665	9186622
13.3M	13234464	13168928	13037856	12775712	12251426	11206488	9282381
13.4M	13334464	13268928	13137856	12875712	12351426	11306298	9378266
13.5M	13434464	13368928	13237856	12975712	12451426	11406124	9474206
13.6M	13534464	13468928	13337856	13075712	12551426	11505980	9570249
13.7M	13634464	13568928	13437856	13175712	12651425	11605825	9666364
13.8M	13734464	13668928	13537856	13275712	12751425	11705689	9762618
13.9M	13834464	13768928	13637856	13375712	12851425	11805548	9858964
14.0M	13934464	13868928	13737856	13475712	12951425	11905437	9955306
14.1M	14034464	13968928	13837856	13575712	13051425	12005318	10051762
14.2M	14134464	14068928	13937856	13675712	13151425	12105187	10148339
14.3M	14234464	14168928	14037856	13775712	13251425	12205080	10245025
14.4M	14334464	14268928	14137856	13875712	13351425	12304974	10341792
14.5M	14434464	14368928	14237856	13975712	13451425	12404875	10438678
14.6M	14534464	14468928	14337856	14075712	13551425	12504772	10535607
14.7M	14634464	14568928	14437856	14175712	13651425	12604690	10632601
14.8M	14734464	14668928	14537856	14275712	13751425	12704618	10729595
14.9M	14834464	14768928	14637856	14375712	13851425	12804530	10826613
15.0M	14934464	14868928	14737856	14475712	13951425	12904462	10923845
15.1M	15034464	14968928	14837856	14575712	14051424	13004397	11021244
15.2M	15134464	15068928	14937856	14675712	14151424	13104310	11118579
15.3M	15234464	15168928	15037856	14775712	14251424	13204247	11215898
15.4M	15334464	15268928	15137856	14875712	14351424	13304182	11313297
15.5M	15434464	15368928	15237856	14975712	14451424	13404110	11410738
15.6M	15534464	15468928	15337856	15075712	14551424	13504040	11508202
15.7M	15634464	15568928	15437856	15175712	14651424	13603999	11605874
15.8M	15734464	15668928	15537856	15275712	14751424	13703953	11703560
15.9M	15834464	15768928	15637856	15375712	14851424	13803901	11801236
16.0M	15934464	15868928	15737856	15475712	14951424	13903861	11899051
16.1M	16034464	15968928	15837856	15575712	15051424	14003807	11996838
16.2M	16134464	16068928	15937856	15675712	15151424	14103752	12094750
16.3M	16234464	16168928	16037856	15775712	15251424	14203708	12192725
16.4M	16334464	16268928	16137856	15875712	15351424	14303666	12290669
16.5M	16434464	16368928	16237856	15975712	15451424	14403623	12388681
16.6M	16534464	16468928	16337856	16075712	15551424	14503585	12486733
16.7M	16634464	16568928	16437856	16175712	15651424	14603553	12584808
16.8M	16734464	16668928	16537856	16275712	15751424	14703524	12682912
16.9M	16834464	16768928	16637856	16375712	15851424	14803488	12781127
17.0M	16934464	16868928	16737856	16475712	15951424	14903456	12879337
17.1M	17034464	16968928	16837856	16575712	16051424	15003425	12977634
17.2M	17134464	17068928	16937856	16675712	16151424	15103396	13076030
17.3M	17234464	17168928	17037856	16775712	16251424	15203379	13174358
17.4M	17334464	17268928	17137856	16875712	16351424	15303355	13272762
17.5M	17434464	17368928	17237856	16975712	16451424	15403335	13371202
17.6M	17534464	17468928	17337856	17075712	16551424	15503319	13469702
17.7M	17634464	17568928	17437856	17175712	16651424	15603292	13568257
17.8M	17734464	17668928	17537856	17275712	16751424	15703269	13666849
17.9M	17834464	17768928	17637856	17375712	16851424	15803253	13765429
18.0M	17934464	17868928	17737856	17475712	16951424	15903234	13863977
18.1M	18034464	17968928	17837856	17575712	17051424	16003219	13962602
18.2M	18134464	18068928	17937856	17675712	17151424	16103198	14061250

SAMPLES	CRC23	CRC24	CRC25	CRC26	CRC27	CRC28	CRC29
0.1M	598	306	137	70	33	32	6
0.2M	2335	1234	566	286	148	80	36
0.3M	5306	2735	1297	660	338	185	76
0.4M	9430	4829	2366	1184	593	317	136
0.5M	14681	7449	3695	1874	921	480	212
0.6M	21107	10766	5245	2713	1329	693	298
0.7M	28501	14579	7107	3685	1816	904	418
0.8M	37024	18949	9289	4775	2368	1200	552
0.9M	46627	24062	11747	6030	2999	1535	726
1.0M	57487	29702	14566	7434	3696	1883	900
1.1M	69275	35841	17618	8982	4420	2278	1085
1.2M	82141	42418	20918	10651	5242	2735	1276
1.3M	96156	49607	24643	12528	6177	3183	1499
1.4M	111276	57246	28584	14504	7199	3696	1758
1.5M	127029	65713	32852	16703	8258	4216	2014
1.6M	143865	74504	37372	18965	9457	4783	2301
1.7M	161585	83821	42201	21422	10655	5389	2619
1.8M	180441	93854	47342	24001	11889	6021	2951
1.9M	200263	104260	52762	26616	13185	6772	3319
2.0M	221162	115303	58522	29495	14641	7464	3695
2.1M	242900	126968	64519	32496	16135	8248	4043
2.2M	265379	138820	70649	35669	17693	9107	4425
2.3M	288571	151326	77168	38938	19352	9945	4823
2.4M	313292	164446	83828	42437	21123	10814	5259
2.5M	338649	178029	90793	46129	22904	11731	5707
2.6M	364782	191998	98126	49769	24770	12694	6162
2.7M	391948	206469	105679	53707	26723	13659	6674
2.8M	419944	221809	113607	57564	28802	14709	7193
2.9M	448832	237389	121759	61602	30890	15774	7706
3.0M	478396	253470	130141	65867	33047	16816	8240
3.1M	508687	270291	138637	70316	35271	17905	8812
3.2M	540217	287476	147678	74859	37606	19129	9408
3.3M	572296	305265	156955	79640	39914	20350	10023
3.4M	605420	323515	166486	84549	42430	21573	10604
3.5M	638872	342001	176178	89627	44887	22792	11253
3.6M	673129	361187	186194	94767	47494	24140	11900
3.7M	708473	380771	196431	100218	50156	25444	12592
3.8M	744369	400876	206800	105706	52979	26836	13295
3.9M	780955	421301	217722	111263	55733	28324	14002
4.0M	818390	442216	228815	117014	58573	29743	14807
4.1M	856571	463657	240135	122766	61487	31332	15604
4.2M	895532	485462	252048	128679	64498	32896	16394
4.3M	935469	507851	264139	134772	67682	34453	17218
4.4M	975900	530708	276442	141257	70868	36074	18028
4.5M	1017374	554071	288827	147595	74039	37776	18855
4.6M	1059203	577909	301600	154174	77331	39428	19643
4.7M	1101552	602257	314549	160859	80834	41170	20477
4.8M	1144992	626778	327859	167784	84408	42867	21341
4.9M	1188794	651887	341437	174827	87939	44739	22290
5.0M	1233483	677637	355189	181913	91607	46549	23210
5.1M	1278421	703639	369263	189188	95288	48468	24240
5.2M	1324268	730216	383778	196721	99069	50336	25218
5.3M	1370968	757144	398346	204267	103016	52277	26184
5.4M	1417902	784180	413025	211841	106849	54250	27094
5.5M	1465747	811487	428132	219655	110759	56255	28133
5.6M	1514383	839518	443263	227626	114699	58339	29120
5.7M	1563810	868006	458810	235669	118800	60468	30139
5.8M	1613471	896956	474399	243918	123037	62585	31232
5.9M	1663949	926603	490449	252118	127315	64666	32315
6.0M	1714516	956492	506785	260532	131701	66899	33472
6.1M	1765810	986562	523349	269151	136225	69092	34620
6.2M	1817739	1017192	540065	277971	140628	71259	35762
6.3M	1870430	1048318	557046	286727	145164	73579	36951
6.4M	1923638	1079833	574308	295666	149822	75931	38072
6.5M	1977181	1111621	591828	304971	154424	78272	39252
6.6M	2031459	1144030	609595	314167	159226	80721	40395
6.7M	2085994	1176831	627683	323524	164060	83122	41675

