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D. Connolly
SandboxAQ
R. Barnes
Cisco

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Concrete Hybrid PQ/T Key Encapsulation Mechanisms
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Abstract

PQ/T Hybrid Key Encapsulation Mechanisms (KEMs) combine "post-quantum" cryptographic algorithms, which are safe from attack by a quantum computer, with "traditional" algorithms, which are not. CFRG has developed a general framework for creating hybrid KEMs. In this document, we define concrete instantiations of this framework to illustrate certain properties of the framework and simplify implementors' choices.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at https://cfrg.github.io/draft-irtf-cfrg-concrete-hybrid-kems/draft-irtf-cfrg-concrete-hybrid-kems.html. Status information for this document may be found at https://datatracker.ietf.org/doc/draft-irtf-cfrg-concrete-hybrid-kems/.

Discussion of this document takes place on the Crypto Forum Research Group mailing list (mailto:cfrg@ietf.org), which is archived at https://mailarchive.ietf.org/arch/search/?email_list=cfrg. Subscribe at https://www.ietf.org/mailman/listinfo/cfrg/.

Source for this draft and an issue tracker can be found at https://github.com/cfrg/draft-irtf-cfrg-concrete-hybrid-kems.

Status of This Memo

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1. Introduction

PQ/T Hybrid Key Encapsulation Mechanisms (KEMs) combine "post-quantum" cryptographic algorithms, which are safe from attack by a quantum computer, with "traditional" algorithms, which are not. Such KEMs are secure against a quantum attacker as long as the PQ algorithm is secure, and remain secure against traditional attackers even if the PQ algorithm is not secure.

[HYBRID-KEMS] defines a general framework for creating hybrid KEMs. It includes multiple specific mechanisms for combining a PQ algorithm with a traditional algorithm, with different performance properties and security requirements for the underlying algorithms.

In this document, we describe instances of these different specific combiners, with specific choices for the underlying algorithms. The choices described here illustrate the security analysis required to make choices that meet the requirements of the general framework, and can serve as a baseline for application designers. We also provide test vectors for these instances so that implementors can verify the correctness of their implementations.

2. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

We make extensive use of the terminology in [HYBRID-KEMS].

3. Concrete Nominal Group and KEM Instances

This document introduces concrete hybrid KEM instances that in turn depend on concrete KEM and nominal group instances. This section introduces the nominal groups and KEM instances used for concrete hybrid KEM instances, specified in line with the abstraction from [HYBRID-KEMS]. Section 3.1 defines the concrete nominal groups, and Section 3.2 defines the nominal KEMs.

3.1. Nominal Groups

This section specifies concrete nominal groups that implement the abstraction in [HYBRID-KEMS]. It includes groups based on the NIST curves P-256 and P-384, as well as a group based on Curve25519.

3.1.1. P-256 and P-384 Nominal Groups

The NIST P-256 and P-384 elliptic curves are defined in [SP800-186]. They are widely used for key agreement and digital signature. In this section, we define how they meet the Nominal Group interface described in [HYBRID-KEMS].

Group elements are elliptic curve points, represented as byte strings in the uncompressed representation defined by the Elliptic-Curve-Point-to-Octet-String function in [SEC1]. Scalars are represented as integers in big-endian byte order.

The Nominal Group algorithms are the same for both groups:

* Exp(p, x) -> q: This function computes scalar multiplication between the input element (or point) p and the scalar x, according to the group law for the curve specified in [SP800-186].

* RandomScalar(seed) -> k: Implemented using rejection sampling from a PRG, as described below.

* ElementToSharedSecret(p) -> ss: The shared secret is the X coordinate of the elliptic curve point p, encoded as an Nss-byte string using the Field-Element-to-Octet-String function in [SEC1].

The RandomScalar algorithm depends on an pseudo-random generator (PRG), with the following API:

* Init(seed) -> state: Initialize a new state of the pseudo-random generator based on the provided seed.

* Read(state, n) -> data: Read n pseudo-random bytes from the PRG, updating state to reflect that this read has happened.

A hybrid KEM using these curves MUST specify the PRG that should be used. All of the hybrid KEMs in this document use SHAKE256 [FIPS202].

