Impact Factor:

ISRA (India)	= 6.317	SIS (USA)	= 0.912	ICV (Poland)	= 6.630
ISI (Dubai, UAE)	= 1.582	РИНЦ (Russia)	= 0.191	PIF (India)	= 1.940
GIF (Australia)	= 0.564	ESJI (KZ)	= 8.100	IBI (India)	= 4.260
JIF	= 1.500	SJIF (Morocco)	= 7.184	OAJI (USA)	= 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2025 **Issue:** 04 **Volume:** 144

Received: 02.04.2025
Accepted/Published: 30.04.2025

https://T-Science.org

Issue Article

Nizomiddin Najmiddin ugli Ochilov
Kimyo International University
Tashkent

A ENCRYPTION/DECRYPTION ALGORITHM BASED ON THE O'ZDST 1105:2009 STANDARD

***Abstract**: The article discusses the priorities of the international community to ensure information security. Cooperation between states in this area is still developing, and in the Republic of Uzbekistan, special attention is paid to the protection of state secrets and confidential information. In the Republic of Uzbekistan, there is a encryption/decryption algorithm based on the O'zDSt 1105:2009 standard, which describes a block cipher algorithm. This article presents the theoretical results obtained on the basis of the O'zDSt 1105:2009 standard. In the cryptographic standard O'zDSt 1105:2009, the exchange of a table consists of replacing 256 values, and according to a given formula, a bit is formed on the arguments d, L, R, depending on the extended key k_{se}. During the analysis, the initialization time of the system in encryption modes was also studied. In most cases, the initial time deviations of the encryption depending on the selected mode are not significant. In CBC and CFB modes, the initialization time increases.*

***Key words**: encryption, decryption, standard, parallel computing, linear, differential, round, key length.*

***Language**: English*

***Citation**: Ochilov, N.N. (2025). A encryption/decryption algorithm based on the O'ZDST 1105:2009 standard. ISJ Theoretical & Applied Science, 04 (144), 9-14.*

***Soi**: https://s-o-i.org/1.1/TAS-04-144-3 **Doi**: crossref https://dx.doi.org/10.15863/TAS.2025.04.144.3*

***Scopus ASCC**: 2600.*

Introduction

The operation of cryptographic functions is performed in the process of functions that determine the minimum latency of responses to queries. The amount of RAM required to perform such actions must be reserved in advance by the system administrator. Because the computer has a limited amount of RAM, libraries cannot be used anywhere.

Modern operating systems use cryptographic methods of information protection everywhere. A special module is created to unify cryptographic functions into operating systems. This module includes various cryptographic functions.

MATERIAL AND METHODS.

In the cryptographic standard O'zDSt 1105:2009, the table exchange consists of the replacement of 256 values, and according to the given formula the bit on the arguments d, L, R is formed depending on the extended key k_{se}

$$\{[((i+L)\ mod\ 256)+1]^d\}\ mod\ 256 \qquad (1.1)$$

where d is the elevation with the R parameter. The total number of replacement tables generated on the basis of different values of these parameters is 4,161,600. Therefore, our main goal is to analyze the method of automatic checking the quality of switching tables used in the encryption algorithm of the standard O'zDSt 1105:2009 of the Republic of Uzbekistan.

The algorithm used in the cryptographic standard O'zDSt 1105:2009 is relatively new because it is relatively new. The analysis of the cryptographic standard O'zDSt 1105:2009 uses a parallel algorithm that allows you to automatically evaluate its replacement tables.

Allows you to analyze arbitrary replacement tables based on the created algorithm. For example, it will be possible to improve this algorithm when checking the stability of all 4-bit switch tables or specific function classes. Since the S-block is the "heart" of the entire cryptosystem, the results of research on it are of great practical importance [1].

The main object of our analysis is an exchange table consisting of the exchange of natural numbers. A lookup table or substitutionbox is a bijective transformation.

$$F: \mathbb{F}_2^{\,n} \longrightarrow \mathbb{F}_2^{\,n}$$

where $\mathbb{F}_2$ is a secondary limited area.