6.8M	2141515	1210039	646090	333102	168887	85585	42911
6.9M	2197223	1243855	664616	342720	173795	88099	44193
7.0M	2253569	1277740	683171	352551	178905	90730	45393
7.1M	2310351	1312201	702035	362443	183878	93317	46719
7.2M	2367654	1346849	721347	372719	189118	95933	48061
7.3M	2425624	1382084	740728	383077	194279	98579	49507
7.4M	2483970	1417656	760522	393410	199683	101318	50878
7.5M	2542727	1453590	780226	403876	204928	104062	52287
7.6M	2602062	1489780	800270	414469	210419	106871	53734
7.7M	2661912	1526505	820536	425143	215961	109711	55135
7.8M	2722210	1563733	841047	436063	221645	112607	56571
7.9M	2782962	1601126	861733	447190	227269	115499	58002
8.0M	2844204	1638734	882940	458253	233187	118369	59377
8.1M	2905933	1676572	904301	469550	238933	121290	60813
8.2M	2968083	1715260	925998	480909	244884	124155	62297
8.3M	3030784	1754147	947997	492632	250902	127264	63749
8.4M	3093943	1793254	970024	504392	256839	130274	65237
8.5M	3157444	1832970	992239	516154	263022	133460	66790
8.6M	3221068	1872706	1014848	528065	269138	136573	68376
8.7M	3285260	1912830	1037537	540147	275389	139855	70009
8.8M	3349847	1953431	1060607	552455	281775	143027	71640
8.9M	3414900	1994427	1083885	564788	288229	146179	73270
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9.1M	3546460	2077748	1131341	589682	300996	152798	76575
9.2M	3612868	2119929	1155187	602578	307633	156161	78284
9.3M	3679701	2162297	1179455	615511	314329	159465	79963
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9.5M	3814413	2248449	1228279	641663	327926	166447	83343
9.6M	3882334	2291530	1253011	654731	334816	169884	85126
9.7M	3950743	2335211	1278081	668064	341818	173394	86907
9.8M	4018912	2379492	1303287	681715	348896	176927	88708
9.9M	4088083	2424026	1328878	695455	356134	180502	90526
10.0M	4157313	2468796	1354647	709235	363253	184126	92350
10.1M	4227398	2513755	1380688	723112	370404	187748	94204
10.2M	4297481	2558656	1406727	737107	377737	191364	96045
10.3M	4368102	2604129	1433107	751260	385239	195041	98009
10.4M	4438798	2650293	1459641	765752	392742	198809	99969
10.5M	4510042	2696494	1486393	780126	400293	202587	101951
10.6M	4581494	2743142	1513628	794526	407826	206438	103843
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11.0M	4870833	2933014	1623715	854401	438894	221970	111864
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11.3M	5091586	3078432	1708619	900291	462611	234149	117973
11.4M	5165891	3127402	1737305	915864	470699	238213	120022
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11.6M	5315253	3226697	1795435	947538	487157	246682	124342
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11.9M	5541510	3377708	1884039	995634	512374	259459	130703
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12.2M	5770390	3531628	1974367	1044907	538294	272762	137362
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12.6M	6079098	3740241	2097803	1112416	573656	290780	146435
12.7M	6156852	3793168	2129166	1129462	582679	295409	148752
12.8M	6234991	3846455	2160857	1146942	591699	300053	151066
12.9M	6313305	3899816	2192755	1164452	600923	304684	153359
13.0M	6391805	3953652	2224742	1181916	610099	309438	155758
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13.3M	6629008	4116612	2322142	1235564	637862	323755	163051
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13.7M	6948959	4337624	2454599	1308817	676284	343233	173033
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13.9M	7110350	4449972	2522082	1345862	696013	353394	178152
14.0M	7191282	4506534	2556145	1364605	705930	358453	180769
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14.2M	7353898	4620464	2624855	1402482	725903	368824	185983
14.3M	7435652	4677820	2659181	1421719	735908	374015	188678
14.4M	7517384	4735237	2693761	1441152	745999	379321	191295
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14.6M	7682109	4850729	2763886	1480268	766496	389859	196492
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14.8M	7847673	4967248	2834418	1519422	787405	400734	201999
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15.0M	8014101	5084718	2906005	1559431	808712	411700	207448
15.1M	8098470	5143511	2941725	1579422	819426	417066	210173
15.2M	8182415	5202876	2977903	1599562	830197	422610	212874
15.3M	8266184	5262744	3014356	1619957	840902	428061	215697
15.4M	8350008	5322434	3051127	1640445	851750	433659	218539
15.5M	8433990	5382231	3088288	1660993	862623	439354	221429
15.6M	8518595	5442684	3125526	1681579	873448	445058	224222
15.7M	8603030	5503319	3162868	1702220	884636	450645	227145
15.8M	8687708	5564179	3200416	1723095	895735	456224	230029
15.9M	8772689	5625449	3237976	1744179	906845	461952	232930
16.0M	8857973	5686672	3275817	1765436	918138	467618	235861
16.1M	8943288	5748209	3313973	1786788	929331	473402	238842
16.2M	9028668	5810109	3351938	1808177	940389	479146	241816
16.3M	9114163	5872118	3390118	1829751	951696	485017	244776
16.4M	9200121	5934331	3428694	1851395	963180	490947	247822
16.5M	9286007	5996612	3467221	1872875	974620	496944	250882
16.6M	9372012	6059317	3506292	1894849	986234	502734	253973
16.7M	9458202	6122215	3545563	1917044	997824	508770	257098
16.8M	9544827	6185514	3585185	1939007	1009459	514758	260095
16.9M	9631424	6248792	3624656	1961210	1021186	520766	263145
17.0M	9717886	6312228	3664147	1983486	1033057	526828	266255
17.1M	9804653	6376231	3704077	2005842	1045006	533034	269413
17.2M	9891451	6440246	3744092	2028282	1056942	539151	272609
17.3M	9978615	6504484	3784090	2050970	1068949	545393	275829
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17.5M	10153638	6633419	3864988	2096617	1093007	558241	282168
17.6M	10241316	6698409	3905771	2119439	1105345	564643	285307
17.7M	10329060	6763735	3946805	2142721	1117568	571041	288589
17.8M	10416956	6829189	3987814	2165682	1129935	577460	291925
17.9M	10505125	6894783	4028719	2188977	1142181	583945	295143
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SAMPLES	CRC30	CRC31	CRC32	CRC33	CRC34	CRC35	CRC36
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0.2M	14	12	5	3	0	1	0
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0.4M	73	37	20	10	9	3	3
0.5M	110	65	29	16	12	4	4
0.6M	161	86	44	22	14	6	5
0.7M	219	121	66	33	14	8	5
0.8M	292	151	84	41	19	9	5
0.9M	370	195	104	53	26	11	5
1.0M	455	238	124	68	29	12	6
1.1M	557	281	149	78	32	15	8
1.2M	669	350	178	88	38	17	12
1.3M	786	401	213	93	42	19	14
1.4M	924	472	240	105	43	24	14
1.5M	1055	533	265	120	50	29	16
1.6M	1222	592	302	133	58	37	19
1.7M	1364	662	345	152	61	42	24
1.8M	1520	744	378	171	74	47	25
1.9M	1700	825	413	192	90	54	28
2.0M	1905	910	465	219	108	60	30
2.1M	2125	1004	528	239	116	68	33