Given a PRG, the RandomScalar algorithm is defined as follows:

```
def RandomScalar(seed):
  state = XOF.Init(seed)
  sk = OS2IP(XOF.Read(state, Nscalar))
  while sk == 0 || sk >= order:
    sk = OS2IP(XOF.Read(state, Nscalar))
  return (sk, pk(sk))
```

The OS2IP function converts a byte string to a non-negative integer, as described in [RFC8017], assuming big-endian byte order. The order variable represents the order of the curve being used (see Section 3.2.1 of [SP800-186]), reproduced here for reference:

P-256:
0xffffffff00000000ffffffffffffffffbce6faada7179e84f3b9cac2fc632551

P-384:
0xffffffffffffffffffffffffffffffffffffffffffffffffc7634d81f4372ddf
581a0db248b0a77aecec196accc52973

The group constants for the P-256 group are as follows:

* Nseed: 32

* Nscalar: 32

* Nelem: 65

* Nss: 32

The group constants for the P-384 group are as follows:

* Nseed: 48

* Nscalar: 48

* Nelem: 97

* Nss: 48

3.1.2. Curve25519 Nominal Group

The following functions for the Curve25519 nominal group are defined:

* Exp(p, x) -> q: Implemented by X25519(x, p) from [RFC7748].

* RandomScalar(seed) -> k: Implemented by sampling and outputting 32 random bytes from a cryptographically secure pseudorandom number generator.

* ElementToSharedSecret(p) -> ss: Implemented by the identity function, i.e., by outputting P.

The following constants are also defined.

* Nseed: 32

* Nscalar: 32

* Nelem: 32

* Nss: 32

3.2. Concrete KEM Instances

This section specifies concrete KEM instances that implement the KEM abstraction from [HYBRID-KEMS].

3.2.1. ML-KEM-768 and ML-KEM-1024

The ML-KEM-768 and ML-KEM-1024 KEMs are defined in [FIPS203]. The algorithms defined in that specification map to the KEM abstraction in [HYBRID-KEMS] as follows:

* GenerateKeyPair() -> (ek, dk): Implemented as KeyGen in Section 7.1 of [FIPS203].

* DeriveKeyPair(seed) -> (ek, dk): Implemented as KeyGen_internal(seed[0:32], seed[32:64]), where KeyGen_internal is defined in Section 6 of [FIPS203].

* Encaps(ek) -> (ct, ss): Implemented as Encaps in Section 7.2 of [FIPS203].

* Decaps(dk, ct) -> ss: Implemented as Encaps in Section 7.3 of [FIPS203].

The KEM constants for ML-KEM-768 are as follows:

* Nseed: 64

* Nek: 1216

* Ndk: 32

* Nct: 1120

* Nss: 32

The KEM constants for ML-KEM-1024 are as follows:

* Nseed: 64

* Nek: 1629

* Ndk: 32

* Nct: 1629

* Nss: 32

3.3. Concrete PRG instances

This section specifies concrete PRG instances that implement the PRG abstraction from [HYBRID-KEMS] and meet the required security definitions.

3.3.1. SHAKE256

SHAKE256 is an extendable-output function (XOF) defined in the SHA-3 specification [FIPS202]. It can be used as a PRG for arbitrary values of Nout. When SHAKE256 is used as the PRG component in a hybrid KEM, it is implcit that Nout == KEM_T.Nseed + KEM_PQ.Nseed or Nout == Group_T.Nseed + KEM_PQ.Nseed as appropriate.

3.4. Concrete KDF instances

This section specifies concrete KDF instances that implement the KDF abstraction from [HYBRID-KEMS] and meet the required security definitions.

3.4.1. SHA-3

The SHA-3 hash function is defined in [FIPS202]. It produces a 32-byte output, so it is appropriate for use in hybrid KEMs with Nss = 32.

4. Concrete Hybrid KEM Instances

This section instantiates the following concrete KEMs:

MLKEM768-P256: A hybrid KEM composing ML-KEM-768 and P-256 using the CG framework, with SHAKE256 as the PRG and SHA3-256 as the KDF.

MLKEM768-X25519: A hybrid KEM composing ML-KEM-768 and Curve25519 using the CG framework, with SHAKE256 as the PRG and SHA3-256 as the KDF. This construction is identical to the X-Wing construction in [XWING-SPEC].

MLKEM1024-P384: A hybrid KEM composing ML-KEM-1024 and P-384 using the CG framework, with SHAKE256 as the PRG and SHA3-256 as the KDF.

Each instance specifies the PQ and traditional KEMs being combined, the combiner construction from [HYBRID-KEMS], the label to use for domain separation in the combiner function, as well as the PRG and KDF functions to use throughout.

4.1. MLKEM768-P256

This hybrid KEM combines ML-KEM-768 with P-256 using the CG framework from [HYBRID-KEMS]. It has the following components:

* Group_T: P-256 Section 3.1.1
* KEM_PQ: ML-KEM-768 Section 3.2.1
* PRG: SHAKE-256 [FIPS202]
* KDF: SHA3-256 [FIPS202]
* Label: |-()-| (0x7C2D28292D7C)

The KEM constants for the resulting hybrid KEM are as follows:

* Nseed: 32
* Nek: 1217
* Ndk: 32
* Nct: 1121
* Nss: 32

4.2. MLKEM768-X25519

This hybrid KEM combines ML-KEM-768 with X25519 using the CG framework from [HYBRID-KEMS]. It is identical to the X-Wing construction from [XWING-SPEC]. It has the following components:

* KEM_PQ: ML-KEM-768 Section 3.2.1
* Group_T: Curve25519 Section 3.1.2
* PRG: SHAKE-256 [FIPS202]
* KDF: SHA3-256 [FIPS202]
* Label: \.//^\ (0x5C2E2F2F5E5C)

The following constants for the hybrid KEM are also defined:

* Nseed: 32
* Nek: 1216
* Ndk: 32
* Nct: 1120
* Nss: 32

4.3. MLKEM1024-P384

This hybrid KEM combines ML-KEM-1024 with P-384 using the CG framework from [HYBRID-KEMS]. It has the following components:

* Group_T: P-384 Section 3.1.1
* ‘KEM_PQ: ML-KEM-1024 Section 3.2.1
* PRG: SHAKE-256 [FIPS202]
* KDF: SHA3-256 [FIPS202]
* Label: ‘ | /-‘ (0x207C202F2D5C)

The following constants for the hybrid KEM are also defined:

* Nseed: 32
* Nek: 1629
* Ndk: 32
* Nct: 1629
* Nss: 32

5. Security Considerations

The Security Considerations section in generic hybrid KEM framework lays out the requirements for component algorithms in order for a hybrid KEM constructed according to the framework to be secure [HYBRID-KEMS]. In brief:

* A nominal group needs to be one in which the Strong Diffie-Hellman problem is hard.

* A KEM need to be IND-CCA secure.

* When the C2PRI combiner is used (as it is here), the PQ KEM also needs to satisfy the C2PRI property.

* KDFs need to be indifferentiable from a random oracle, even by a quantum attacker.

* A PRG needs to be a secure pseudo-random generator

The components used in this document meet these requirements:

* The security of X25519, P-256, and P-384 as nominal groups is shown in [ABH_21].

* ML-KEM is shown to be IND-CCA in https://eprint.iacr.org/2024/843 and shown to be C2PRI in [XWING].

* The sponge construction used by SHA3-256 is shown to be indifferentiable from a random oracle by a classical attacker in [BDP_08]. Indifferentiability with respect to quantum attackers is shown in [ACM_25].

* Since SHAKE256 is built on the same sponge construction as SHA3-256, it is also indifferentiable from a random oracle, which is a sufficient condition for being a secure pseudorandom generator.

6. IANA Considerations

This document requests that the following values be added to the "Hybrid KEM Labels" registry:

Label	Fw	PQ Component	T Component	KDF	PRG	Nseed	Nss	Reference
"|-()-|"	CG	ML-KEM-768	Curve25519	SHA3-256	SHAKE-256	32	32	[RFCXXXX]
"\.//^\"	CG	ML-KEM-768	Curve25519	SHA3-256	SHAKE-256	32	32	[RFCXXXX]
" | /-\"	CG	ML-KEM-768	Curve25519	SHA3-256	SHAKE-256	32	32	[RFCXXXX]

Table 1: Hybrid KEM Labels

[RFC EDITOR: Please replace "XXXX" above with the number assigned to this RFC]

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7.1. Normative References

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Appendix A. Test Vectors

This section provides test vectors for the three concrete hybrid KEM instantiations defined in this document. Each test vector represents a single key generation followed by an encapsulation:

* seed - the seed used for deterministic key generation
* decapsulation_key - the derived decapsulation key
* decapsulation_key_pq - the decapsulation key sub-key for the PQ component
* decapsulation_key_t - the decapsulation key sub-key for the T component
* encapsulation_key - the derived encapsulation key
* randomness - the randomness used for encapsulation
* ciphertext - the ciphertext produced by the encapsulation operation
* shared_secret - the shared secret produced by the encapsulation operation

A.1. MLKEM768-P256

```
seed = 0000000000000000000000000000000000000000000000000000000000000000
       0000000
randomness = 6464646464646464646464646464646464646464646464646464646464
             4646464646464646464646464646464646464646464646464646464646
             6464646464646464646464646464
encapsulation_key = 3d209f716752f6408e7f89bceef97ac3885300453779
                    27644ef046c0a7cae978c8841a0133aac4f1e1a70272
                    77f671219cf58b85d29c8fec08edd432e787a3cf9936
                    fe0026a113cb9efb1d7214049527bfe2141ea170b029
                    4a59403ab0ce16760a8baa95b823cbb8aacdcc17ef32
                    775223c791e3740163941f9bb3f63346bef1c050c31f
                    932c62719429aff14c2bd438ab135bed692d56c77c04
```