F can also be calculated as a system of logical functions (f: $\{0, 1\}^n \longrightarrow \{0, 1\}^n$):

$$F(x_1, x_2, \ldots, x_n) = (f_1, f_2, \ldots, f_n)$$

$$\begin{cases} f_1 = f_1(x_1, x_2, \ldots, x_n) \\ f_2 = f_1(x_1, x_2, \ldots, x_n) \\ \qquad\qquad \ldots \\ f_n = f_1(x_1, x_2, \ldots, x_n) \end{cases} \qquad (1.2)$$

Therefore, the i-function is called F_i, the i-component of the vector. We express $x = (x_1, x_2, \ldots, x_n)$, x_i.

We define the binary vector 1 in position i as $e_i = (0, 0, \ldots, 1, 0, \ldots, 0)$.

$$\textstyle\sum_i = \{(x', x''): x', x'' \in X, x_i' + x_i'' = e_i\}, i = \overline{1, n}, \ \sum = \bigcup_{i=1}^{n} \Sigma_i \qquad (1.3)$$

get If n changes one of the incoming bits, then each outgoing bit varies with probability p = ½, then F satisfies the basic rigid criterion. If F meets the basic strict criterion

$$P(v_i^j = 1) = \frac{1}{2}, \forall j = \overline{1, n} \qquad v_i = (x', x'') = F(x') + F(x''), (x', x'') \in \Sigma_i \quad (1.4)$$

Therefore, parallel algorithms with high dimension and accuracy based on parallel computing technology were created through OpenMPI (message interface library). The algorithm automatically adapts to the computing resources given to it - the number of computational processes - without changing the code. In addition, high accuracy ensures that none of the computers in the cluster running the algorithm run idle, even if they have different parameters [1, 2].

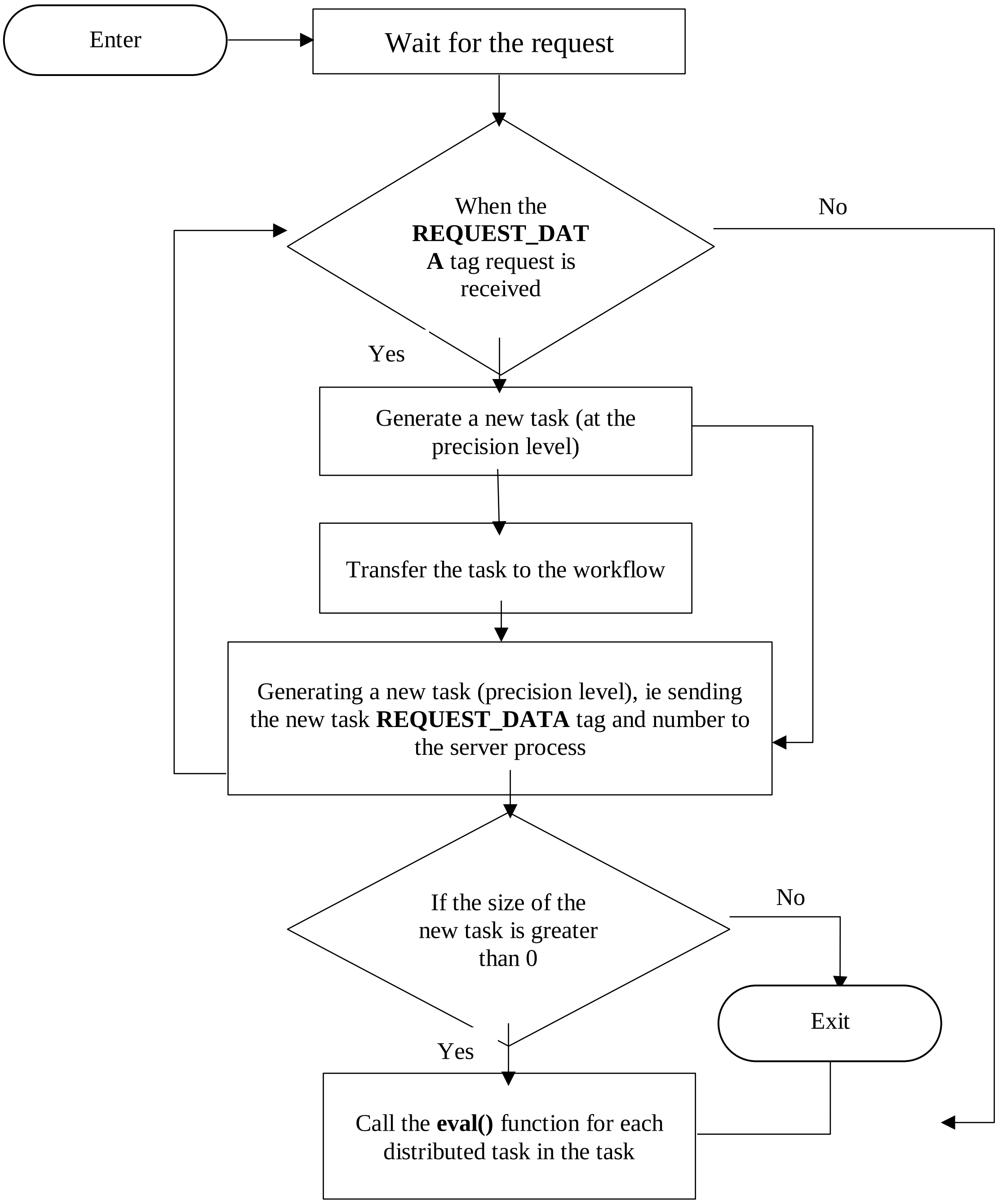
There are at least two calculation processes, and they are all numbered (from 0). One of the processes is called the server process (from 0) or simply the server cluster, the rest are called computing or working processes. Server performance algorithms and workflows differ. The server devices are responsible for breaking down the initial task into smaller classes of a certain size (set in the compilation of the program). The algorithm is presented in block diagram 1.