2.2M	2335	1121	587	270	124	78	37
2.3M	2537	1210	632	288	136	86	43
2.4M	2742	1328	680	314	151	95	48
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2.6M	3198	1533	808	375	180	110	56
2.7M	3455	1655	882	417	194	117	58
2.8M	3705	1772	954	447	212	125	63
2.9M	3959	1895	1010	482	231	143	65
3.0M	4220	2023	1085	509	250	157	69
3.1M	4492	2181	1153	547	268	162	70
3.2M	4759	2326	1238	582	292	171	73
3.3M	5075	2469	1339	623	311	182	76
3.4M	5401	2633	1427	673	333	191	80
3.5M	5677	2779	1506	708	357	205	93
3.6M	6026	2951	1581	758	384	218	97
3.7M	6364	3121	1669	804	413	232	100
3.8M	6708	3283	1757	835	430	244	103
3.9M	7076	3471	1834	880	452	255	106
4.0M	7439	3661	1927	919	473	266	113
4.1M	7833	3841	2027	962	499	270	117
4.2M	8246	4053	2112	1007	533	278	120
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4.9M	11251	5503	2812	1350	704	364	154
5.0M	11717	5751	2936	1400	737	375	160
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5.2M	12657	6200	3175	1526	789	406	172
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5.9M	16091	7976	4067	1950	1037	509	229
6.0M	16659	8246	4215	2026	1073	534	236
6.1M	17254	8532	4362	2095	1112	555	244
6.2M	17798	8790	4510	2157	1148	570	248
6.3M	18420	9085	4651	2245	1187	590	258
6.4M	19001	9380	4825	2300	1225	601	268
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7.0M	22729	11258	5715	2748	1448	721	321
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7.2M	24041	11916	6019	2924	1532	763	342
7.3M	24704	12273	6168	3009	1567	782	350
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7.8M	28206	14045	7054	3481	1802	887	399
7.9M	28985	14434	7249	3573	1842	913	410
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8.1M	30449	15167	7621	3779	1917	958	428
8.2M	31227	15563	7825	3868	1976	988	440
8.3M	31961	15903	8007	3963	2018	1013	454
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8.6M	34361	17108	8654	4256	2172	1082	483
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8.8M	36012	17952	9038	4470	2270	1133	506
8.9M	36815	18365	9245	4563	2325	1163	516
9.0M	37651	18780	9479	4665	2368	1186	529



9.1M	38487	19235	9680	4778	2424	1213	546
9.2M	39342	19662	9904	4908	2463	1236	558
9.3M	40204	20111	10096	5015	2512	1264	568
9.4M	41091	20551	10331	5124	2560	1293	580
9.5M	41938	21011	10555	5214	2601	1332	597
9.6M	42800	21427	10769	5332	2662	1367	611
9.7M	43735	21870	10981	5447	2711	1388	625
9.8M	44634	22288	11210	5573	2773	1426	644
9.9M	45530	22731	11436	5686	2835	1449	652
10.0M	46438	23254	11632	5806	2895	1468	673
10.1M	47382	23687	11873	5923	2940	1493	686
10.2M	48408	24141	12107	6042	2996	1518	703
10.3M	49328	24617	12346	6165	3070	1544	710
10.4M	50264	25093	12593	6302	3138	1570	728
10.5M	51204	25574	12855	6426	3194	1608	741
10.6M	52219	26095	13111	6542	3263	1639	758
10.7M	53182	26614	13358	6659	3333	1666	772
10.8M	54136	27110	13599	6774	3404	1694	787
10.9M	55135	27646	13864	6895	3464	1723	805
11.0M	56179	28181	14130	7037	3513	1766	827
11.1M	57241	28667	14358	7151	3581	1795	838
11.2M	58307	29175	14617	7287	3644	1832	852
11.3M	59374	29686	14885	7417	3710	1870	872
11.4M	60438	30202	15161	7563	3786	1897	890
11.5M	61468	30806	15414	7693	3861	1934	909
11.6M	62586	31353	15707	7843	3913	1971	925
11.7M	63662	31921	15995	7975	3980	2007	939
11.8M	64767	32464	16272	8121	4049	2039	953
11.9M	65897	32981	16545	8269	4108	2076	967
12.0M	66985	33509	16845	8415	4172	2124	985
12.1M	68102	34069	17123	8547	4237	2156	1005
12.2M	69190	34659	17398	8677	4303	2185	1018
12.3M	70382	35204	17669	8825	4386	2242	1038
12.4M	71516	35825	17955	8962	4458	2280	1061
12.5M	72756	36455	18259	9090	4542	2310	1071
12.6M	73997	37059	18549	9209	4629	2342	1080
12.7M	75137	37678	18854	9351	4708	2363	1103
12.8M	76299	38247	19150	9491	4785	2408	1124
12.9M	77493	38850	19471	9662	4866	2442	1141
13.0M	78651	39403	19777	9796	4936	2481	1160
13.1M	79844	40002	20081	9967	4999	2513	1174
13.2M	81058	40633	20368	10107	5081	2543	1194
13.3M	82236	41261	20669	10240	5151	2585	1215
13.4M	83469	41874	20970	10393	5233	2622	1234
13.5M	84700	42521	21304	10573	5326	2662	1254
13.6M	85951	43170	21652	10747	5399	2709	1277
13.7M	87223	43782	21981	10896	5501	2754	1300
13.8M	88494	44437	22300	11024	5571	2795	1318
13.9M	89791	45049	22605	11176	5662	2832	1340
14.0M	91070	45680	22967	11342	5743	2874	1358
14.1M	92347	46305	23306	11497	5834	2933	1383
14.2M	93635	46972	23656	11701	5917	2976	1401
14.3M	95019	47648	23981	11870	5985	3035	1426
14.4M	96365	48364	24299	12019	6057	3068	1446
14.5M	97729	49043	24620	12203	6130	3120	1471
14.6M	99114	49774	24949	12355	6207	3156	1488
14.7M	100474	50460	25291	12531	6282	3199	1513
14.8M	101838	51157	25664	12678	6348	3238	1546
14.9M	103199	51886	26018	12852	6447	3279	1578
15.0M	104561	52562	26337	13045	6544	3317	1604
15.1M	105950	53225	26686	13225	6656	3366	1622
15.2M	107447	53905	27040	13395	6746	3411	1644
15.3M	108912	54637	27370	13572	6837	3448	1667
15.4M	110277	55329	27727	13724	6933	3501	1687
15.5M	111673	56046	28109	13911	7025	3535	1714
15.6M	113141	56768	28469	14101	7094	3580	1733
15.7M	114587	57501	28818	14277	7174	3630	1760
15.8M	116054	58230	29180	14451	7258	3686	1786
15.9M	117459	58962	29544	14622	7354	3742	1807

16.0M	118907	59704	29923	14827	7466	3791	1830
16.1M	120412	60447	30307	15029	7563	3847	1847
16.2M	121895	61164	30692	15190	7664	3894	1866
16.3M	123428	61928	31046	15393	7752	3939	1891
16.4M	124961	62691	31444	15576	7839	3991	1920
16.5M	126444	63473	31815	15776	7948	4043	1938
16.6M	127945	64235	32207	16004	8046	4097	1962
16.7M	129517	64984	32588	16230	8148	4144	1984
16.8M	131019	65739	32974	16438	8244	4194	2010
16.9M	132553	66529	33358	16632	8351	4248	2036
17.0M	134113	67326	33756	16835	8444	4290	2060
17.1M	135661	68138	34135	17032	8553	4344	2086
17.2M	137279	68952	34510	17234	8665	4387	2114
17.3M	138840	69781	34891	17448	8765	4436	2136
17.4M	140575	70594	35276	17629	8858	4483	2161
17.5M	142290	71396	35726	17807	8955	4521	2189
17.6M	143864	72236	36174	17994	9072	4561	2214
17.7M	145485	73014	36600	18204	9167	4637	2241
17.8M	147093	73825	36971	18396	9261	4682	2260
17.9M	148720	74638	37388	18586	9357	4735	2289
18.0M	150358	75498	37804	18802	9452	4801	2305
18.1M	152014	76347	38195	19014	9551	4861	2324
18.2M	153722	77254	38638	19232	9652	4914	2343

SAMPLES	CRC37	CRC38	CRC39	CRC40	CRC41	CRC42	CRC43
0.1M	0	0	0	0	0	0	0
0.2M	0	0	0	0	0	0	0
0.3M	1	0	0	0	0	0	0
0.4M	1	0	0	0	0	0	0
0.5M	2	0	0	0	0	0	0
0.6M	2	0	0	0	0	0	0
0.7M	2	0	0	0	0	0	0
0.8M	3	0	1	0	0	0	0
0.9M	4	0	1	0	0	0	0
1.0M	6	0	1	0	0	0	0
1.1M	6	0	1	0	0	0	0
1.2M	6	1	1	0	0	0	0
1.3M	8	1	2	0	0	0	0
1.4M	9	1	3	0	0	0	1
1.5M	11	1	3	2	1	0	1
1.6M	12	1	3	3	1	0	1
1.7M	14	3	4	3	1	0	1
1.8M	16	3	4	3	1	0	1
1.9M	17	3	4	3	1	0	1
2.0M	19	4	4	3	1	0	1
2.1M	20	4	4	3	2	0	1
2.2M	24	5	6	3	2	0	1
2.3M	24	5	6	3	2	0	1
2.4M	25	5	6	3	2	0	1
2.5M	27	6	7	3	2	0	1
2.6M	29	7	7	3	2	0	1
2.7M	30	8	7	3	2	0	1
2.8M	32	8	7	3	2	0	1
2.9M	34	10	7	3	2	0	1
3.0M	35	12	7	3	2	0	1
3.1M	36	14	8	5	2	0	1
3.2M	37	16	8	5	2	0	1
3.3M	41	22	9	5	2	0	1
3.4M	43	23	11	5	2	0	1
3.5M	49	24	12	5	2	0	1
3.6M	52	27	12	5	3	0	1
3.7M	54	29	13	8	3	0	1
3.8M	59	31	15	8	3	0	1
3.9M	60	34	16	10	3	0	1
4.0M	64	36	16	11	4	0	1
4.1M	67	36	18	11	4	0	1
4.2M	72	36	18	11	4	0	1
4.3M	77	36	19	11	4	0	1
4.4M	85	40	19	12	5	0	1