cbbffd6335b578318b513771e84b14ea821262141ca0
06ccb8bf2500aa1008970f216fe7f1ae34125aa29049
2c069a189222adc322f97649c762c7d3128ad3bb2667
971d0744014bc3b67445cbcd0b3e7ea69fb1cb9f9c33
1f97487920187292926d04a25a2650abbd44982bb0c3
c6301fe6a61330d24d8a3c7021dc3e3392c79a139b37
613bba67a2984298507b84a4d61eef18acfb979af2d3
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17671c26a7c046457533cc32844581277a03eb065c45
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79601725fa545fd280b404530318bbc3371194710b6d
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a46861c50032c9b630bcc1445a30878979bc55a2c095
5bf399b231203b90c651b6afe0e242b5a543250b142f
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ac6772aa5f3674042b7c4a18a2186289a4ac4e200774
596ca03e6798c7506b984999db6ac142586bae0799f1
e776f9f5247dc574d8556ddf9bbbc4ca3643263457f7
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af2dc33665826351872c293350ab324518c8c0c80b52
1c80c81a56bdc968a5650315a830c8bb17532c62ccc2
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967e36ceb2a1aa0b71875a22751d706b72ca9ecd0c81
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820261daab361f8a2dcbb240c55abd6a8105e5291b42
7b566d731e6b7047189cff20d8b120e0b3e72472d1b0
086812200fd3698e23f06e4f4e08bbb54cc204d3702e
64fe14548e25139ab5cf9da22011eb6161d071a97baa

```
                    5126df13b4106a341c26d90d10df91ffdf6c58cddc31
                    fbae5c726b67a68fc19f5b4ff1a3a2adef
   decapsulation_key = 0000000000000000000000000000000000000000000000
                    0000000000000000000
   decapsulation_key_pq = f5977c8283546a63723bc31d2619124f11db46586
                      43336741df81757d5ad3062221e124311ec7f7181
                      568de7938df805d894f5fded465001a04e260a494
                      82cf5
   decapsulation_key_t = 84012cb7215cc5b52b947b984b691cd0ee89493e3c
                     e346a16f268dcc6099b244
   ciphertext = d81018a94f8078e02105beaa814e003390befa4589bb614f773
                97af42d8e8150796f2c88a4efca81b8cf93c0ae3716c54ec1b0
                45e3875f38c2dd12d7f717bd7fb701a9fecda5ed8b764c9a35d
                4a5c1d8930f6071f653eebb2d1afa77debb8302d16f17e0f5f3
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                8baf2bd1f6667c017a1e65ff8a1554458fb3f367c02721752bf
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                e41006d91b25adcafc098fe66f7554be8dad493c4f4b1dbf7a5
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   shared_secret = 83c45ea5dacceadc655deb9c8fbc05374cd866c1200ec832
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   seed = 0101010101010101010101010101010101010101010101010101010101010
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   randomness = 6565656565656565656565656565656565656565656565656565656
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                6565656565656565656565656565
   encapsulation_key = ec7b50cddc8360f98b189bac73d395ef947b37d84538
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   decapsulation_key = 0101010101010101010101010101010101010101010101
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   decapsulation_key_pq = dbf77c8d79c80ad6b0763d42a3fe53f0f1dc03022
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                         988d9355e816055cf986e280532d47cc19f2240cc
                         23419
   decapsulation_key_t = 78da64917300acc091289b52e29e78013ecc0880fb
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   ciphertext = 600ecf4026683898d0e339eeea9ebd437a4a802952bf32bfa32
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                6c1136ee23e7544cfa7524c6c04ed9ec29aed307b5dfd0108f2
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                4a905d453eac1caafe2bfe4e6c904556ca91b01b2302215ab3d
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   shared_secret = 1c9da2bcbbcda3f3fc4489b48f135d7c785d3a9c854712a1
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   seed = 0202020202020202020202020202020202020202020202020202020202020202
          2020202
   randomness = 6666666666666666666666666666666666666666666666666666666666666666
                6666666666666666666666666666666666666666666666666666666666666666
                66666666666666666666666666
   encapsulation_key = 08118d8819772292c976ec971ee3039195800c823544
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   decapsulation_key = 0202020202020202020202020202020202020202020202
                       02020202020202020202
   decapsulation_key_pq = 971619c09e6627cea855bbf7817dd36cdbf7d2de9
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                          de29420fb451103347536bb655a2bab5fbaba8a67
                          86fe9
   decapsulation_key_t = 37883eb9bcc96844d92ca5a09b72dde8a89bd46875
                         d451e547e7007a93d49c9b
   ciphertext = 413c55d5710bae6376761dada807daffd4dc45f9f70d825e0d4
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   shared_secret = 3bfd10e7f3b86302615dcbe11213f0e49d96722c810db515
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   seed = 0303030303030303030303030303030303030303030303030303030303030
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   randomness = 6767676767676767676767676767676767676767676767676767676
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   decapsulation_key = 0303030303030303030303030303030303030303030303
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   decapsulation_key_pq = 49b46321ef5a24c1c036750879c0ad29dd08607d4
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   decapsulation_key_t = 2d516ba0e4ffc69fd2a972c1986aa772a6b8747a5c
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   ciphertext = f40d556d507802ebe7be0e65ab82b0aa9ff26c825d24f98148f
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                2dc2b723a7f2f69830a52326621ee034c8a9e80f39070456bfd
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                c3ec3caadf08b0f920667fae9ad18560edc3f8571986ca0bf1e
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                a44c12bcc23ed7b1b96442108843e5fcee04a7e4497fa828e47
                049b581075bdf9edff7cfaf00858936c30ffaca0849b31eb5a0
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   shared_secret = f9b92989544321a9ba5969af5d1de455d29d27341ab57791
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   seed = 0404040404040404040404040404040404040404040404040404040
          4040404
   randomness = 6868686868686868686868686868686868686868686868686
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   encapsulation_key = 6afa82ec0b8e8449591cb9a11be36dc43146c18a6ad3
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                       aa81b01be2864cc958a0642496f264b4042ec5f7b25a
                       5220a8a9c9633081aef104ef9abd4da0af068a84e7b0
