A One-Time-Pad Alternative
Mathematical Secrecy with one round of Transposition

ENCRYPTING A MESSAGE SUCH THAT ANY FINITE NUMBER OF MESSAGE-CANDIDATES WILL BE AS LIKELY A PLAINTEXT AS THE MESSAGE ITSELF.

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Abstract: **Vernam cipher offers mathematical security because every possible message of same length as the encrypted message can be decrypted from the given ciphertext. This irreducible equivocation is the basis of the celebrated Vernam's One Time Pad cipher. A comparable equivocation can be achieved by first encoding a message in a smart unary way where bit identity carries no content information. Instead, content is expressed by bit count, using bit identities only to mark where one countable string begins and another ends. The resultant encoded expression, albeit, larger, undergoes a single round of transposition. It turns out that the thoroughly transposed bits can be reassembled to construct any content that can be originally expressed in a bit string of some finite size. This includes the full range of bit size up to an arbitrary limit. By transposing n bits, with a key in the form of a single positive integer, k, of a limited range, one can include the key for the next message in the present message, and maintain a limited but persistent level of equivocation. A repeat use of the same transposition key will deteriorate the initial mathematical secrecy, but the rate of deterioration is subject to user's control. This Transposition Encoding Alphabet Method (TEAM) cipher may be positioned as a Vernam alternative, also serving as a mathematical secrecy reference to computationally secure ciphers.**

I. INTRODUCTION

Transposition is arguably the most basic cryptographic primitive, it requires no alphabet, and it's complexity is super-exponential. It lends itself to very efficient execution in hardware, which explains its popularity in most common cryptographic protocols. Herewith we investigate the premise that it may be a sufficient operation for purpose of security. We present TEAM: Transposition Encryption Alphabet Method, s cipher based on one round of transposition for generating secrecy. The TEAM cipher is based on randomized at-will encoding of the plaintext so that its transposition will generate any desired measure of security.

A bit string b comprised of t bits, can be encoded in a format b* through a string b_v comprised of v+1 bits of identity "0" where v is the binary value interpretation of b, associated with a string b_r, of r+1 bits of identity "0", where r represents the count of leading zeros in b.

Illustration: let b = 0001011. We write v = 11, r=3, and hence:

b*: $\{b_v, b_r\}$ = {v+1 "0"s, r+1 "0"} = {000 000 000 000, 0000}

There is clear bijection between b and b*.

Let string b_1 be so encoded to b^*_1, and b_2 so encoded to b^*_2 only that for b^*_2, we switch the bit identities from "0" to "1". . We write:

b_1 = {v_1+1 "0", r_1+1 "0"}
b_2 = {v_2+1 "1", r_2+1 "1"}

We now express a concatenation between b_1, and b_2 as follows:

$$b_1||b_2 = \{b_{v1}||b_{v2}, b_{r1}||\ b_{r2}\}$$

Illustration: let b_1 = 00101 and b_2 = 0001000. Accordingly v_1 = 5, r_1 = 2, and v_2 = 8, r_2 = 3. And thus we write:

b_1= {v_1+1 "0", r_1+1 "0"} = {000 000, 000}
b_2= {v_2+1, r_2+1} = {111 111 111, 1111}

$b_1||b_2$ = {$b_{v1}||b_{v2}$, $b_{r1}||$ b_{r2}} = {000 000 111 111 111, 000 1111}

Since b_{v2} is comprised of "1"s and b_{r1} is comprised of "0"s we can concatenate without confusion:

$$b_1||b_2 = \{b_{v1}||b_{v2}, b_{r1}||\ b_{r2}\} = b_{v1}||b_{v2}||b_{r1}||\ b_{r2}$$

Similarly for a string B comprised of arbitrary number, n, of subsections: $B = b_1||b_2.....||b_n$ versus $B^* = b^*_1||b^*_2.....||b^*_n$. For an even value of i (i=1,2,...n) the b_{vi} and b_{ri} strings of b_i will be written with "1"s while for an odd value of i b_{vi} and b_{ri} will be written with :"0"s.

