



RANDOM NUMBER GENERATOR EVALUATION CERTIFICATE

FOR

HILLSIDE (NEW MEDIA MALTA) PLC

**CERTIFICATE NUMBER:
71172HNMBGR001**

CONFIDENTIAL

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1. INTRODUCTION

Hillside (New Media Malta) PLC requested eCOGRA to evaluate the randomness of the ComScire Quantum Number Generator which generates random numbers for their Virtual Sports product for jurisdiction license applications.

Hillside (New Media Malta) PLC are a well-established and leading provider of gaming. Their products cover a wide variety of game types (including casino, poker, bingo and virtual sports) with an international client base. The Random Number Generator (RNG) used for their virtual sports gambling applications is hardware based.

2. COMPONENTS INSPECTED

License Holder:	Hillside (New Media Malta) PLC
License Holder Address:	Office 1/2373, Level G, Quantum House, 75 Abate Rigord Street, Ta' Xbiex XBX 1120, Malta
Product Name:	ComScire Quantum Number Generator: PureQuantum™ Model PQ4000KU
Supplier:	ComScire
Product Description:	PureQuantum™ Model PQ4000KU. The PQ4000KU is a quantum random number generator used for cryptographic purposes as well as online gaming and other applications requiring high levels of security and randomness properties.
Product Version:	PureQuantum™ Model PQ4000KU
RNG Type:	Hardware
Jurisdictions:	Bulgaria
Test Entity:	eCOGRA
Test Entity Address:	2 nd Floor Berkeley Square House, Berkeley Square, London, W1J 6BD
Date:	20 November 2017
Test Engineer:	Sphamandla Langa, Sthembiso Mvelase, Pooveshan Gounden, Rachel Chinyoka
Supervision and Approval:	Gary Lupton-Smith

3. RNG VERSION HARDWARE DETAILS

RNG	Description	Interface
RNG	PureQuantum™ Model PQ4000KU	USB interface

4. TESTS PERFORMED

The scope of the evaluation consisted of an assessment of the following components:

- Documentation;
- Source code review;
- Statistical and mathematical analysis;
- RNG range; and
- RNG scaling.

The RNG evaluation was performed to ensure the following requirements were met:

- The data must be randomly generated;
- The data must be unpredictable; and
- The series cannot be reproduced.

The tests used to perform the evaluation included the following:

- Chi-Squared Tests
- Wald-Wolfowitz (or Runs) Tests
- Expected probabilities for shuffle decks
- Diehard Test Suite

5. TEST RESULTS

Recognised statistical and mathematical tests were performed to certify the RNG operated in compliance with the requirements stipulated in the regulations of highly regulated online gambling jurisdictions. This included tests for probability (to ensure the expected number of occurrences), randomness (so that one cannot predict the following occurrence with any degree of certainty) and uniformity (to determine that each possible outcome is equally likely over the long-term). The acceptance criteria for the statistical tests is a pass at a 95% confidence level.

1. OUTPUT BASED TESTING ON SCALED RANGES: 0-33, 0-36, 0-51, 0-66, 0-99, 0-500, 0-999

a. OUTPUT BASED TESTING ON SCALED RANGES RESULTS

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	0.05154	0.30361	0.57560	0.04278	0.47522	0.22933
2	3 000 000	0-36	36	0.21951	0.89358	0.95688	0.16060	0.05006	0.93872
3	3 000 000	0-51	51	0.67184	0.79086	0.11211	0.09250	0.81717	0.56121
4	3 000 000	0-66	66	0.04571	0.08254	0.35396	0.42111	0.25545	0.08139
5	3 000 000	0-99	99	0.38228	0.75081	0.92634	0.57336	0.97352	0.21927
6	3 000 000	0-500	500	0.82703	0.38278	0.64627	0.37672	0.02713	0.46879
7	3 000 000	0-999	999	0.99441	0.09927	0.57186	0.69682	0.27345	0.72762

b. SCALED DATA RANDOMNESS TEST SUCCESS (✓) OR FAILURE (x) SUMMARY

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	✓	✓	✓	✓	✓	✓
2	3 000 000	0-36	36	✓	✓	✓	✓	✓	✓
3	3 000 000	0-51	51	✓	✓	✓	✓	✓	✓
4	3 000 000	0-66	66	✓	✓	✓	✓	✓	✓
5	3 000 000	0-99	99	✓	✓	✓	✓	✓	✓
6	3 000 000	0-500	500	✓	✓	✓	✓	✓	✓
7	3 000 000	0-999	999	✓	✓	✓	✓	✓	✓