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                       99ad43080d3fdcc2d910b16b297bb86436e3d5b79dc0
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                    595dc3134ef5da09c668a804ea1e2f1469edba0d457a
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   decapsulation_key = 040404040404040404040404040404040404040404040404
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   decapsulation_key_pq = 79f1b2ce3b601ebf5ba31006e5a8e4c86cd58148c
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                          4de5a388fab8e60419b04710475367a0fa9c1397c
                          96d61
   decapsulation_key_t = 7b94a03443099c55b76a662c2e84181311641cc09c
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   ciphertext = cfe31862853164950123baa75549418c7a406cfb60003b825eb
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                cad45095359a4dd80e9637f0140504a7b1303fa69d121d2d214
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   shared_secret = 4301a232420a7d7d65151cf952f640436bd1a6b5f5a4ae0e
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   seed = 0505050505050505050505050505050505050505050505050505050505050
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   randomness = 6969696969696969696969696969696969696969696969696969696
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   encapsulation_key = 33393446a76c2c01b44da5696d8452b29ab7b9178776
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                        3d5d974963a524bf708c44e198dd212dfcf69213a42e
                        32e6b7c860148ed38c51002b83b0c4b979b52a753bf2
                        c3381c027623b8a8251e60f55524b56b959a14d84637
                        086a15567717dbda7aff9fd61d09589ac8c004c958d1
                        50a423ecd0e314c891883470c73044db2d17a961a246
                        7a77968968847d519e1f0d9cd1ef2bf820e7f92e4523
                        a0405c39b62de04fa43ec2e5ddcabf02cc
   decapsulation_key = 0505050505050505050505050505050505050505050505
                        0505050505050505050505
   decapsulation_key_pq = 749fe3a6fc429b2369d9e8191f72d4fd3b292f2f1
                           22312bfaf4b6a90f1600c4670ebea7aec851d89f0
                           095c61a2caffb37f1ba7f21dd514b0e20006969d4
                           85ca9
   decapsulation_key_t = 8de509b54db550c7d70b561152875a2ad28105ee0e
                          469e4f2348d6da0f0233d5
   ciphertext = 6dc476cbc91fa3895cfd69bda5799b95b7c0dc87e5c78dec9b3
                67df58abf3e7852afb7b31caff856e5e4136a23a24f303c6100
                d9a0a6673164f6f44ea472f4614c2b42496d0049a27e02f1aa4
                5ba04442a74b5e0035df3d8877266a4241e650a86ccdfb0c6ce
                f22c62f376543bd5749353f808308eb74ed031e73c9f42ebdc8
                a484b30769a17906e39fe8fa65c0f88fcc3436c0bfe26a4995d
                82a41c6a99140a36d166cba6ad2dd065ac19cebadfd455c9fd5
                d15ab2facaf9f5c79bcd12d31ef88842403ebfef226f9a1de78
                d18d2a0a57a7808e5c4d9c7c510bd1813db60a2e0121e72c52e
                df77084222dbcd94a10cd4dc3b09080e8e5a8971761cd46ded6
                5c78ac4d896d818a400ed832830570d492665dec3f8c11168ee
                e66f33d0c13ce3062252f107a3777d1d91234f58598184ff827
                f6b2e73638fce0e4e51ef704e1d3f8dd5312191e36db31d82b2
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                0cc712abc23dff6f5ce00631fd3dbaceba030c2ec18fd0c39c9
                c60134a4dfca521dcd71cda1179d8ef08f06a42686c360c9272
                f15b4258e78514c8814ad70a1092d26557a45764041b8324bbc
                d69b5d2868a6fd96c871cf83413113c898e4bb983187fa4c1cb
                b73cd41d3d4f4db185047afdd241f1b7e7007c00b03aa8ab836
```

```
                cedad6127938f87861108047298d3d945b343c62e2fe852a035
                4ff31dadc1ed08a4ddab41d91c0262283b11fcbb1ddb4e9fddd
                7cc338e925cedfadf4e306f84863fd45a70f57df0384e123422
                0103b0f693144a5ecc9d99ab1d6f725740d1bb09c3a4b4ea614
                ac01bfb1288bbf14dcd572ecbb6c822fe541b04a0d6498b5a14
                727c2d543c9647277bd67822a5fabda4a98f23ef50ad12b3213
                77fd4ee24b234b0f296049906aced9d08671de994956a217939
                4d37b585a31e405325ef880a108ec492c1c87da90adba72d8be
                4643ccf29431cae053f9cf5271f7e1c7a4de093ceb053351873
                d657737ebbef086640d417c6a05ae7fa9e30b11292135952904
                27032f26ebcd1546b9c9c1bcf01ff3d18fb1ebdbe0fee540f4b
                5318ba65877f457736d30c750e42e0e773aaa6e526bc6143ef6
                31f6b3f8811a026374dc28e06c92acd09e1f3f97c12e512b778
                038563b67de0d6b34a48157f1b936abb8b9f3da3adb88b5f36d
                0dae48627cdc1a403810c816e32e0d1112594a4f372e9abe4e6
                721ff83f488421022189b82e1f7f27a33e4d11969522e91d19f
                be1a3b9eb6eb3dbdc2b199db9e86e56bf695d0e6e79457226b2
                b3cefdd2ee3775dae268020392f0336c6fcb3928bdfdeac7124
                6343c08f2be397daa1fb9c252653307d0f7bc24111ba8df6ab2
                9923b4e7f3471be2923f46dccabb2063427f3d4e53baf6a9ecb
                88c12d9c233ff14f63ccfd76a8f046cc2d96733e72d56c835db
                c9a1aa2a5bdee915ae7eb3e5dbbc8ba24df6e634bffb4364a81
                039b06a2c5cb31c9cd8985e7fe2985c3e0a8f1d52feb2bfc354
                9c3817989cc1746fcfe8938888e122744804a9ee9e22d0fd228
                1df2afbd947d2da54a3239b7c24ed446c3c39153ea8710a1d45
                895c4ae3bc9ec5d020d921adf9f4fd0eb931618b58b79b9fb30
                cd6b99fe0ab
   shared_secret = 0ac06695450113b2d67ca5cff6ab6715a8d5dfb24dec92f2
                   e4ec459f6254b881

   seed = 0606060606060606060606060606060606060606060606060606060606
          6060606
   randomness = 6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a
                a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a
                6a6a6a6a6a6a6a6a6a6a6a6a
   encapsulation_key = c3f9a6305222862c2c89ec0dbd805c547b2120405ba8
                       e994947b1d74eacc58277260ba837de29a0a2b84a7fc
                       80589334fb2626c9f61c01c88d60b20b0728110f0840
                       fc01a6187a506ab23d2b459fe0853c44f86a69953328
                       4577f7913b69898361bb67d3711680c6c25f2524c560
                       22227477f28a194e90b4702901b0046ba798cd1b8431
                       92f3bc841c8f9748a1ab34b5336b12c58585fcd010bf
                       d6c48e775e761525b260c7f6e646e8f17690aab51bab
                       30c9763fc53b8547d0b56b0c82c458c61d84587d9897
                       85600b8e987a36423d388ca11d61765a01a4a79ca20a
                       925908494eae0a3b6db1b08cbbb7a4ab5edcd96bd767
                       25e928055b0c2883ebce0a59bc9ec282cf300ba6c538
                       0d1b70f13b2dc6f616c76087a73a70daab7a6f97171c
```