We now write:

$$B^* = \{B^*_v = b_{v1}||b_{2v}||.....b_{nv},\ B^*_r = b_{r1}||b_{2r}||.....b_{nr}\}$$

Further concatenating the two strings:

$$B^* = B^*_v\ ||\ B^*_r = b_{v1}||b_{v2}||.....b_{vn}||\ b_{r1}||b_{r2}||.....b_{rn}$$

In order to mark where the bits of b_{vn} end, and the bits of b_{r1} begin, it is necessary that n will be divided by 4 (n = 0 MOD 4). We shall see below that this requirement may be overcome, using the NULL entity.

We now define b_0 = 'NULL' as the 'NULL' string which will be mapped to b^*_0 with v = 0, and r=0, namely: b^*_0 = {v+1 "0", r+1 "0"} = {0,0} or: b^*_0 = {v+1 "1", r+1 "1"} = {1,1} where we agree to switch bit identities for adjacent NULLs characters: b_0b_0 = {0,0}{1,1}, or {1,1}{0,0}, no ~~{00}{0,0} {1,1}{1,1}~~.

One ready use of the NULL is to allow an arbitrary string B to be parceled out to any n number of subsections. Adding one, two, or three NULLs anywhere in B will make the total number of subsections n' = 0 MOD 4 and will insure that the bit identity comprising b_{vn} will be opposite the bit identity comprising b_{r1} so there will be no confusion as to when b_{vn} ends and b_{r1} begins.

We can implant NULL characters throughout a bit-string:

$$B = b_1\ ||\ b_2\ ||..\ ||\ b_n = b_1\ ||\ b_2\ ||...||\ b_i\ ||\ b_0\ ||\ b_0....\ ||\ b_0\ ||\ b_{i+1}\ ||\ b_{i+2}...\ ||\ b_n$$

and so:

$$B^* = b^*_1\ ||\ b^*_2\ ||...\ ||\ b^*_n = b^*_1\ ||\ b^*_2\ ||.....||\ b^*_i\ ||\ b^*_0\ ||\ b^*_0...\ ||\ b^*_0\ ||\ b^*_{i+1}\ ||\ b^*_{i+2}....\ ||\ b^*_n$$

We shall regard the above described encoding of an arbitrary bit string as TEAM-encoding, and the reverse process as TEAM-decoding.

Let B^{*T} be an arbitrary transposition of B* using a transposition key, K^T: B^{*T} = TP (B*, K^T), and let |B*| = $|B^{*T}|$ be the bit count of either of these two strings.

Both B^{*T}, and B* have the same number of '0' bits, 0_c, and the same number of '1' bits, 1_c where $0_c + 1_c = |B^*| = |B^{*T}|$. Let bit string B' ≠ B be encoded into B'* where $0'_c = 0_c$, and $1'_c = 1_c$. Accordingly there exists a transposition key K'_t such that $B^{*T} = TP(B'^*, K'_t)$. In other words, anyone with possession of B^{*T} without a possession of its generating transposition key, K_t will not be able to determine whether B or B' were used to generate it. Since B' is arbitrary, this means that all the bit strings that can be encoded to a string with 0_c zeros and 1_c ones -- are valid candidates for being the string that was transposed to B^{*T}. The larger the class of such B' string, the larger the equivocation -- up to perfect secrecy as defined by Claude Shannon.

We shall show now how to encode an arbitrary B' to B'* with $0'_c = 0_c$, and $1'_c = 1_c$

Step 1: parcel B' to m consecutive subsections of arbitrary sizes: $b'_1||\ b'_2||\ ....||.b'_m$.

Step 2: TEAM-encode B': Read b'_{1v} and b'_{1r} and construct b'_1 = {v'_1 + 1 "0", r'_1 + 1 "0"]. Continue respectively with b'_i for i=1,2,...p where p ≤ m, as follows:

$$b'_i = \{v'_i + 1\ "Q",\ r'_i + 1\ "Q"]$$

where 'Q' represent bits of identity '0' for odd i, and identity '1' for even i.

Step 3: TEAM-Encode B' to B'*, as above, then count the number of '0' bits in B'* ($0'_c$), and the number of '1' bits in B'* (1_c):

$0'_c = \Sigma\ v'_{2i+1} + r'_{2i+1} + 2$ ..... *for i=0,1,2,3.... no higher than p/2.*

$1'_c = \Sigma\ v'_{2i} + r'_{2i} + 2$ ..... *for i=1,2,.... no higher than p/2* .