In order not to lose all data during a power outage or power outage while the program is running, data of a certain frequency is written to temporary files using functions in the log file.

RESULTS. The total number of replacement tables generated on the basis of the different values above was 4,161,600, for each of which the automatic quality evaluation eval () function was worked out using linear and differential method, and the attacks were organized.

1 - table. The difference between encryption algorithms

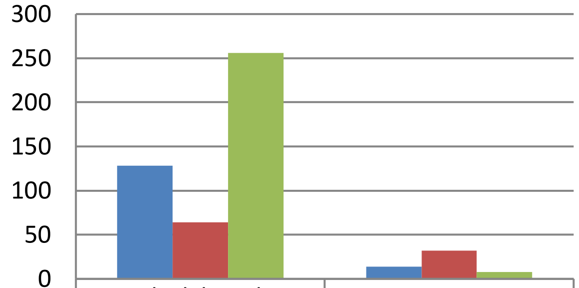
Algorithm name	Key length, bits	Block length, bits	The number of cycles in the encryption
Rijndael	256	128	14
GOST 28147-89	256	64	32
O’z DSt 1105:2009	256 (512)	256	8



2. Block diagram. Algorithm block diagram based on parallel computing technology.

If tables are identified during the linear analysis process, then the independence criteria for such tables are not met. Based on the results obtained, the replacement tables allow to confirm that they are resistant to linear and differential analysis, which is sufficient for more than 4 rounds.

O'zDSt1105:2009 encryption algorithm and the difference between GOST 28147-89 encryption algorithms in Table 1 and other foreign countries.

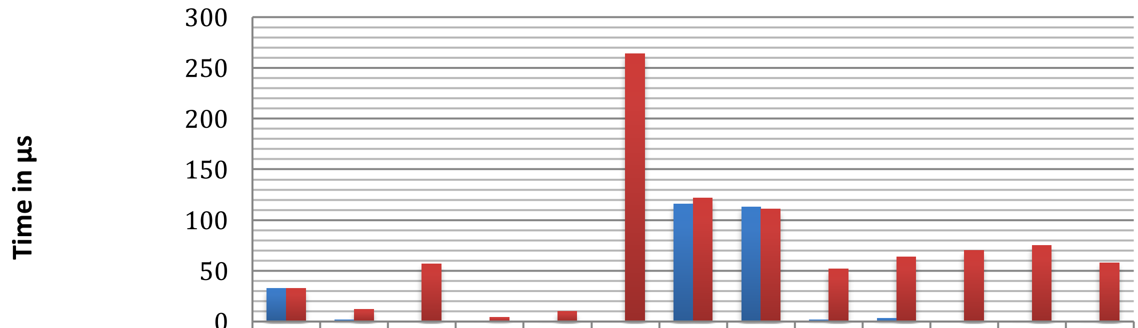


	Б Block length, bits ıт	The number of cycles in the encryption
Rijndael 256	128	14
GOST 8147-89 256	64	32
O'z DSt 1105:2009 256 (512)	256	8