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                        a5997bf40e87b95f33a53347ba6c7ba89bcec9041701
                        226fda1243f4b1fa047740c7b753d630fe386f09e2a2
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                        e45b75e3a0cc714c81f72187b105a2120b9beaaac116
                        bf9835c504713f2218b526f13d8a8c02c95aa0f2927c
                        27e996e4564578e056227b07bbda8af0cc5d99f55eab
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                        198cd44cf77180bb8664f9aa1a9511527233cdb68269
                        76d34276f62257ec382172bf97b310bdd34056ea61f2
                        d74ce1cc9544b02263cc3d3133a308911556345a17c3
                        2acb470444f5536fd21f81cc3c968ab7e4db9cea564c
                        55d3a601066375f6417691c0ee3b39228860f1bc0069
                        3293c4bca327176da52b7282495bafc2932d1154c036
                        72f4db49bd40967ca41fb8f8696382a5208c5547640e
                        5193459b3507f4817ae3707930508969a18b1d168e67
                        b5939532160b50a538ec9074e733dfaa4af09755f831
                        720cec8519f3bd74809539347b8786868fb2ab9ab742
                        fe020c87930d37c45aa9b836c986ba01804a5de26974
                        ac647d8b921484b748d9999447875fe2746ad1112fc5
                        7ea3999f5899374ce2536c58310033ccdabc75d63a64
                        1a5651bd08079a41c1e59894cb3a1c8bac7614e96058
                        1a1d191a3a386209b6e82efc92b655c51d91e11e8d39
                        190863909a97cc6017af2c35500b860a21c9c48d4883
                        4eb561f58c683372968fd89be52a26995317855b3123
                        acc2071683ca669d78c3cce5bb9c9f9429a643bbb140
                        1d1d665dbf45ace6524cba3b0d33582105dc7c38165f
                        f0959d325914f437a4008ca751878bb8287eeaf09202
                        1b1b3647bb4a9b562a7aae80625739f66b636c309a09
                        376ac4cec6d76ce4629aef46ae488b4c696106952759
                        4e0c22ec55226f47085bec5e0343cbfb421ffc838b56
                        e9553e411ce39c811a1b4a53b051b404af3b58bf6513
                        76360c040a607f946c6357020ba1fa99daf19ad3f020
                        431a98b1647040038383719ff9fc7d4cc75d6bcb6d4f
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                        8621c7f29bbb28da1cceab369609c64efc5e91a79451
                        bc8100eabc85541d1f2435b96b532fa14c1cb76b9990
                        8c418118e2472c66511ab558aa06f03fd8fc15f10a20
                        99dc4df1360d15910d2a7747d8abab40fa3d77b7470d
                        8477cd63024aa40268f55139d37548223ed5823f1368
                        05752c0b5f7f23edfd90a89dd1f90ee344df0421176e
                        f81299b81bfe97a99f8ce266a305167c2d866870281d
                        494d0a4acf54e4356efee93cbdcf3f057e6e12f53e6c
                        7cca9dd358c4f2830c7201c89b89d7dc02
   decapsulation_key = 0606060606060606060606060606060606060606060606
                       0606060606060606060606
   decapsulation_key_pq = f7d6c6a46a9c534d6ee0532938a99f0c450da4935
                          e2953c4daea5d5b0a59ea69c700a40817fdf445dd
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                          5b73ed69a557afa27839191b8e71214ef9ef97e9d
                          9bb99
   decapsulation_key_t = aeb2039c4f41decff6e13a8a71607f5603ec8fa344
                         1443e182ebdb5971d157a4
   ciphertext = 56a06e6443b53c24f647cb6798257899ea1c49cbfd4c4e3e54d
                d73a1139dc4df519067a5934733a34538f941cd9a2d9de37162
                3247f1bbcb728d8cfd59b59d6995a2430ab14490b336ac502cd
                21dea47dc7c89fa026310ec05fbbe50179b45e4b68c507fd90f
                ab06e36fb1c9b21c06115fe42beba15083385764cde8c527c36
                69507bcaded45f70a8cca789ad71e9087948e4f1d682c4a77ad
                306c25b1e6364f43fb51c0c5d72f455da72f46041f8fcb143f6
                7c7517b425e24cd803032645cfeba77e0d8d2d0cfb57768b8fa
                3238c10ebb99471710973bf9d22fea51471354e53f153dfbac6
                95a6f8ccb10524a0453e804bb013b450f38007fe21ce898c052
                a132ea74c9e69512ca4c18c32ae37884df520d12721b95acb51
                5067f3516ced73c930786d6924cc7dcc08b50a3abef4e0df82a
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                cbdb5cb45eaafbfc8b93e753bf323e2f76b0a61af96997d97f4
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                33d263787405d11dce0854fbafe59f58d39a2995b991187ff86
                d3906e1e27812d5acd2a8d11b95ea20c7bf1e8ca9146cd9bdd1
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                c5a18c2f258edefa2946f799b88e17ea475e8bda8cffa3531ed
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                75b71a025f05fec67fed05e5f193f2b71e0352755ff4aa61bc6
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                a15c173b9e803a53112a081e7c2c945786b24e6d226aefbe7cb
                184a23dd504813975e25067f33bc90e13ecd4857473e0bb0fa3
                3b3f5f0255eb51da214717511378927c0d04f40db6fb99fff72
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              4730ac8ee428c1db0a917f922184e109848e85000aeef7cdf10
              5e5946a9a3b
   shared_secret = ae06dd951a17e5faf27e2b510b4ebde8ae41e56063707935
                   2c711ac5196cecd6