If $0'_c > 0_c$, or $1'_c > 1_c$ then B' go to "oversize options". Otherwise:

Step 4: compute:

$$\Delta 0 = 0_c - 0'_c$$
$$\Delta 1 = 1_c - 1'_c$$

Add Δ0 '0' bits as a header according to the set forth "header protocol", and add Δ1 '1' bits as a trailer according

to the set forth "trailer protocol.". The resultant header and trailer wrapped string $B'^* \rightarrow B'^*_w$ is comprised of 0_c bits of identity '0' and 1_c bits of identity '1', and hence B'^*_w is a permutation of both B* and B^{*T}. Namely, there exists a transposition key K'_t such that:

$$B^{*T} = TP (B'^*_w, K'_t)$$

Hence anyone holding B^{*T} without holding K_t cannot conclude that B^{*T} was generated from B*, and not from B'*. Every bit string sufficiently short will qualify as B' in the preceding analysis. This includes B' comprised of a string of 'NULLS'. In other words the size of B*, |B*|, and its Hamming weight, not its content, determines the range of candidate strings (B') that all qualify to be the string that generates B^{*T}. It is this vastness of this range that determines the security of the cipher.

When we combine this fact with the ability of the TEAM cipher user to increase the size of the TEAM-encoded version, (B*), of the original string B, at will (using as many NULL elements as desired, as well as wrapping the B with header and trailer as described ahead), we conclude that a transmitter of a message B using the TEAM cipher would be able to increase indefinitely the range of plaintext candidates that would encrypt to the transmitted ciphertext (B*). This is a very strong statement. Which in effect makes it unnecessary to use any more algorithmic protection for data. Using the TEAM cipher, security is achieved through investing in greater computational effort in terms of executing transposition of large bits strings and through handling and transmitting large ciphertext. This resource investment is decided ad hoc by the user, not the cipher designer or builder. Such shift of responsibility for the security of transmitted data is far reaching.

OVERSIZE OPTIONS

In the event that $O'_c > 0_c$, or $1'_c > 1_c$, then one can try a different way to parcel out B'. Otherwise, it is possible to increase the size of B through adding NULLs or through attaching larger headers and trailers. This can be done until 0_c and 1_c are high enough, implying that the TEAM encoder has full control over the degree of equivocation that protects their transmission.

A. Header/Trailer Wrapping

The TEAM-encoded bit string B* over bit string B, may be wrapped with a leading header, HDR, and a trailing trailer TRL: $B^* \rightarrow B^*_w$ = HDR-B*-TRL.

The header will be in the form 00.....1. Namely h '0' bits followed by '1', where h=1,2,.... open ended.

The trailer will be in the form 011.. 1. Namely *l* '1' bits following a single '0', where *l* = 1,2,.... open ended.

The values of h and *l* are arbitrary, and determined by the encoder.

As defined, the recipient of the wrapped string B^*_w will readily strip the header and the trailer to recover the unwrapped version, B*. To strip the header the recipient will remove all the leading zeros and the following '1'. To strip the trailer the recipient will remove all the trailing '1' and the preceding '0'.

Wrapping allows the TEAM encoder to add as many '0' and '1' bits to the pre-transposed string, in order to pack the transposed list with the same number of '1' an '0' bits, or any other ratio.

If headers and trailers are allowed then, at a minimum a single 0 added header and a single 1 added trailer will be needed to properly interpret the bit string.

B. Encoding Considerations

TEAM encoding creates an encoded string B* off a pre-encoded bit string B, such that the encoded size (bit count) is larger than the pre encoded size. We first examine this size-factoring.

It is readily seen that the smallest increase in size will happen for a string comprised of n "0" bits: 00....0. Encoded as a single section, it will register v=0, r=n. Hence: B* = { 1 "Q", (n+1) "Q"} where Q is a bit of either identity "1" or identity "0". Since there is only one section we may have opposite identities for the v and the r. Alternatively we could add a NULL element. and keep both the r bits and the v bits of same identity.