2. OUTPUT BASED TESTING ON SHUFFLED DECKS

a. OUTPUT BASED TESTING ON SHUFFLED DECKS RESULTS

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	5 Card Hands	8	0.93870	0.47408	0.45315	0.56904	0.37145	0.73236
2	3 000 000	7 Card Hands	9	0.44669	0.09647	0.12693	0.82022	0.61623	0.04994
3	3 000 000	5-7 Card Multiples Combinations	17	0.97120	0.26622	0.37617	0.95204	0.26959	0.31616
4	3 000 000	5-7 Card Suit Combinations	29	0.75744	0.91498	0.07738	0.49122	0.88268	0.66855

b. SHUFFLED DECKS RANDOMNESS TEST SUCCESS (✓) OR FAILURE (✗) SUMMARY

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	5 Card Hands	8	✓	✓	✓	✓	✓	✓
2	3 000 000	7 Card Hands	9	✓	✓	✓	✓	✓	✓
3	3 000 000	5-7 Card Multiples Combinations	17	✓	✓	✓	✓	✓	✓
4	3 000 000	5-7 Card Suit Combinations	29	✓	✓	✓	✓	✓	✓

3. DIEHARD TESTS

a. DIEHARD TEST RESULTS

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	0.2615	0.0529	0.3838	0.1680	0.0937	0.0131
OVERLAPPING 5-PERMUTATION TEST	48 000 000	0.7663	0.1661	0.0104	0.0886	0.2127	0.6364
THE BITSTREAM TEST	48 000 000	0.1518	0.0539	0.0010	0.1772	0.1098	0.0066
COUNT-THE-1's TEST bytes	48 000 000	0.0109	0.0328	0.0796	0.0483	0.0742	0.0846
MINIMUM DISTANCE TEST	48 000 000	0.6396	0.4067	0.9500	0.1235	0.8094	0.4408
SQUEEZE TEST	48 000 000	0.1214	0.9329	0.0588	0.8275	0.7534	0.2284
RUNS TEST	48 000 000	0.1227	0.0118	0.1063	0.0603	0.1204	0.5246
CRAPS TEST	48 000 000	0.1377	0.3500	0.5805	0.2499	0.3863	0.4398

b. DIEHARD TESTS SUCCESS (✓) OR FAILURE (×) SUMMARY

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	✓	✓	✓	✓	✓	✓
OVERLAPPING 5-PERMUTATION TEST	48 000 000	✓	✓	✓	✓	✓	✓
THE BITSTREAM TEST	48 000 000	✓	✓	✓	✓	✓	✓
COUNT-THE-1's TEST bytes	48 000 000	✓	✓	✓	✓	✓	✓
MINIMUM DISTANCE TEST	48 000 000	✓	✓	✓	✓	✓	✓
SQUEEZE TEST	48 000 000	✓	✓	✓	✓	✓	✓
RUNS TEST	48 000 000	✓	✓	✓	✓	✓	✓
CRAPS TEST	48 000 000	✓	✓	✓	✓	✓	✓

Our test results for RNG products produced statistically acceptable random numbers that were free of any significant statistical bias or predictability.

6. CONCLUSION

The results obtained from eCOGRA's testing confirm the random number generator operates in compliance with the applicable requirements of the regulations of highly regulated online gambling jurisdictions.

Project Approval:

A handwritten signature in black ink, appearing to read "Gary Lupton-Smith".

Gary Lupton-Smith, Technical Services Manager