   seed = 0707070707070707070707070707070707070707070707070707070
          7070707
   randomness = 6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6
                b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b
                6b6b6b6b6b6b6b6b6b6b6b6b6b
   encapsulation_key = 0e12760b95266a50a52bc6ba3df697c1261d3ba51098
                       7a299a83cc0b9134c2ea4ddc47889b72c6dea65b49e0
                       66b1a2822f269e8ea904a667cfe6f7035aa83cd9c041
                       efc38d23053ea6d754c550cd5d1936d4e74ea047c4dc
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                       a573451dc746bc491c143d14837af83c4f4b1f5aaa59
                       bd5a2b03c144ba6ccb445bce2d384ab4082327134212
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                        dc2e1247766db853210a099e4917c70650e147956adb
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   decapsulation_key = 0707070707070707070707070707070707070707070707
                        07070707070707070707
   decapsulation_key_pq = d7b4cf68d3f1b711924ccded71a241faf8162f7ef
                          6ce748370a10e86b94befc198683377946eb96641
                          eebf10062c6dde3a010a09b2ceb1145210a9c17ee
                          fc5b7
   decapsulation_key_t = 44b3561961a160254c8658a9db5fb49e257fb65c07
                         7b2143a4059abfb1b8b541
   ciphertext = 892f7a7985caf0c231b2b35e3bc7de3e5a4739b72d3f9be342e
                326c0173d55a5089ebe9826c834792a3236800eecc2612b4d92
                ecfdbed013a6bfcd4d1ffe5c4150e7257a9e7c0b2e0cbee757f
                c86b5debe03aaf796c76a5825cc78667189e0e37f4a1c3dda77
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                ce283b3f834c56f64ef829dd492eb70f6815c45128c66e77324
                bb03f71baf57bf0e200b5a59bfb1628e2bf209e8d3d39a2fdcc
                9c3cc7655224efa1efa86f550e72c11b5ebaa0b375e11d77d0a
                4cfe4f1f5eb048f0cff1c2882fbe01d14fcd97cb2ed5a40aa97
                c125f81c8c91164cbe8477058ff9e380604da9c2ac1b061853c
                2e4e979811bebb99948911dab9cb03d7c4975461d8e723bc415
```