So if B = 000000 then B* = { 0000000, 1} = 00000001 or B* = B* NULL = 0000000101

In the first way the size of B* is |B*| = n + 2, and the latter way it is |B*| = n + 2 + 2. Namely |B*| ~ |B|.

The largest expansion happens for a string of n bits of identity "1": B =11.....1. In the case where the string is referred to as a single section we have B* = {2^n - 1 "Q", 1 "Q"}. An exponential expansion: $\eta = |B^*|/|B| = 2^n/n$.

The actual expansion, η, ranges between these two extremes:

$$1 < \eta \leq 2^n$$

When an n-"1" bits string B is divided to s subsections of equal size then the encoded version, B* counts: $|B^*| = s * 2^{n/s}$ bits where the size decreases with rising value of s.

To minimize the value of η for an arbitrary bit string, B, comprised of n bits, one should divide it to the maximum number of subsections: one-bit size each. We can write:

for b=0 we have v=0, r=1, and hence b* = {Q, QQ} and for b=1 we have v=1, r=0, and hence b* = {QQ, Q}

where Q is a bit of either identity 1 or identity 0.

Accordingly b* is three times the size of b: η = 3

Analyzing subsections of size 2 bits:

```
b  v r b*
- - - - - - -
00 0 2 Q,QQQ
01 1 1 QQ,QQ
10 2 0 QQQ,Q
11 3 0 QQQQ,Q
```

This is average size increase of η = 4.25

for |b| = 3 the η will range from 5, (for 000, 001, 010, 011) to 9 (for 111).

C. Subsection Strategy

The strategy for parceling the plaintext B to subsections is critical in determining the size increase of the ciphertext, $B^* = B^{*T}$ over the plaintext B. We have seen above how large is this range. In practice the subsections may be of varying sizes. These size variety may be chosen through a randomization process, perhaps between two limits (upper and lower per subsection size). By using ad-hoc randomness the security of the operation vastly increases. Yet, it can also be chosen in some deterministic way. In fact the very choice of the subsection sizes may be used to deliver a secondary hidden message to the intended recipient.

D. Decoy Strategy

The transmitter of a TEAM message may increase security by using a high η value -- a large ciphertext compared to the un-encoded plaintext. They can use two ready methods to inflate the ciphertext, and add so called 'decoy bits'. One method is by peppering the message with NULL elements. A NULL element does not add anything to the message but it requires 2 bits to be expressed. With NULLs it is impossible to add at will more 0 bits than 1, or at will more 1 bits than 0. The alternative method is headers and trailers where both '1' bits and '0' bits can be added in any desires number.

The following string, E. is empty:

E = 00000000000101010101010101010101010111111

because it is comprised a header, 10 NULLS, and a trailer: HDR NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL TRL

E = 000000000001 01010101010101010101 0111111

The transmitter may 'hide' a message M in a series of empty transmissions E_1, E_2, .,,:

$$E_1\ E_2\ ,.....\ E_i\ M\ E_{i+1},\ E_{i+2}\ .....,\ E_q$$

By applying sufficient decoys the transmitter may protect his message with any desired measure of security.

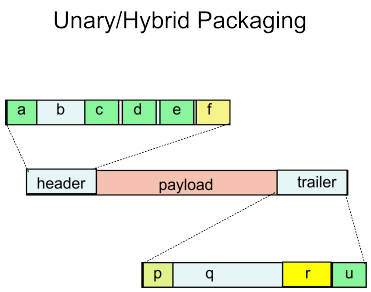
II. OPERATION

The transmitter of a TEAM enciphered message enjoys a great measure of control over the security of the sent message. The transmitter decides how much to pay, aware of how much security will be purchased. The price is rated with computational burden. Some of this burden may be alleviated through hardware, and some through communication channels and memory.

TEAM security is based on a shared transposition key and a single transposition round, on encoding variety, and on decoy strategy. The larger the transposition list, the better the security. This size, depending on implementation, may be non pre-shared, namely unilaterally determined by the transmitter on account of the desired security. Same for the encoding scheme, and the decoy management, which are also unilaterally determined and feed on ad-hoc randomness. That means the transmitter who is in the best position to appreciate the security needs for its transmission, is the right agent to determine which encoding scheme to use and the degree of decoy defense. This determination may be made for each transmission. So that when a single key must be used over and over again, it can each time, be used with more protection through more elaborate encoding and more extensive decoy management. This is an important distinction relative to mainstay ciphers where security is built in to the published algorithm and is threatened by unpublished attack scheme. The TEAM user relies on ad-hoc high quality randomness in desired quantities. Security shifts from the algorithm designer to the message transmitter; from well known cipher algorithm to unknown on-demand randomness.

