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Issuing Laboratory: GLI Test Labs Canada ULC
(dba Technical System Testing (TST), A GLI Company)

Evaluating Laboratory: GLI Test Labs Canada ULC
(dba Technical System Testing (TST), A GLI Company)

Report Recipient: OMI Gaming AB
Tengdahlgatan 18,
116 41 Stockholm, Sweden

Jurisdiction: Malta

Technical Standard for Testing: Lotteries and Gaming Authority's **Remote Gaming Regulations, 2004, Third Schedule – Technical Requirement for Gaming System**

Software Supplier: OMI Gaming AB
Tengdahlgatan 18,
116 41 Stockholm, Sweden

Submitting Party: OMI Gaming AB
Tengdahlgatan 18,
116 41 Stockholm, Sweden

Product Tested: Random Number Generator

Evaluation Period: 30 January 2012 to 29 March 2012

File Number: RN-332-OMI-12-01

Testing Result: Subject to the Conditions of Evaluation (page 7):
Recommended for Approval

Report Sections:

- Software Product Details
- RNG Evaluation
- Conditions of Evaluation
- Terms and Conditions

Amendment Notice: *This Evaluation Report is issued as an amendment to the previous report issued on 29 March 2012*

Software Product Details

TST tested the OMI Gaming AB (OMI)'s Random Number Generator (RNG) to be used with the following games:

- Jungle Fruits,
- Princess Fortune,
- Tres Hombres, and
- Benny The Panda.

The OMI RNG is intended to be run in the following environment:

Hardware	Operating System	Software
Intel architecture with 512 MB Ram	32-bit Debian 5.0 (Unix)	Oracle Java Runtime

For version-control of OMI's RNG, TST gathered Message Digest Five (MD5) and Secure Hash Algorithm One (SHA-1) checksums of the following source code files submitted for testing:

File Name	MD5 Checksum	SHA-1 Checksum
BaseFeature.java	0E8C455CF3A930D89134748A38A6E15A	B36B00D2A33A093A3E8649772C288DB8DE E54E57
EntropyCollector.java	5045611553C2E88ACC6448F009642350	F0339FC201F136B089BC724941B934A8D3B CF800
RandomNumberGenerator.java	D52EE147F3BDB68FAE6A81B2A91F5D9A	A1B17F335E4C0AAC965299719C5D1A794D 077419
RngTest.java	2BF5AD50A7EDB6FAE5B842C3AE568FBA	8F946C799C617C3806D7BA22F1A2CD6082 9C61B2
SecureRandomNumberGenerator.java	9B367FE23643465BDA3900C0B6B546EB	28DB71A38751FD6CFE94489EB9A20C59E8 116612

RNG Evaluation

TST's RNG Evaluation included (but was not necessarily be limited to) the following elements:

- General RNG Analysis:
 - Submitted documentation review
 - Source code review
 - Theoretical math analysis
 - Assessment for the RNG period
 - Determination of the RNG range
 - Investigation of the seeding / re-seeding
 - Inspection of the background cycling / activity
- DIEHARD Battery of Tests
- Final Outcome Distribution tests

TST's evaluation of the OMI RNG was performed with the aim of identifying and detailing system weaknesses and potential issues of non-compliance with applicable requirements from the following appointed standard:

The Technical Standards Document (TSD) for the jurisdiction of Malta, the **Remote Gaming Regulations, 2004, Third Schedule – Technical Requirement for Gaming System**, which states the following RNG-specific requirements:

3. The gaming system must satisfy the following criteria for randomness, following Schneier:-
 - (a) the data must be randomly generated, passing appropriate statistical tests of randomness;
 - (b) the data must be unpredictable, i.e. it must be computationally infeasible to predict what the next number will be, given complete knowledge of the algorithm or hardware generating the sequence, and all previously generated numbers;
 - (c) the series cannot be reliably reproduced, i.e. if the sequence generator is activated again with the same input (as exactly as is reasonably possible) it will produce two completely unrelated random sequences.

General RNG Analysis

The RNG submitted for testing is a software-based pseudo. TST has verified the RNG's period is sufficiently large and covers all possible outcomes for the games / applications to which it is connected.

The RNG algorithm requires a seed value to produce a random number. TST has verified that the method of initial seed generation and re-seeding implemented in the OMI RNG complies with the appointed Technical Standard, and is considered to be acceptable.

The RNG implements background cycling / activity at an acceptable level, and complies with the appointed Technical Standard.

DIEHARD Battery of Tests

The DIEHARD Battery of Tests is a group of 15 statistical tests designed to assess the predictability or presence of significant statistical bias in the raw outcomes generated from the RNG algorithm¹. The following tables summarises the results of the DIEHARD Battery of Tests for the 95%, 98% and 99% Confidence Levels.

