



# **Random Number Generator Report for Netent**

**23 January 2012**



## 1. Operator

Net Entertainment Malta Ltd Net Entertainment International Ltd	URL: <a href="http://www.netentertainment.com">www.netentertainment.com</a>
The Marina Buisness Centre Abate Rigord Street Ta 'Xbiex XBX 1120 Malta	

## 2. Test house

iTech Labs Australia	URL: <a href="http://www.itechlabs.com.au">http://www.itechlabs.com.au</a>
Suite 24, 40 Montclair Ave Glen Waverley VIC 3150, Australia	e-mail: ( <a href="mailto:info@itechlabs.com.au">info@itechlabs.com.au</a> )

## 3. Software Provider

Net Entertainment Malta Service Ltd	URL: <a href="http://www.netentertainment.com">www.netentertainment.com</a>
The Marina Buisness Centre Abate Rigord Street Ta 'Xbiex XBX 1120 Malta	

## 4. System/Module tested

System: N/A	URL: N/A
Module: Pseudo Random Number Generator (PRNG).	
Date evaluation completed: 23 January 2012	

## 5. Previous history of items under test

None
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## 6. Evaluation performed

iTech Labs has conducted evaluation for the PRNG implementation as below:

<p>NetEnt RNG consists of implementation of Fortuna algorithm. Our evaluation of the RNG implementation consisted of source code evaluation, Diehard tests on the raw numbers generated by the algorithm and chisquare tests on the scaled/shuffled numbers.</p> <ol style="list-style-type: none"><li>Source code examination The following source code evaluation was conducted:<ol style="list-style-type: none"><li>Identification of algorithm;</li></ol></li></ol>
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- b) Security of internal state, seeding and re-seeding, thread safety
- c) Scaling of numbers for slot games, Roulette and scratch tickets

2. Tests conducted

- a) Marsaglia's "Diehard" tests were applied to 2 sets of 80 million bits of raw 32 bit random numbers generated by the algorithm. The following diehard tests were conducted on 80 million bits for each test;
  - i) BIRTHDAY SPACINGS
  - ii) OVERLAPPING 5-PERMUTATIONS
  - iii) BINARY RANK TEST for 31x31 matrices
  - iv) BINARY RANK TEST for 32x32 matrices
  - v) BINARY RANK TEST for 6x8 matrices
  - vi) BITSTREAM TESTS ON 20-BIT Words
  - vii) BITSTREAM TESTS OPSO, OQSO, DNA
  - viii) COUNT-THE-1's IN A STREAM OF BYTES
  - ix) COUNT-THE-1's IN SPECIFIC BYTES
  - x) PARKING LOT TEST
  - xi) MINIMUM DISTANCE TEST
  - xii) THE 3DSPHERES TEST
  - xiii) THE SQUEEZE test
  - xiv) OVERLAPPING SUMS TEST
  - xv) RUNS TEST
  - xvi) CRAPS TEST
- b) The following Chi-squared tests were conducted on the scaled numbers.
  - i) Scaling tests for slot games and Roulette games.  
The tests were conducted for ranges 1, 6, 31, 32, 36, 62, 63, 64, 999 and 9999.
  - ii) Scaling tests for scratch tickets  
The tests were conducted for ranges 0-1,000,000 and 0-2,000,000
- c) Shuffling for single deck card games (without joker and one joker), 4 decks, 6 decks and 8 decks without joker.

The RNG implementation was tested for compliance to Malta Lotteries & Gaming Authority standards and Remote Technical and requirements of Gibraltar Regulatory Authority.

## 7. Evaluation results

1. Source code examination

The RNG implementation uses Fortuna – an algorithm based on continuous reseeding from multiple entropy sources (this has been assessed and found acceptable)

The Security of internal state, seeding, re-seeding and thread safety of PRNG is OK.

The PRNG state is initialised from Entropy Sources.

2. Tests conducted

- a) Marsaglia's "Diehard" tests.  
The results passed satisfactorily.
- b) Chi-squared tests.
  - i) Chisquare tests passed satisfactorily.  
Range:0-1 DOF:1  
Range:0-6 DOF:5

Range: 0 -31 DOF: 31  
 Range: 0 -32 DOF: 32  
 Range: 0 - 36 DOF: 36  
 Range: 0 - 62 DOF: 62  
 Range: 0 - 63 DOF: 63  
 Range: 0 - 64 DOF: 64  
 Range: 0 - 999 DOF: 999  
 Range: 0 -9999 DOF: 9999  
 Range: 0 - 1,000,000; DOF: 198, 316, 442, 508 and 999  
 Range: 0 - 2,000,000; DOF: 198, 316, 442, 508 and 999

ii) Shuffle tests passed satisfactorily.

Each of these tests was conducted for a total of over 1 million decks for sets ranging from 1,000 to 100,000 decks.