A. *Unary Encoded Packaing*

The figure abreast shows how the payload (the ciphertext) is wrapped by a header and a trailer. The header has 6 elements: (a). message start signal, (b) sender id, time of transmission, open fields, (c) encoding data, (d) transposition key indicators, (e) payload size, (f) header end indicator. The trailer is identified with four elements: (p) trailer start indicator, (q) transmission history, (r). signature (payload hash / header hash), (u). end of trailer indicator.



B. *Transposition Options*

We consider two methods. One is based on US Patent 10608814, Equivoe-T, the other on hard-wired TSIC (Transposition Specific Integrated Circuits). Equivoe-T offers the advantage of having an integer as a key, which applies to any size of transposed list. This gives the TEAM user the advantage of choosing each time a different size of bit string to transpose. TSIC is much faster, but it is geared towards a fixed size bit string to be transposed. We will focus on the TSIC fixed size option.

C. *Fixed Size Transposition*

The advantage of fixed size transposition in hardware implementation is that it allows for hard wiring of the transposition operation to allow any permutation of n-items list to any other permutation of the same list. The issue here is that this transposition is fixed, and applies to a fixed size list.

Size variety can still be applied over a range from some low threshold L, and high threshold H (bit count). Any size value X: $L \le X \le H$ can be used for the payload, with the balance of H-X bits contributed through NULLs or through header or trailers, such that the pre-transposition size will always be H, which is the hard wired size.

It can be implemented over a fixed size input and output, of n item, where some t fixed transposition wiring units are listed in order: T_1, T_2,.... T_t. These t transposition rounds are combined into a single device. The input to the combined device includes a designation of which u transposition units (among the available t transposition operations) are to be applied over the input to generate the respective output. This list of u items is the 'secondary transposition key', K^*_t. The first key is expressed in the hard-wired t units. This implies that a group can share the hard-wired device with t transposition units, but bilateral confidential communication within the group will be carried out via a secret shared secondary transposition key, which has a key space of 2^t.

Every processing round in the device may involve a randomized selection of the next K^*_t key, to be used in the next processing round in the device (the next application of the TSIC). Say the first payload P_1 is comprised of the first message M_1, and the secondary transposition key to be used for the next message: K^*_{t1}: $P_1 = M_1 - K^*_{t2}$. P_1 will be transposed with the pre agreed first transposition key, K^*_1:

$$P_1^T = TP ([M_1\text{-}K^*_{t2}], K^*_{t1})$$

and then:

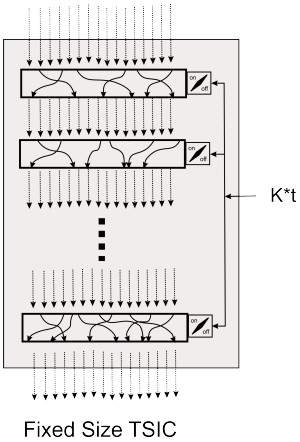
$$P_2^T = TP ([M_2\text{-}K^*_{t3}], K^*_{t2})$$

and so on for i=1,2,...

$$P_i^T = TP ([M_i\text{-}K^*_{ti+1}], K^*_{ti})$$

There are 2^t combinations to select active units among the available t, so the key space for the secondary key is: $|K^*_t| = 2^t$.

The transposition can be hard wired to operate on individual bits or on sub-strings of bits of equal size.



Fixed Size TSIC

The device input string S_0 will enter the first hard wired transposition unit, T_1, and come out transposed, S_1. This output string, S_1, will then encounter a decision node. If T_2 is listed in K^*_t as a unit to be activated then S_1 will be fed into T_2 for another round of transposition. If T_2 is not listed in K^*_t then S_1 will by pass the 2nd transposition unit and be routed to a similar decision before node T_3. Every transposition unit will be preceded by a routing decision junction based on the value of K^*_t.