4.5M	86	42	20	12	5	0	1
4.6M	91	44	20	12	5	0	1
4.7M	94	46	22	12	5	0	1
4.8M	96	47	22	13	5	0	1
4.9M	99	49	23	13	5	0	1
5.0M	102	50	25	14	6	0	1
5.1M	106	52	27	15	7	0	2
5.2M	110	55	27	16	7	0	2
5.3M	114	57	27	16	7	0	2
5.4M	114	57	28	16	8	0	2
5.5M	115	58	28	16	9	1	2
5.6M	120	62	29	16	9	1	2
5.7M	125	65	30	17	9	1	2
5.8M	129	67	30	18	9	1	2
5.9M	130	68	30	18	9	1	2
6.0M	131	70	31	18	9	1	2
6.1M	133	72	33	19	9	1	2
6.2M	140	76	34	19	9	1	2
6.3M	146	78	34	19	10	1	2
6.4M	148	81	36	20	10	1	2
6.5M	149	82	42	21	10	1	2
6.6M	151	84	42	23	11	1	3
6.7M	158	86	43	23	12	1	3
6.8M	162	89	46	24	12	1	3
6.9M	165	93	46	25	12	1	3
7.0M	167	98	46	25	12	1	3
7.1M	172	100	47	25	12	1	3
7.2M	178	107	48	26	13	2	3
7.3M	185	108	50	27	13	2	3
7.4M	194	110	51	29	13	2	3
7.5M	206	111	51	29	14	2	3
7.6M	213	113	53	30	14	4	3
7.7M	219	117	54	32	14	4	3
7.8M	225	121	54	32	14	4	3
7.9M	234	125	55	32	14	4	3
8.0M	238	129	56	32	15	5	3
8.1M	247	133	58	33	15	5	3
8.2M	255	136	60	33	15	5	3
8.3M	259	139	64	33	15	5	3
8.4M	264	145	64	34	15	5	3
8.5M	270	151	67	37	15	5	3
8.6M	277	154	70	37	15	5	3
8.7M	288	156	70	39	15	7	3
8.8M	292	158	71	39	15	7	3
8.9M	297	167	72	40	15	7	3
9.0M	307	169	74	42	16	8	3
9.1M	312	172	74	42	17	8	3
9.2M	316	180	76	43	17	8	4
9.3M	320	181	79	44	17	9	5
9.4M	326	184	82	45	17	9	5
9.5M	335	187	83	46	17	10	5
9.6M	340	190	85	49	17	10	5
9.7M	346	190	87	50	17	10	5
9.8M	351	195	89	51	17	10	5
9.9M	361	199	89	54	17	11	5
10.0M	370	204	90	54	17	12	5
10.1M	376	206	91	54	18	13	5
10.2M	382	208	94	57	18	13	5
10.3M	388	212	98	57	18	13	5
10.4M	394	214	99	58	19	13	5
10.5M	398	220	101	60	19	13	5
10.6M	405	225	102	60	19	13	6
10.7M	415	231	103	62	20	13	6
10.8M	418	236	103	63	20	13	6
10.9M	428	244	103	63	21	13	6
11.0M	435	247	107	64	21	13	6
11.1M	444	251	111	65	21	13	6
11.2M	450	251	113	65	21	14	6
11.3M	459	259	113	68	24	14	6

11.4M	464	264	115	68	25	14	6
11.5M	466	267	116	69	26	14	6
11.6M	474	271	120	69	27	14	6
11.7M	481	274	122	69	27	14	6
11.8M	490	279	125	69	28	15	6
11.9M	498	287	126	72	28	15	7
12.0M	505	293	129	72	28	16	7
12.1M	512	298	132	72	29	17	7
12.2M	518	302	137	72	29	17	7
12.3M	523	310	138	74	29	18	7
12.4M	542	315	145	75	30	20	7
12.5M	555	320	147	77	30	20	7
12.6M	564	324	148	78	31	21	7
12.7M	573	326	150	79	33	21	7
12.8M	587	328	151	80	33	21	7
12.9M	599	332	155	82	35	21	7
13.0M	603	338	157	85	37	22	7
13.1M	615	341	162	86	38	22	8
13.2M	629	345	166	86	39	23	8
13.3M	639	349	169	86	39	23	8
13.4M	654	354	171	87	40	24	9
13.5M	661	360	173	89	40	24	9
13.6M	673	367	174	91	41	24	9
13.7M	682	369	178	91	41	25	9
13.8M	697	374	181	93	42	25	9
13.9M	713	377	183	98	43	25	10
14.0M	719	384	183	99	44	25	10
14.1M	728	393	186	101	45	26	10
14.2M	737	398	190	101	47	27	11
14.3M	748	401	196	101	47	27	12
14.4M	757	403	200	101	48	27	12
14.5M	764	408	200	101	48	27	12
14.6M	774	415	203	101	48	27	12
14.7M	783	417	205	102	49	28	12
14.8M	793	418	207	102	50	28	12
14.9M	802	425	208	102	51	29	13
15.0M	822	430	210	102	52	29	14
15.1M	827	434	212	102	53	29	14
15.2M	833	437	215	103	53	29	14
15.3M	847	442	218	104	54	29	14
15.4M	855	446	221	105	56	29	14
15.5M	867	452	225	106	56	29	14
15.6M	880	458	227	106	57	30	14
15.7M	891	467	228	109	57	32	14
15.8M	906	477	231	110	59	33	14
15.9M	915	482	234	111	59	33	14
16.0M	923	489	234	114	61	34	15
16.1M	943	496	240	114	61	35	15
16.2M	961	505	243	117	62	35	15
16.3M	975	511	245	118	63	35	16
16.4M	989	515	247	122	65	36	17
16.5M	998	521	248	122	65	37	17
16.6M	1012	531	249	123	65	38	17
16.7M	1020	533	250	123	66	40	17
16.8M	1033	539	253	128	66	40	17
16.9M	1043	546	254	129	67	41	17
17.0M	1054	550	257	129	69	42	17
17.1M	1067	555	260	130	70	42	18
17.2M	1083	561	263	133	70	44	19
17.3M	1090	573	266	135	70	46	20
17.4M	1096	586	271	137	71	46	20
17.5M	1108	594	275	139	72	46	20
17.6M	1120	597	280	140	72	48	21
17.7M	1134	603	287	142	72	48	21
17.8M	1146	608	287	146	73	48	21
17.9M	1162	614	291	147	73	50	21
18.0M	1176	621	293	149	73	50	21
18.1M	1185	626	298	150	75	51	21
18.2M	1204	637	302	152	75	52	21