1. Picture. Difference diagram of encryption algorithms.

It is known that in order to create and use high-quality encryption algorithms, programmers need sufficient knowledge and experience in this field. It is recommended to have an idea about optimizing their algorithms when using ready-made cryptographic libraries and testing them in practice. Pre-calculating the values of some functions during the initial calculation process and storing them in the form of a search table allows the data in it to be exchanged in existing tables, which leads to optimization of processor time. High-level programming languages do not allow to perform some of the operations required to create cryptographic algorithms efficiently. In the Assembler language, the program code provides optimal performance, taking into account the specific features of the processor architecture (Figure 2).

However, the use of these methods reduces the portability of the program, complicating modification and maintenance. Such methods are widely used in open source OpenSSL and LibreSSL cryptographic libraries, including SSL / TLS protocols, symmetric and asymmetric encryption algorithms, and hashing functions. Modern processors support efficient data set processing functions.



	md4	md5	sha1	des cbc	des ede3	blow fish cbc	aes-192 cbc	O'zD St 1105:2009	rsa 512 bits sign	rsa 1024 bits sign	rsa 2048 bits sign	ГОСТ 28147-89	ГОСТ 34.12-2015
in assembly language	33	2	0	0	1	0	116	113	2	3	0	1	1
without assembly lang.	33	12	57	4	10	264	122	111	52	64	70	75	58

2. Picture. Copulation rate in Intel Compiler technology

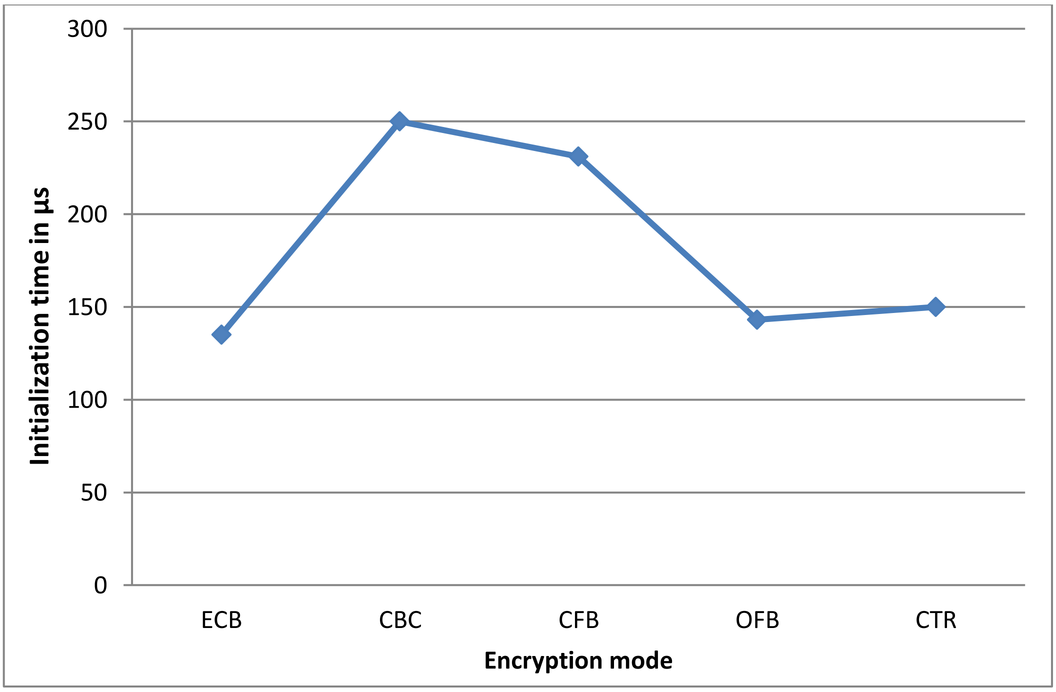
Parallelization of calculations allows different phases of the same algorithms to be performed simultaneously, thus significantly reducing their execution time. There are many ways to organize parallel computing: performing multi-stream operations on a single processor core, performing parallel operations on multiple processor cores within a single processor, performing parallel operations on all processors available on the network but on different computers.

It is also not possible to effectively parallel all operating modes of block encryption. The ECB (electronic codebook, simple switching mode) and CTR (counter mode) can parallel simple text blocks for independent processing.