The device will be built to allow for reverse transposition by simply reversing the input/output ports, using the same K^*_t.

TSIC may feature, say, $n=10^6$ register bits, and t=1000 transposition units, which will allow this device to be used in 2^{1000} different ways: $|K^*_t| = 2^{1000} = 1.07 * 10^{301}$.

D. Latchable TEAM cipher

The transposition operation is the security hub of the TEAM operation. One may then implement it in a latchable device, to be bio-activated, and be latchable to a computer to provide specifically transposition and reverse transposition services only.

E. Decryption

The recipient of the ciphertext (the transposed encoded message, B^{*T}), will first reverse-transpose it, then decode it to extract the original message:

$$B^{*T} \rightarrow B^* \rightarrow B$$

F. TEAM hash

Any bit string can be parceled out to substrings, such that each substring is comprised only of same identity bits. And if the number of such substrings divides by 4 then this string can be interpreted as TEAM-encoded off a smaller string. If the total number of such substrings does not divide by four then one could concatenate to it Q, QQ, or QQQ as required: " where Q is a bit of identity opposite the identity of the last bit in the string to which it is concatenated (or a similar solution). Hence if a string B is comprised of 37 strings and the last string is 111, then QQQ is needed to make the count of subsections divide by 4, namely QQQ = 010. This arbitrary string comprised of 4k same identity substrings (k=1,2,...) can be compressed to its TEAM-decoded version. The compressed encoding can be further compressed iteratively. This 'decoding' process is not reversible because the corresponding encoding involves an arbitrary division of the decoded string to substrings.

Let B_0 be the original string, of size $|B_0|$l bits. It can be compresses (as stated above, in a lossy way) to B_1, which in turn can be compressed (decoded) to B_2, and so on, string B_i may be compressed to string B_{i+1} . This process may continue until a terminal string B_t comprised on NULLs. Unlike the typical hashing procedures, the TEAM hash does not end at a preset size, but it can be continued until the hash equals or is less than a threshold size. The resultant hash may be applied like the more common hash procedures.

We designate dB as the TEAM-decoded version of string B. And so we can write: $B_i = dB_{i-1} = d^jB_{i-j} = d^iB_0$.

Illustration: Let B_0 = 11100110010001. B_0 is comprised of 7 same-bit-identity strings: 111 00 11 00 1 000 1. We need therefore to concatenate it with Q=0:

$$B'_0 = 111\ 00\ 11\ 00\ 1\ 000\ 1\ 0$$

So $dB' = b_1 \| b_2 \| b_3 \| b_4$, where:

$b_1 = (v_1 = 2, r_1 = 0) = 10$
$b_2 = (v_2 = 1, r_2 = 2) = 001$
$b_3 = (v_3 = 1, r_3 = 0) = 1$
$b_4 = (v_4 = 1, r_4 = 0) = 1$

Thus:

$$dB' = b_1 \| b_2 \| b_3 \| b_4 = 10\ 001\ 1\ 1$$

The original string is comprised of 14 bits, and the decoded one is comprised of 7 bits.

Decoding again: dB' = 1 000 111 is comprised of 3 same-bit-identity subsections, so Q=0 will have to be added to create a number of subsections that divides by 4:

$$d(dB')' = d(1\ 000\ 111\ 0) = b_1 \| b_2$$

$b_1 = (v_1 = 0, r_1 = 2) = 00$
$b_2 = (v_2 = 2, r_2 = 0) = 10$

And hence:

$$d(dB')' = d(1\ 000\ 111\ 0) = b_1 \| b_2 = 0010$$

To continue we need to add '1', and end up with a string with four subsections

$$d(d(dB')')' = d(00\ 1\ 0\ 1) = b_1 \| b_2$$

$b_1 = (v_1 = 1, r_1 = 0) = 1$
$b_2 = (v_2 = 0, r_2 = 0) = NULL$

and hence:

$$d(d(dB')')' = d(00\ 1\ 0\ 1) = b_1 \| b_2 = 1$$

To continue, we must add QQQ = 010

$$d(d(d(dB')')')''' = d(1010) = b_1 \| b_2$$

$b_1 = (v_1 = 0, r_1 = 0) = NULL$
$b_2 = (v_2 = 0, r_2 = 0) = NULL$

G. Transposed HASH

Any string in the series B_0, B_1, ... may be transposed before it is decoded. When these transpositions are carried out with a secret key, they create a secret hash.