SAMPLES	CRC44	CRC45	CRC46	CRC47	CRC48	CRC49	CRC50
0.1M	0	0	0	0	0	0	0
0.2M	0	0	0	0	0	0	0
0.3M	0	0	0	0	0	0	0
0.4M	0	0	0	0	0	0	0
0.5M	0	0	0	0	0	0	0
0.6M	0	0	0	0	0	0	0
0.7M	0	0	0	0	0	0	0
0.8M	0	0	0	0	0	0	0
0.9M	0	0	0	0	0	0	0
1.0M	0	0	0	0	0	0	0
1.1M	0	0	0	0	0	0	0
1.2M	0	0	0	0	0	0	0
1.3M	0	0	0	0	0	0	0
1.4M	0	0	0	0	0	0	0
1.5M	0	0	0	0	0	0	0
1.6M	0	0	0	0	0	0	0
1.7M	0	0	0	0	0	0	0
1.8M	0	0	0	0	0	0	0
1.9M	0	0	0	0	0	0	0
2.0M	0	0	0	0	0	0	0
2.1M	0	0	0	0	0	0	0
2.2M	0	0	0	0	0	0	0
2.3M	0	0	0	0	0	0	0
2.4M	0	0	0	0	0	0	0
2.5M	0	0	0	0	0	0	0
2.6M	0	0	0	0	0	0	0
2.7M	0	0	0	0	0	0	0
2.8M	0	0	0	0	0	0	0
2.9M	0	0	0	0	0	0	0
3.0M	1	0	0	0	0	0	0
3.1M	1	0	0	0	0	0	0
3.2M	1	0	0	0	0	0	0
3.3M	1	0	0	0	0	0	0
3.4M	1	0	0	0	0	0	0
3.5M	1	0	0	0	0	0	0
3.6M	2	0	0	0	0	0	0
3.7M	3	0	0	0	0	0	0
3.8M	3	0	0	0	0	0	0
3.9M	3	0	0	0	0	0	0
4.0M	3	0	0	0	0	0	0
4.1M	3	0	0	0	0	0	0
4.2M	3	0	0	0	0	0	0
4.3M	3	0	0	0	0	0	0
4.4M	3	0	0	0	0	0	0
4.5M	3	0	0	0	0	0	0
4.6M	3	0	0	0	0	0	0
4.7M	3	0	0	0	0	0	0
4.8M	3	0	0	0	0	0	0
4.9M	3	0	0	0	0	0	0
5.0M	4	0	0	0	0	0	0
5.1M	4	0	0	0	0	0	0
5.2M	4	0	0	0	0	0	0
5.3M	4	0	0	0	0	0	0
5.4M	4	0	0	0	0	0	0
5.5M	4	0	0	0	0	0	0
5.6M	5	0	0	0	0	0	0
5.7M	5	0	0	0	0	0	0
5.8M	5	0	0	0	0	0	0
5.9M	5	0	0	0	0	0	0
6.0M	5	0	0	0	0	0	0
6.1M	5	0	0	0	0	0	0
6.2M	5	0	0	0	0	0	0
6.3M	5	0	0	0	0	0	0
6.4M	5	0	0	0	0	0	0
6.5M	5	0	0	0	0	0	0
6.6M	5	0	0	0	0	0	0
6.7M	5	0	0	0	0	0	0

6.8M	5	0	0	0	0	0	0
6.9M	5	0	0	0	0	0	0
7.0M	5	0	0	0	0	0	0
7.1M	5	0	0	0	0	0	0
7.2M	5	0	0	0	0	0	0
7.3M	5	0	0	0	0	0	0
7.4M	5	0	0	0	0	0	0
7.5M	5	0	0	0	0	0	0
7.6M	5	0	0	0	0	0	0
7.7M	5	0	0	0	0	0	0
7.8M	5	0	0	0	0	0	0
7.9M	5	1	0	0	0	0	0
8.0M	5	1	0	0	0	0	0
8.1M	5	1	0	0	0	0	0
8.2M	5	1	0	0	0	0	0
8.3M	5	1	0	0	0	0	0
8.4M	5	1	0	0	0	0	0
8.5M	5	1	0	0	0	0	0
8.6M	5	1	0	0	0	0	0
8.7M	5	1	0	0	0	0	0
8.8M	5	1	0	0	0	0	0
8.9M	5	2	0	0	0	0	0
9.0M	5	2	0	0	0	0	0
9.1M	5	2	0	0	0	0	0
9.2M	5	2	0	0	0	0	0
9.3M	5	2	0	0	0	0	0
9.4M	5	2	0	0	0	0	0
9.5M	5	2	1	0	0	0	0
9.6M	5	2	1	0	0	0	0
9.7M	5	2	1	0	0	0	0
9.8M	5	2	1	0	0	0	0
9.9M	5	2	1	0	0	0	0
10.0M	5	2	1	0	0	0	0
10.1M	6	2	1	0	0	0	0
10.2M	6	2	1	0	0	0	0
10.3M	6	2	1	0	0	0	0
10.4M	6	2	1	0	0	0	0
10.5M	6	2	1	0	0	0	0
10.6M	6	2	1	0	0	0	0
10.7M	6	2	1	0	0	0	0
10.8M	6	2	1	0	0	0	0
10.9M	6	2	1	0	0	0	0
11.0M	6	2	1	0	0	0	0
11.1M	6	2	1	0	0	0	0
11.2M	6	2	1	0	0	0	0
11.3M	6	2	1	0	0	0	0
11.4M	6	2	1	0	0	0	0
11.5M	6	2	1	0	0	0	0
11.6M	6	2	1	0	0	0	0
11.7M	6	2	1	0	0	0	0
11.8M	6	2	1	0	0	0	0
11.9M	6	2	1	0	0	0	0
12.0M	6	2	1	0	0	0	0
12.1M	6	2	1	0	0	0	0
12.2M	6	2	1	0	0	0	0
12.3M	6	2	1	0	0	0	0
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12.5M	6	4	1	0	0	0	0
12.6M	7	4	1	0	0	0	0
12.7M	7	4	1	0	0	0	0
12.8M	7	4	1	0	0	0	0
12.9M	7	4	1	0	0	0	0
13.0M	7	4	1	0	0	0	0
13.1M	7	4	1	0	0	0	0
13.2M	7	4	1	0	0	0	0
13.3M	7	4	1	0	0	0	0
13.4M	7	4	1	0	0	0	0
13.5M	7	4	1	0	0	0	0
13.6M	7	4	1	0	0	0	0

13.7M	7	4	1	0	0	0	0
13.8M	7	4	1	0	0	0	0
13.9M	7	4	1	0	0	0	0
14.0M	7	4	1	0	0	0	0
14.1M	7	4	1	0	0	0	0
14.2M	7	4	1	0	0	0	0
14.3M	7	4	1	0	0	0	0
14.4M	7	4	1	0	0	0	0
14.5M	7	4	1	0	0	0	0
14.6M	7	4	1	0	0	0	0
14.7M	7	4	1	0	0	0	0
14.8M	7	4	1	0	0	0	0
14.9M	7	4	1	0	0	0	0
15.0M	7	4	1	0	0	0	0
15.1M	8	4	1	0	0	0	0
15.2M	8	4	1	0	0	0	0
15.3M	8	4	1	0	0	0	0
15.4M	8	4	1	0	0	0	0
15.5M	9	4	1	1	0	0	0
15.6M	9	4	1	1	0	0	0
15.7M	11	4	1	1	0	0	0
15.8M	11	4	1	1	0	0	0
15.9M	11	4	1	1	0	0	0
16.0M	11	4	1	1	0	0	0
16.1M	11	4	1	1	0	0	0
16.2M	12	5	1	1	0	0	0
16.3M	12	5	1	1	0	0	0
16.4M	12	5	1	1	0	0	0
16.5M	12	5	1	1	0	0	0
16.6M	12	5	1	1	0	0	0
16.7M	13	5	1	1	0	0	0
16.8M	13	5	1	1	0	0	0
16.9M	13	5	1	1	0	0	0
17.0M	13	5	1	1	0	0	0
17.1M	13	5	1	1	0	0	0
17.2M	13	5	1	1	0	0	0
17.3M	13	6	1	1	0	0	0
17.4M	13	6	1	1	0	0	0
17.5M	13	6	1	1	0	0	0
17.6M	13	6	1	1	0	0	0
17.7M	13	6	1	1	0	0	0
17.8M	13	6	1	1	0	0	0
17.9M	13	6	1	1	0	0	0
18.0M	13	6	1	1	0	0	0
18.1M	13	6	1	1	0	0	0
18.2M	13	7	1	1	1	0	0

SAMPLES	CRC51	CRC52	CRC53	CRC54	CRC55	CRC56	CRC57
0.1M	0	0	0	0	0	0	0
0.2M	0	0	0	0	0	0	0
0.3M	0	0	0	0	0	0	0
0.4M	0	0	0	0	0	0	0
0.5M	0	0	0	0	0	0	0
0.6M	0	0	0	0	0	0	0
0.7M	0	0	0	0	0	0	0
0.8M	0	0	0	0	0	0	0
0.9M	0	0	0	0	0	0	0
1.0M	0	0	0	0	0	0	0
1.1M	0	0	0	0	0	0	0
1.2M	0	0	0	0	0	0	0
1.3M	0	0	0	0	0	0	0
1.4M	0	0	0	0	0	0	0
1.5M	0	0	0	0	0	0	0
1.6M	0	0	0	0	0	0	0
1.7M	0	0	0	0	0	0	0
1.8M	0	0	0	0	0	0	0
1.9M	0	0	0	0	0	0	0
2.0M	0	0	0	0	0	0	0
2.1M	0	0	0	0	0	0	0