¹ Marsaglia, George. "The Marsaglia Random Number CDROM including the Diehard Battery of Tests of Randomness." Department of Statistics and Supercomputer Computations Research Institute. 1995. Florida State University. <<http://www.stat.fsu.edu/pub/diehard/>>

DIEHARD Battery of Tests 95% Confidence Level				
	Test Name	Sample Set	Test Results	Overall Test Result
1	Birthday Spacings	1	Pass	Pass
		2	Pass	
		3	Pass	
2	Overlapping 5-Permutations	1	Pass	
		2	Pass	
		3	Pass	
3a	Binary Rank 31x31 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3b	Binary Rank 32x32 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3c	Binary Rank 6x8 Matrices	1	Pass	
		2	Pass	
		3	Pass	
4	Bitstream	1	Pass	
		2	Pass	
		3	Pass	
5	OPSO	1	Pass	
		2	Pass	
		3	Pass	
6	OQSO	1	Pass	
		2	Pass	
		3	Pass	
7	DNA	1	Pass	
		2	Pass	
		3	Pass	
8a	Count 1's (Stream of Bytes)	1	Pass	
		2	Pass	
		3	Pass	
8b	Count 1's (Specific Byte)	1	Pass	
		2	Pass	
		3	Pass	
9	Parking Lot	1	Pass	
		2	Pass	
		3	Pass	
10	Minimum Distance	1	Pass	
		2	Pass	
		3	Pass	
11	3D Spheres	1	Pass	
		2	Pass	
		3	Pass	
12	Squeeze	1	Pass	
		2	Pass	
		3	Pass	
13	Overlapping Sums	1	Pass	
		2	Pass	
		3	Pass	
14	Runs	1	Pass	
		2	Pass	
		3	Fail	
15	Craps	1	Pass	
		2	Pass	
		3	Pass	

DIEHARD Battery of Tests 98% Confidence Level				
	Test Name	Sample Set	Test Results	Overall Test Result
1	Birthday Spacings	1	Pass	Pass
		2	Pass	
		3	Pass	
2	Overlapping 5-Permutations	1	Pass	
		2	Pass	
		3	Pass	
3a	Binary Rank 31x31 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3b	Binary Rank 32x32 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3c	Binary Rank 6x8 Matrices	1	Pass	
		2	Pass	
		3	Pass	
4	Bitstream	1	Pass	
		2	Pass	
		3	Pass	
5	OPSO	1	Pass	
		2	Pass	
		3	Pass	
6	OQSO	1	Pass	
		2	Pass	
		3	Pass	
7	DNA	1	Pass	
		2	Pass	
		3	Pass	
8a	Count 1's (Stream of Bytes)	1	Pass	
		2	Pass	
		3	Pass	
8b	Count 1's (Specific Byte)	1	Pass	
		2	Pass	
		3	Pass	
9	Parking Lot	1	Pass	
		2	Pass	
		3	Pass	
10	Minimum Distance	1	Pass	
		2	Pass	
		3	Pass	
11	3D Spheres	1	Pass	
		2	Pass	
		3	Pass	
12	Squeeze	1	Pass	
		2	Pass	
		3	Pass	
13	Overlapping Sums	1	Pass	
		2	Fail	
		3	Pass	
14	Runs	1	Pass	
		2	Pass	
		3	Fail	
15	Craps	1	Pass	
		2	Pass	
		3	Pass	

DIEHARD Battery of Tests 99% Confidence Level				
	Test Name	Sample Set	Test Results	Overall Test Result
1	Birthday Spacings	1	Pass	Pass
		2	Pass	
		3	Pass	
2	Overlapping 5-Permutations	1	Pass	
		2	Pass	
		3	Pass	
3a	Binary Rank 31x31 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3b	Binary Rank 32x32 Matrices	1	Pass	
		2	Pass	
		3	Pass	
3c	Binary Rank 6x8 Matrices	1	Pass	
		2	Pass	
		3	Pass	
4	Bitstream	1	Pass	
		2	Pass	
		3	Pass	
5	OPSO	1	Pass	
		2	Pass	
		3	Pass	
6	OQSO	1	Pass	
		2	Pass	
		3	Pass	
7	DNA	1	Pass	
		2	Pass	
		3	Pass	
8a	Count 1's (Stream of Bytes)	1	Pass	
		2	Pass	
		3	Pass	
8b	Count 1's (Specific Byte)	1	Pass	
		2	Pass	
		3	Pass	
9	Parking Lot	1	Pass	
		2	Pass	
		3	Pass	
10	Minimum Distance	1	Pass	
		2	Pass	
		3	Pass	
11	3D Spheres	1	Pass	
		2	Pass	
		3	Pass	
12	Squeeze	1	Pass	
		2	Pass	
		3	Pass	
13	Overlapping Sums	1	Pass	
		2	Pass	
		3	Pass	
14	Runs	1	Pass	
		2	Pass	
		3	Fail	
15	Craps	1	Pass	
		2	Pass	
		3	Pass	