Table 2 - Modes of operation of different block encryption algorithms

	ECB	CBC	CFB	OFB	CTR	Cryptographic libraries
DES	+	+	+	+		LibreSSL
AES 256	+	+	+	+		LibreSSL
GOST 28147-89	+		+		+	LibreSSL
GOST 34.12-2015	+	+	+	+	+	Library of GOST algorithm
O’zDSt 1105:2009		+				Based on additional libraries

CBC (cipher block chaining mode) and CFB (cipher feedback mode) are only well-parallel decryption procedures. There is no possibility of parallelization in OFB (output feedback mode), but it is possible to increase the efficiency of encryption and decryption issues by other methods, as shown in Table 2.



3. Picture. Encryption modes initialization time

CONCLUSION.

The analysis of the encryption standard O'zDSt 1105:2009 revealed the following:

1. O'zDSt 1105:2009 encryption algorithm uses 2 keys - encryption key and functional key, each of which is a 256-bit sequence. The interaction of these keys is equivalent to the use of a 512-bit encryption key in the encryption algorithm, which in turn prevents the possibility of unauthorized decryption of data;

2. If high-level security elements are used, the functional key is changed in each session;

3. O'zDSt 1105:2009 encryption standard has been confirmed to be resistant to linear and differential analysis, which requires more than 4 rounds.

4. The following classification of the evaluation of the quality indicators of encryption algorithms is proposed and the analysis of encryption modes using parallelization problems was performed. During the analysis, the initialization time of the system in encryption modes was also studied. In most cases, the initial time deviations of the encryption depending on the selected mode are not significant. In CBC and CFB modes, the initialization time increases. In SVS mode, the cryptographic tolerance of the encryption algorithm increases (Figure 3). Parallelization in encryption of the highest index in SVS mode was performed at 0.00025 sec.

References:

1. Qi Luo (2009). *Advancing Computing, Communication, Control and Management*, *Springer Science & Business Media*, 2009., p.290.
2. (1996). *Algorithm for cryptographic transformation GOST 28147-89*, IPK Standards Publishing House, Moscow.
3. Mao, V. (2005). *Modern cryptography: theory and practice: trans.* from English. Moscow: Publishing House "Williams".
4. Stallings, V. (2001). *Cryptography and protection of networks: principles and practice:* trans. from English. Moscow: Publishing House "Williams".
5. Ferguson, N., & Schneier, B. (2005). *Practical cryptography:* trans. from English. Moscow: Publishing House "Williams".
6. Shannon, K. (1963). *Communication theory in secret systems. Works on information theory and cybernetics:* trans. from English. (pp.333-369). Moscow: Publishing house of foreign literature.
7. Schneier, B. (2012). *Applied cryptography: protocols, algorithms, source texts in C:* per. from English. Moscow: Triumph.
8. (n.d.). *GOST 28147—89 "Information processing systems. Cryptographic protection. Algorithm for cryptographic transformation ".*
9. (2006). *GOST R 34.13—2015 "Information technology. Cryptographic information protection. Modes of Operation of Block Ciphers ".ISO/IEC 18033-2:2006 Information technology — Security techniques — Encryption algorithms — Part 2: Asymmetric ciphers.*
10. (2001). *FIPS PUB 197. Federal Information Processing Standards Publication. Advanced Encryption Standard (AES).* November 26,2001.
11. (2008). *FIPS PUB 198-1. Federal Information Processing Standards Publication. The Keyed-Hash Message Authentication Code (HMAC).* July 2008.
12. (2015). *FIPS PUB 202. Federal Information Processing Standards Publication. SHA-3 Standard: Permutation-Based Hash and Extendable-Output Functions.* August 2015.
13. (2001). *NIST SP 800-38A 2001 Edition. Recommendation for Block Cipher Modes of Operation. Methods and Techniques*. NIST. — Dec. 2001.
14. (2010). *Addendum to NIST Special Publication 800-38A Recommendation for Block Cipher Modes of Operation: Three Variants of Ciphertext Stealing for CBC Mode*. October 2010.
15. (2010). *Addendum to NIST Special Publication 800-38A Recommendation for Block Cipher Modes of Operation: Three Variants of Ciphertext Stealing for CBC Mode*. October 2010.