2.2M	0	0	0	0	0	0	0
2.3M	0	0	0	0	0	0	0
2.4M	0	0	0	0	0	0	0
2.5M	0	0	0	0	0	0	0
2.6M	0	0	0	0	0	0	0
2.7M	0	0	0	0	0	0	0
2.8M	0	0	0	0	0	0	0
2.9M	0	0	0	0	0	0	0
3.0M	0	0	0	0	0	0	0
3.1M	0	0	0	0	0	0	0
3.2M	0	0	0	0	0	0	0
3.3M	0	0	0	0	0	0	0
3.4M	0	0	0	0	0	0	0
3.5M	0	0	0	0	0	0	0
3.6M	0	0	0	0	0	0	0
3.7M	0	0	0	0	0	0	0
3.8M	0	0	0	0	0	0	0
3.9M	0	0	0	0	0	0	0
4.0M	0	0	0	0	0	0	0
4.1M	0	0	0	0	0	0	0
4.2M	0	0	0	0	0	0	0
4.3M	0	0	0	0	0	0	0
4.4M	0	0	0	0	0	0	0
4.5M	0	0	0	0	0	0	0
4.6M	0	0	0	0	0	0	0
4.7M	0	0	0	0	0	0	0
4.8M	0	0	0	0	0	0	0
4.9M	0	0	0	0	0	0	0
5.0M	0	0	0	0	0	0	0
5.1M	0	0	0	0	0	0	0
5.2M	0	0	0	0	0	0	0
5.3M	0	0	0	0	0	0	0
5.4M	0	0	0	0	0	0	0
5.5M	0	0	0	0	0	0	0
5.6M	0	0	0	0	0	0	0
5.7M	0	0	0	0	0	0	0
5.8M	0	0	0	0	0	0	0
5.9M	0	0	0	0	0	0	0
6.0M	0	0	0	0	0	0	0
6.1M	0	0	0	0	0	0	0
6.2M	0	0	0	0	0	0	0
6.3M	0	0	0	0	0	0	0
6.4M	0	0	0	0	0	0	0
6.5M	0	0	0	0	0	0	0
6.6M	0	0	0	0	0	0	0
6.7M	0	0	0	0	0	0	0
6.8M	0	0	0	0	0	0	0
6.9M	0	0	0	0	0	0	0
7.0M	0	0	0	0	0	0	0
7.1M	0	0	0	0	0	0	0
7.2M	0	0	0	0	0	0	0
7.3M	0	0	0	0	0	0	0
7.4M	0	0	0	0	0	0	0
7.5M	0	0	0	0	0	0	0
7.6M	0	0	0	0	0	0	0
7.7M	0	0	0	0	0	0	0
7.8M	0	0	0	0	0	0	0
7.9M	0	0	0	0	0	0	0
8.0M	0	0	0	0	0	0	0
8.1M	0	0	0	0	0	0	0
8.2M	0	0	0	0	0	0	0
8.3M	0	0	0	0	0	0	0
8.4M	0	0	0	0	0	0	0
8.5M	0	0	0	0	0	0	0
8.6M	0	0	0	0	0	0	0
8.7M	0	0	0	0	0	0	0
8.8M	0	0	0	0	0	0	0
8.9M	0	0	0	0	0	0	0
9.0M	0	0	0	0	0	0	0



9.1M	0	0	0	0	0	0	0
9.2M	0	0	0	0	0	0	0
9.3M	0	0	0	0	0	0	0
9.4M	0	0	0	0	0	0	0
9.5M	0	0	0	0	0	0	0
9.6M	0	0	0	0	0	0	0
9.7M	0	0	0	0	0	0	0
9.8M	0	0	0	0	0	0	0
9.9M	0	0	0	0	0	0	0
10.0M	0	0	0	0	0	0	0
10.1M	0	0	0	0	0	0	0
10.2M	0	0	0	0	0	0	0
10.3M	0	0	0	0	0	0	0
10.4M	0	0	0	0	0	0	0
10.5M	0	0	0	0	0	0	0
10.6M	0	0	0	0	0	0	0
10.7M	0	0	0	0	0	0	0
10.8M	0	0	0	0	0	0	0
10.9M	0	0	0	0	0	0	0
11.0M	0	0	0	0	0	0	0
11.1M	0	0	0	0	0	0	0
11.2M	0	0	0	0	0	0	0
11.3M	0	0	0	0	0	0	0
11.4M	0	0	0	0	0	0	0
11.5M	0	0	0	0	0	0	0
11.6M	0	0	0	0	0	0	0
11.7M	0	0	0	0	0	0	0
11.8M	0	0	0	0	0	0	0
11.9M	0	0	0	0	0	0	0
12.0M	0	0	0	0	0	0	0
12.1M	0	0	0	0	0	0	0
12.2M	0	0	0	0	0	0	0
12.3M	0	0	0	0	0	0	0
12.4M	0	0	0	0	0	0	0
12.5M	0	0	0	0	0	0	0
12.6M	0	0	0	0	0	0	0
12.7M	0	0	0	0	0	0	0
12.8M	0	0	0	0	0	0	0
12.9M	0	0	0	0	0	0	0
13.0M	0	0	0	0	0	0	0
13.1M	0	0	0	0	0	0	0
13.2M	0	0	0	0	0	0	0
13.3M	0	0	0	0	0	0	0
13.4M	0	0	0	0	0	0	0
13.5M	0	0	0	0	0	0	0
13.6M	0	0	0	0	0	0	0
13.7M	0	0	0	0	0	0	0
13.8M	0	0	0	0	0	0	0
13.9M	0	0	0	0	0	0	0
14.0M	0	0	0	0	0	0	0
14.1M	0	0	0	0	0	0	0
14.2M	0	0	0	0	0	0	0
14.3M	0	0	0	0	0	0	0
14.4M	0	0	0	0	0	0	0
14.5M	0	0	0	0	0	0	0
14.6M	0	0	0	0	0	0	0
14.7M	0	0	0	0	0	0	0
14.8M	0	0	0	0	0	0	0
14.9M	0	0	0	0	0	0	0
15.0M	0	0	0	0	0	0	0
15.1M	0	0	0	0	0	0	0
15.2M	0	0	0	0	0	0	0
15.3M	0	0	0	0	0	0	0
15.4M	0	0	0	0	0	0	0
15.5M	0	0	0	0	0	0	0
15.6M	0	0	0	0	0	0	0
15.7M	0	0	0	0	0	0	0
15.8M	0	0	0	0	0	0	0
15.9M	0	0	0	0	0	0	0

16.0M	0	0	0	0	0	0	0
16.1M	0	0	0	0	0	0	0
16.2M	0	0	0	0	0	0	0
16.3M	0	0	0	0	0	0	0
16.4M	0	0	0	0	0	0	0
16.5M	0	0	0	0	0	0	0
16.6M	0	0	0	0	0	0	0
16.7M	0	0	0	0	0	0	0
16.8M	0	0	0	0	0	0	0
16.9M	0	0	0	0	0	0	0
17.0M	0	0	0	0	0	0	0
17.1M	0	0	0	0	0	0	0
17.2M	0	0	0	0	0	0	0
17.3M	0	0	0	0	0	0	0
17.4M	0	0	0	0	0	0	0
17.5M	0	0	0	0	0	0	0
17.6M	0	0	0	0	0	0	0
17.7M	0	0	0	0	0	0	0
17.8M	0	0	0	0	0	0	0
17.9M	0	0	0	0	0	0	0
18.0M	0	0	0	0	0	0	0
18.1M	0	0	0	0	0	0	0
18.2M	0	0	0	0	0	0	0