We write: $B_i = H(B_{i-1}, K_t) = HB_{i-1}$ for i=1,2,..

H. Implementation

TEAM can be used generically wherever symmetric encryption is used. But it would be prominent for applications based on a latchable gadget fitted into a computer, and holding the TSIC chip. A similar chip will be useful for medical devices that are body implanted and are fine-tuned remotely. It is important to insure that these devices will not be mal-controlled. Alas, same devices use tiny battery and can't spare the energy to compute AES or alike.

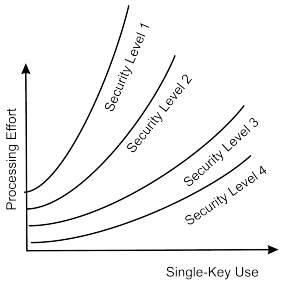
I. TEAM Security

While common ciphertexts commit to their generating plaintext, and given enough cryptanalysis will yield their secret, a TEAM cipher will challenge its attacker with irreducible equivocation, the extent of which is determined by its user. This is a strong security statement.

CONTEXTUAL MATHEMATICAL SECRECY

Contextually an adversary aware of the fact that his opponent sent a ciphertext c of size |c| at a given moment of time, will be able to list some t candidates for the identity of the message encrypted into c: $M = \{m_1, m_2, ... m_t\}$. The adversary, again contextually, will appraise a probability p_i for message m_i (i=1,2,...t) to be the one encrypted into c, where $P = \{p_1, p_2, ... p_t\}$. We now define Contextual Mathematical Secrecy as the case where knowledge of the content of c (not just its size) does not change the probability distribution over M: $P_{|c|} = P_c$.

We propose to assume that the transmitter of a secret message $m^* \in M$ will share the adversary's list, M (although not the probability distribution P), and hence will be able to encrypt m^* inflated enough (with NULLs, a header and a trailer) to insure that all members $m_i \in M$ will be associated with an equally likely reverse-transposition key k_i that will decrypt c to m_i. Thereby the transmitter unilaterally -- without pre coordination with the recipient -- will insure contextual mathematical secrecy for their transmission.



Buying Security with Processing Effort

We have seen that given a plaintext P, the transmitter thereto will be able to render an arbitrary different plaintext, $P' \neq P$ to be an equally likely candidate for the generating plaintext. To do so, the transmitter may have to inflate the number of transposable zeros (0_c) and the number of transposable 1 bits (1_c) to a sufficient level. From a practical point of view this feature is equivalent to mathematical secrecy as defined by Claude Shannon.

TEAM cipher equivocation security may be extended to repeat use of the same transposition key. Let a transmitter use the same transposition key, K_t, over q plaintext messages P_1, P_2, ... P_q. For each transmission i (i=1,2,...q) let an attacker have a list L_i of plausible plaintexts for that transmission, where this list is compiled before the respective ciphertext is released. So a-priori the number of possible sets of q messages is: $EQV = \pi |L_i|$. Since the transmitter can inflate the size of the pre-transposed string to any desired size, they can assure that given the q released ciphertext, there are likely to remain some desired number s, of transposition keys that will reduce the equivocation lists L_1, L_2, ... L_q to L'_1, L'_2,.....L_q, respectively where while for every i=l,2,...q there exists $L'_i < L_i$, the residual equivocation $EQV'(s) = \pi |L'_i|$ will be above a preset security threshold, S: $EQV'(s) < S$. In practice this implies that the user can control the security projection of their transmitted data.

J. Outlook

In the post-Coronavirus universe we expect to experience a proliferation of work-from-home practice. Bankers and confidential workers of all sorts will find it necessary to routinely communicate highly confidential data among distributed locations. This will pose new challenges before cyber technology. Security responsibility will have to shift to the transmitters of sensitive information. Not only content, but pattern will have to be concealed to enable the emerging, lasting work configurations. The new wave of Trans Vernam ciphers is well prepared to meet that challenge, and the TEAM cipher fits right in.

III. REFERENCE

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