1 deck 1 Joker

Tests	DOF
Suits	212
Ranks	689
Cards	2756

1 deck no joker

Tests	DOF
Suits	156
Ranks	624
Cards	2652

4 decks no joker

Tests	DOF
Suits	312
Ranks	1248
Cards	5304

6 decks no joker

Tests	DOF
Suits	312
Ranks	1248
Cards	5304

8 decks no joker

Tests	DOF
Suits	312
Ranks	1248
Cards	5304

## 8. Observations

None

## 9. Certification

Date of Certification: 23 January 2012  
 Software provider: Net Entertainment Malta Service Ltd



Operator: Net Entertainment Malta Ltd  
Net Entertainment International Ltd  
Operator URL: [www.netentertainment.com](http://www.netentertainment.com)  
Total number of pages: 7

iTech Labs certifies that the PRNG (listed in Appendix-A) comply with the Malta Lotteries & Gaming Authority standards and Remote Technical and requirements of Gibraltar Regulatory Authority subject to the conditions in *section 10 Conditions*.

## 10. Conditions of Certification

1. The source code provided to iTech Labs (as per Appendix-A) must be used for compilation of the PRNG module.
2. Any change to the PRNG source files listed in Appendix-A must be verified by iTech Labs.

## 11. Conclusion

While it is not possible to test all possible scenarios in a laboratory environment, iTech Labs has conducted a level of testing appropriate for a submission of this type.

Accordingly, subject to the above comment, iTech Labs certifies that the items under test comply with the relevant Technical Standards, unless otherwise stated.



## Appendix – A

### 1. Md5sum\* of RNG source files

File Name	Size (bytes)	Md5sum
com.netent.random.fortuna.entropy.source.DevUrandomEntropySource.java	1221	21d8a5f72a14dd2b514ba08172b5f936
com.netent.random.fortuna.entropy.source.DiskWriteEntropySource.java	1674	d56e0181c4c9e7f5ad6b490a0fb3a146
com.netent.random.fortuna.entropy.EntropyAccumulator.java	3929	5d1d26ce5e79521d7f905e3b445003dc
com.netent.random.fortuna.entropy.EntropyBytes.java	1322	d81d563523660fa7e8d5e052c8361b65
com.netent.random.fortuna.entropy.EntropyCollector.java	950	e7d31ea7b677424c8f84f1df6371694d
com.netent.random.fortuna.entropy.EntropyPool.java	2983	3ba6100409ac2cb2a425d21021717c98
com.netent.random.fortuna.entropy.source.EntropySource.java	214	d5fd6ed6274fa207d4bb54c702d3ee8d
com.netent.random.fortuna.entropy.FortunaGenerator.java	3427	87dd948316aa7006ec89f62ab7fdf92f
com.netent.random.fortuna.entropy.FortunaRandom.java	5387	c3f706eeef948b4631441e4fc0b3957b
com.netent.random.fortuna.entropy.source.GarbageCollectionTimeEntropySource.java	741	00e5bc07289bf5a1ae2b36a53604e557
com.netent.random.fortuna.entropy.source.HeapMemoryEntropySource.java	671	70a908470b2f715107cc5812759606e6
com.netent.random.fortuna.entropy.source.LoadAverageEntropySource.java	778	c90409bb799e1c134414d99ab4d690a4
com.netent.random.fortuna.entropy.source.ObjectsPendingFinalizationEntropySource.java	694	0e6478e94adcc4d7bfb3aa85fd4f8156
com.netent.common.commonservice.service.random.RandomGeneratorImpl.java	1345	889a1e7eeaa0ddc3da7b4547caa073c1
com.netent.common.commonservice.service.random.RandomNumberGenerator.java	6487	4968bef2c8d1afb58b0559ad6110c076
com.netent.random.fortuna.seed.SecureRandomSeedGenerator.java	591	cccd173a5de409c928e308cdb6ce01aa
com.netent.random.fortuna.seed.SeedGeneratorFactory.java	298	a5dab6b442d1eec499079d36fae2e405
com.netent.random.fortuna.seed.SeedGenerator.java	120	941d2dcf0490f688d10cb6198bd3a398
com.netent.random.fortuna.entropy.source.ThreadCpuTimeEntropySource.java	756	dda7d8a879169f9d4b130ea10af9898e
com.netent.random.fortuna.entropy.source.ThreadSchedulerEntropySource.java	892	f46297f8caad8eebe25e75ecec4fe1e
com.netent.random.fortuna.seed.UnixSeedGenerator.java	635	0cb69d20880f4eed9d6c3e59de4b5402
com.netent.random.fortuna.entropy.source.UptimeEntropySource.java	859	0614b2d9106bc865461450ea4060e5e2
com.netent.random.fortuna.entropy.source.UsedJvmMemoryEntropySource.java	717	fd66967a3e039a6197086bd6c2dc8f0a

\* Md5sum is calculated using the Linux program md5sum.



## **2. Test results (please see the excel documents)**

- i) Diehard test results
- iii) Chisquare test results