SAMPLES	CRC58	CRC59	CRC60	CRC61	CRC62	CRC63	CRC64
0.1M	0	0	0	0	0	0	0
0.2M	0	0	0	0	0	0	0
0.3M	0	0	0	0	0	0	0
0.4M	0	0	0	0	0	0	0
0.5M	0	0	0	0	0	0	0
0.6M	0	0	0	0	0	0	0
0.7M	0	0	0	0	0	0	0
0.8M	0	0	0	0	0	0	0
0.9M	0	0	0	0	0	0	0
1.0M	0	0	0	0	0	0	0
1.1M	0	0	0	0	0	0	0
1.2M	0	0	0	0	0	0	0
1.3M	0	0	0	0	0	0	0
1.4M	0	0	0	0	0	0	0
1.5M	0	0	0	0	0	0	0
1.6M	0	0	0	0	0	0	0
1.7M	0	0	0	0	0	0	0
1.8M	0	0	0	0	0	0	0
1.9M	0	0	0	0	0	0	0
2.0M	0	0	0	0	0	0	0
2.1M	0	0	0	0	0	0	0
2.2M	0	0	0	0	0	0	0
2.3M	0	0	0	0	0	0	0
2.4M	0	0	0	0	0	0	0
2.5M	0	0	0	0	0	0	0
2.6M	0	0	0	0	0	0	0
2.7M	0	0	0	0	0	0	0
2.8M	0	0	0	0	0	0	0
2.9M	0	0	0	0	0	0	0
3.0M	0	0	0	0	0	0	0
3.1M	0	0	0	0	0	0	0
3.2M	0	0	0	0	0	0	0
3.3M	0	0	0	0	0	0	0
3.4M	0	0	0	0	0	0	0
3.5M	0	0	0	0	0	0	0
3.6M	0	0	0	0	0	0	0
3.7M	0	0	0	0	0	0	0
3.8M	0	0	0	0	0	0	0
3.9M	0	0	0	0	0	0	0
4.0M	0	0	0	0	0	0	0
4.1M	0	0	0	0	0	0	0
4.2M	0	0	0	0	0	0	0
4.3M	0	0	0	0	0	0	0
4.4M	0	0	0	0	0	0	0

4.5M	0	0	0	0	0	0	0
4.6M	0	0	0	0	0	0	0
4.7M	0	0	0	0	0	0	0
4.8M	0	0	0	0	0	0	0
4.9M	0	0	0	0	0	0	0
5.0M	0	0	0	0	0	0	0
5.1M	0	0	0	0	0	0	0
5.2M	0	0	0	0	0	0	0
5.3M	0	0	0	0	0	0	0
5.4M	0	0	0	0	0	0	0
5.5M	0	0	0	0	0	0	0
5.6M	0	0	0	0	0	0	0
5.7M	0	0	0	0	0	0	0
5.8M	0	0	0	0	0	0	0
5.9M	0	0	0	0	0	0	0
6.0M	0	0	0	0	0	0	0
6.1M	0	0	0	0	0	0	0
6.2M	0	0	0	0	0	0	0
6.3M	0	0	0	0	0	0	0
6.4M	0	0	0	0	0	0	0
6.5M	0	0	0	0	0	0	0
6.6M	0	0	0	0	0	0	0
6.7M	0	0	0	0	0	0	0
6.8M	0	0	0	0	0	0	0
6.9M	0	0	0	0	0	0	0
7.0M	0	0	0	0	0	0	0
7.1M	0	0	0	0	0	0	0
7.2M	0	0	0	0	0	0	0
7.3M	0	0	0	0	0	0	0
7.4M	0	0	0	0	0	0	0
7.5M	0	0	0	0	0	0	0
7.6M	0	0	0	0	0	0	0
7.7M	0	0	0	0	0	0	0
7.8M	0	0	0	0	0	0	0
7.9M	0	0	0	0	0	0	0
8.0M	0	0	0	0	0	0	0
8.1M	0	0	0	0	0	0	0
8.2M	0	0	0	0	0	0	0
8.3M	0	0	0	0	0	0	0
8.4M	0	0	0	0	0	0	0
8.5M	0	0	0	0	0	0	0
8.6M	0	0	0	0	0	0	0
8.7M	0	0	0	0	0	0	0
8.8M	0	0	0	0	0	0	0
8.9M	0	0	0	0	0	0	0
9.0M	0	0	0	0	0	0	0
9.1M	0	0	0	0	0	0	0
9.2M	0	0	0	0	0	0	0
9.3M	0	0	0	0	0	0	0
9.4M	0	0	0	0	0	0	0
9.5M	0	0	0	0	0	0	0
9.6M	0	0	0	0	0	0	0
9.7M	0	0	0	0	0	0	0
9.8M	0	0	0	0	0	0	0
9.9M	0	0	0	0	0	0	0
10.0M	0	0	0	0	0	0	0
10.1M	0	0	0	0	0	0	0
10.2M	0	0	0	0	0	0	0
10.3M	0	0	0	0	0	0	0
10.4M	0	0	0	0	0	0	0
10.5M	0	0	0	0	0	0	0
10.6M	0	0	0	0	0	0	0
10.7M	0	0	0	0	0	0	0
10.8M	0	0	0	0	0	0	0
10.9M	0	0	0	0	0	0	0
11.0M	0	0	0	0	0	0	0
11.1M	0	0	0	0	0	0	0
11.2M	0	0	0	0	0	0	0
11.3M	0	0	0	0	0	0	0

11.4M	0	0	0	0	0	0	0
11.5M	0	0	0	0	0	0	0
11.6M	0	0	0	0	0	0	0
11.7M	0	0	0	0	0	0	0
11.8M	0	0	0	0	0	0	0
11.9M	0	0	0	0	0	0	0
12.0M	0	0	0	0	0	0	0
12.1M	0	0	0	0	0	0	0
12.2M	0	0	0	0	0	0	0
12.3M	0	0	0	0	0	0	0
12.4M	0	0	0	0	0	0	0
12.5M	0	0	0	0	0	0	0
12.6M	0	0	0	0	0	0	0
12.7M	0	0	0	0	0	0	0
12.8M	0	0	0	0	0	0	0
12.9M	0	0	0	0	0	0	0
13.0M	0	0	0	0	0	0	0
13.1M	0	0	0	0	0	0	0
13.2M	0	0	0	0	0	0	0
13.3M	0	0	0	0	0	0	0
13.4M	0	0	0	0	0	0	0
13.5M	0	0	0	0	0	0	0
13.6M	0	0	0	0	0	0	0
13.7M	0	0	0	0	0	0	0
13.8M	0	0	0	0	0	0	0
13.9M	0	0	0	0	0	0	0
14.0M	0	0	0	0	0	0	0
14.1M	0	0	0	0	0	0	0
14.2M	0	0	0	0	0	0	0
14.3M	0	0	0	0	0	0	0
14.4M	0	0	0	0	0	0	0
14.5M	0	0	0	0	0	0	0
14.6M	0	0	0	0	0	0	0
14.7M	0	0	0	0	0	0	0
14.8M	0	0	0	0	0	0	0
14.9M	0	0	0	0	0	0	0
15.0M	0	0	0	0	0	0	0
15.1M	0	0	0	0	0	0	0
15.2M	0	0	0	0	0	0	0
15.3M	0	0	0	0	0	0	0
15.4M	0	0	0	0	0	0	0
15.5M	0	0	0	0	0	0	0
15.6M	0	0	0	0	0	0	0
15.7M	0	0	0	0	0	0	0
15.8M	0	0	0	0	0	0	0
15.9M	0	0	0	0	0	0	0
16.0M	0	0	0	0	0	0	0
16.1M	0	0	0	0	0	0	0
16.2M	0	0	0	0	0	0	0
16.3M	0	0	0	0	0	0	0
16.4M	0	0	0	0	0	0	0
16.5M	0	0	0	0	0	0	0
16.6M	0	0	0	0	0	0	0
16.7M	0	0	0	0	0	0	0
16.8M	0	0	0	0	0	0	0
16.9M	0	0	0	0	0	0	0
17.0M	0	0	0	0	0	0	0
17.1M	0	0	0	0	0	0	0
17.2M	0	0	0	0	0	0	0
17.3M	0	0	0	0	0	0	0
17.4M	0	0	0	0	0	0	0
17.5M	0	0	0	0	0	0	0
17.6M	0	0	0	0	0	0	0
17.7M	0	0	0	0	0	0	0
17.8M	0	0	0	0	0	0	0
17.9M	0	0	0	0	0	0	0
18.0M	0	0	0	0	0	0	0
18.1M	0	0	0	0	0	0	0
18.2M	0	0	0	0	0	0	0

```

/*
 * UTIL/CRCTEST.C      - CRC tester, by Matt Dillon
 *
 * This program is designed to test an N-bit CRC against a word dictionary
 * which you pipe into it.  It is not required for normal diablo operation.
 *
 * Warning: This program will eat a lot of memory with large sets.  If the
 * set is known to be unique, you can use -u to reduce the memory footprint.
 *
 * cat unique-words | CRCTEST [-u] [-v] [-q] [-h#]
 *
 * -h#    set final hash size, in bits 16-64, Default is 64 bits.
 * -u     assume unique input, do not store string contents
 * -v     verbose output, print collisions
 * -q     quiet output, do not print the count every 100,000 tests
 *
 * The expected number of collisions is (NSAMP * (NSAMP-1) / 2) / 2^CRCBITS.
 *
 * This is calculated through statistics.  If you had 7 samples and an 8 bit
 * CRC (256 slots), the number of collisions is
 *
 *      sample #1      0/256
 *      sample #2      1/256
 *      sample #3      2/256
 *      sample #4      3/256
 *      sample #5      4/256
 *      sample #6      5/256
 *      sample #7      6/256
 *      +   sample #8      7/256
 *      -----
 *
 *          [ 8*(8-1)/2 ] / 2^CRCBITS
 *
 * NOTE!! this only works if 2^CRCBITS is substantially larger then NSAMP
 * because we aren't taking into account the fact that a prior samples
 * may collide and not increment the chance of collision for later
 * samples.
 *
 * So, for example, a 36 bit CRC with 1M samples should result in around 7
 * collisions.  A 42 bit CRC with 1M samples should result in around 0.1
 * collision.  A 42 bit CRC with 3 million samples should result in around 1
 * collision.
 */