Final Outcome Distribution Tests

TST has verified, through mathematical and statistical analysis, that the OMI RNG distributes numbers with sufficient non-predictability, fair distribution and lack of bias to particular outcomes. TST's statistical analysis of the scaled outcomes of the RNG was performed using confidence intervals of 95%, 98%, and 99%, which are documented levels of confidence for such statistical analysis.

TST collected RNG data from OMI's RNG in the format shown below. The table below summarises the results of TST's statistical testing of the scaled output of the RNG for selected games connected to the RNG.

Data Set	Game Name	Range		# of Selections	Replacement	Samples	Result
		Minimum	Maximum				
1	Jungle Fruits, Princess Fortune, Tres Hombres, Benny the Panda	0	30	5	Yes	32,000,000	Pass
1.1*	Jungle Fruits, Princess Fortune, Tres Hombres, Benny the Panda	0	29,790	1	N/A	31,578,460	Pass
1.2*	Jungle Fruits, Princess Fortune, Tres Hombres, Benny the Panda	0	960	1	N/A	31,982,080	Pass

Note*: Data for these sets were transformed using a base 'b' numbering system for the Poisson test.

The following tests were run on each data set:

- Chi-Square (Set 1)
- Runs (Set 1)
- Serial Correlation (Set 1)
- Interplay Correlation (Set 1)
- Duplicates (Set 1)
- Poisson (Sets 1.1 and 1.2)
- Total Distribution (Set 1)
- Total Distribution by Columns (Set 1)
- Vertical Coupon Collector (Set 1)

Overall Evaluation of the Random Number Generator

Our conclusion based upon the tests applied to the OMI RNG data is that this Random Number Generator has exhibited random behaviour and is suitable for the applications as described herein. If a game utilizes a different range or a different set of selections from the included ranges, the RNG must be resubmitted to test that range.

Conditions of Evaluation

TST's compliance evaluation of the OMI RNG is subject to the following limitations:

- The recipient, by its acceptance of this report or analysis, will be deemed to have acknowledged and agreed to all of the "terms and conditions" set forth below. If the recipient does not agree to all of such terms and conditions, TST withdraws the certification provided or analysis established by this report and the recipient must immediately return to TST all copies of this report and make no reference to this report for any purpose at any time.
- TST's compliance evaluation of the OMI RNG was related only to the technical scope of work elements discussed herein. This specifically excludes any other features or functions provided by the submission not related to these elements.
- TST's findings concerning any statistical analysis of the RNG are within the confidence intervals tested.

- All testing results are based on information and materials submitted by OMI to TST throughout the duration of the project. There are inherent limitations to performing compliance testing within a laboratory environment, and within a finite time period. As a result of these limitations, anticipating all possible configurations, scenarios and events which could potentially occur in the live environment was not feasible.
- TST generated the checksums of the software and source code files using the methods stated below:

GLI Verify® - Verification Procedure for Files or Directories:

1. Open GLI Verify®.
2. Select the 'File' or 'Directory' radio button option.
3. Select the 'Browse' button and then choose the file or the top directory for which a signature is being requested.
4. Click the "Verify" button.
5. The current file/directory being checked will be displayed in the window.
6. The program will generate a CDCK, SHA-1 and MD5 signature and display the results in the centre window.

GLI Verify® v5.2 is an application developed by **Gaming Laboratories International, LLC (GLI)** to generate CDCK, SHA-1 and MD5 signatures on files, folders, DVD, CD and Compact Flash media. GLI Verify® v5.2 can be downloaded from GLI's website at www.gaminglabs.com.

Or contact GLI Compliance at:
1-888-GLI-REGS (454-7347) or
E-Mail at compliance@gaminglabs.com.

Subject to the limitations outlined in the **Conditions of Evaluation**, it is TST's position that the evaluated elements of the OMI RNG comply with the requirements of the applicable Technical Standard. Accordingly, TST recommends the approval of the OMI RNG for use within the jurisdiction of Malta, as regulated by Lotteries and Gaming Authority.

If you should have any questions regarding this information, please feel free to contact our office.

Sincerely,



Ms. Mavis Chan
Quality Assurance Administrator
TECHNICAL SYSTEMS TESTING (TST)
A GLI COMPANY

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Sincerely,

GLI TEST LABS CANADA ULC