```

```

#include
#include
#include
#include

```

```

typedef unsigned int hint_t;      /* we want a 32 bit unsigned integer here */

```

```

typedef struct hash_t {
    hint_t    h1;
    hint_t    h2;
} hash_t;

```

```

typedef struct Hash {
    struct Hash *ha_Next;
    hash_t      ha_Hv;
} Hash;

```

```

#define TESTHSIZE      (4 * 1024 * 1024)
#define TESTHMASK      (TESTHSIZE - 1)

```

```

void inithash(void);
hash_t testhash(const char *p);

```

```

Hash    *HashAry[TESTHSIZE];
int     UniqueOpt;

```

```

int    HashLimit = 64;
int    VerboseOpt = 0;
int    QuietOpt = 0;
void   *rmalloc(int bytes);

int
main(int ac, char **av)
{
    char buf[256];
    int count = 0;
    int total = 0;
    int skip = 100000;
    int i;

    for (i = 1; i < ac; ++i) {
        char *p = av[i];

        if (*p == '-') {
            p += 2;
            switch(p[-1]) {
                case 'u':
                    UniqueOpt = 1;
                    break;
                case 'h':
                    /*
                     * We can't go above 64 for obvious reasons. We can't go
                     * below 16 due to the way I generate the polynomial.
                     */
                    HashLimit = strtol(p, NULL, 0);
                    if (HashLimit > 64 || HashLimit < 16) {
                        printf("valid values for -h between 16 & 64 inclusive\n");
                        exit(1);
                    }
                    break;
                case 'q':
                    QuietOpt = 1;
                    break;
                case 'v':
                    VerboseOpt = 1;
                    break;
                default:
                    fprintf(stderr, "Unknown option: %s\n", p - 2);
                    exit(1);
            }
        }
    }

    inithash();

    while (fgets(buf, sizeof(buf), stdin) != NULL) {
        int i;
        hash_t hv;
        Hash *h;
        char *s;

        for (s = strtok(buf, " ,\t\r\n"); s; s = strtok(NULL, " ,\t\r\n")) {
            hv = testhash(s);
            i = (hv.h1 ^ hv.h2) & TESTHMASK;
            /* printf("%08x.%08x (%d) %s\n", hv.h1, hv.h2, i, s); */
            for (h = HashAry[i]; h; h = h->ha_Next) {
                if (h->ha_Hv.h1 == hv.h1 && h->ha_Hv.h2 == hv.h2) {
                    if (UniqueOpt || strcmp(s, (char *) (h + 1)) != 0) {
                        if (VerboseOpt) {
                            printf("Collision: %s\t%s\n",
                                s,
                                ((UniqueOpt) ? "?" : (char *) (h + 1))
                            );
                        }
                    }
                }
                ++count;
            }
        }
    }
}

```

```

        ++total;
    }
    break;
}
}
if (h == NULL) {
    h = rmalloc(sizeof(Hash) + ((UniqueOpt) ? 0 : strlen(s) + 1));
    h->ha_Next = HashAry[i];
    h->ha_Hv = hv;
    if (UniqueOpt == 0)
        strcpy((char *) (h + 1), s);
    HashAry[i] = h;
    ++total;
}
}
if (total >= skip) {
    if (QuietOpt == 0) {
        printf("Count %d/%d\n", count, total);
        fflush(stdout);
    }
    skip += 100000;
}
}
printf("Count %d/%d\n", count, total);
return(0);
}

/*
 * Poly: 0x00600340.00F0D50A
 *
 */

#define HINIT1 0xFAC432B1UL
#define HINIT2 0x0CD5E44AUL

#define POLY1 0x00600340UL
#define POLY2 0x00F0D50BUL

hash_t CrcXor[256];
hash_t Poly[64+1];

void
inithash(void)
{
    int i;

    /*
     * Polynomials to use for various crc sizes. Start with the 64 bit
     * polynomial and shift it right to generate the polynomials for fewer
     * bits. Note that the polynomial for N bits has no bit set above N-8.
     * This allows us to do a simple table-driven CRC.
     */

    Poly[64].h1 = POLY1;
    Poly[64].h2 = POLY2;
    for (i = 63; i >= 16; --i) {
        Poly[i].h1 = Poly[i+1].h1 >> 1;
        Poly[i].h2 = (Poly[i+1].h2 >> 1) | ((Poly[i+1].h1 & 1) << 31) | 1;
    }

    for (i = 0; i < 256; ++i) {
        int j;
        int v = i;
        hash_t hv = { 0, 0 };

        for (j = 0; j < 8; ++j, (v <<= 1)) {
            hv.h1 <<= 1;
            if (hv.h2 & 0x80000000UL)
                hv.h1 |= 1;

```

```

        hv.h2 = (hv.h2 << 1);
        if (v & 0x80) {
            hv.h1 ^= Poly[HashLimit].h1;
            hv.h2 ^= Poly[HashLimit].h2;
        }
    }
    CrcXor[i] = hv;
}
}

/*
 * testhash() - do the CRC. The complexity is simply due to the programmable
 * nature of the number of bits. We extract the top 8 bits to
 * use as a table lookup to obtain the polynomial XOR 8 bits at
 * a time rather than 1 bit at a time.
 */

hash_t
testhash(const char *p)
{
    hash_t hv = { HINIT1, HINIT2 };

    if (HashLimit <= 32) {
        int s = HashLimit - 8;
        hint_t m = (hint_t)-1 >> (32 - HashLimit);

        hv.h1 = 0;
        hv.h2 &= m;

        while (*p) {
            int i = (hv.h2 >> s) & 255;
            /* printf("i = %d %08lx\n", i, CrcXor[i].h2); */
            hv.h2 = ((hv.h2 << 8) & m) ^ *p ^ CrcXor[i].h2;
            ++p;
        }
    } else if (HashLimit < 32+8) {
        int s2 = 32 + 8 - HashLimit; /* bits in byte from h2 */
        hint_t m = (hint_t)-1 >> (64 - HashLimit);

        hv.h1 &= m;
        while (*p) {
            int i = ((hv.h1 << s2) | (hv.h2 >> (32 - s2))) & 255;
            hv.h1 = (((hv.h1 << 8) ^ (int)(hv.h2 >> 24)) & m) ^ CrcXor[i].h1;
            hv.h2 = (hv.h2 << 8) ^ *p ^ CrcXor[i].h2;
            ++p;
        }
    } else {
        int s = HashLimit - 40;
        hint_t m = (hint_t)-1 >> (64 - HashLimit);

        hv.h1 &= m;
        while (*p) {
            int i = (hv.h1 >> s) & 255;
            hv.h1 = ((hv.h1 << 8) & m) ^ (int)(hv.h2 >> 24) ^ CrcXor[i].h1;
            hv.h2 = (hv.h2 << 8) ^ *p ^ CrcXor[i].h2;
            ++p;
        }
    }
    /* printf("%08lx.%08lx\n", (long)hv.h1, (long)hv.h2); */
    return(hv);
}

void *
rmalloc(int bytes)
{
    static char *RBuf = NULL;
    static int RSize = 0;

    bytes = (bytes + 3) & ~3;

```



```
if (bytes > RSize) {  
    RBuf = malloc(65536);  
    RSize = 65536;  
}  
RBuf += bytes;  
RSize -= bytes;  
return(RBuf - bytes);  
}
```