```
                a3912fe1108de37b32b49174b722022c80dfad2881ad1db9f1d
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                bcd892cd499e35e1c2c20c15c87ee0e79612cbdd04576955bf6
                1153eee2798c26e4d6d3050f3de5f6771add0495459e5300bb4
                e139839bf6a4206d7865c159d1ba9bd566e73d9a085007681d3
                307040c58616f369c6f2baa54fd59b4e27b806513ff678c2c6b
                dcd423e67047460a3a39cb04ead7b095317f0993f3ed75b5fc8
                b74c458a3bd6347c6a82640f4041f0168690f8f68f2cfaa4205
                969fb4dc9ad42d26b3fc2ba5bb08b322d0203118666b665e204
                1fbef0ee957f73f60fec892a65316d3f733112ef2a19c79c259
                5ad99a4d0c98cd148326ee8f2f7b79a161333302268c4270a96
                d5d67e3503b688a332f26543ce54c3dc3817ddd616624ef715a
                41f1a80f4510fc769892196ac3f4c62dd0391d4c5f215ab4472
                99c7bbd0ea1af7d621ad9d662abd35ef65f900a40b36f32f035
                2c97a90e76217c317f1890de7703d6009a218e75037b68c6d34
                f0f8ca6bef01af7894883493da5c47d0fa116af94f948747c96
                9b9779baeb8b279916b6ad0eea9ffc4afc1bd907673203413b6
                09b47ee0fdce780e82a6987d63887c285da97609736ced5fad8
                faeef141d8d0344d70ab0795a6668fae59aa65d411107631415
                112288c7e3284e26b5dcdabf6960821bb74c79fbc6fa73da77a
                4220943e86cdaf4a73e1c5bd918eacd53f6e085a694b9337385
                b409bb1f8604ab2b9bbd390f69cdf50ec2048d593cb2e88da01
                013ae1196dd9ff6fc62058dabdfb6bcb7d031a993345417264e
                6728e56b5a1cd5972242611a66ef9881f56cb429d9daf99d6ac
                53dbd0b4413
   shared_secret = be2023e5e52b38032212668c5f2d06db5b9d8fc56f1870a8
                   957362ca1be5d6ae

   seed = 0808080808080808080808080808080808080808080808080808080808
          8080808
   randomness = 6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c
                c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6
                6c6c6c6c6c6c6c6c6c6c6c6c
   encapsulation_key = 003180282264d14206367c682c2a282a58c114675507
                       95801e36393cc16e49f565bac995ab504448d4840b85
                       526e836ca6d641f151bd50897e1f9a5f6c718a61f97f
                       866b364a217c87e52cd28765ab18bf3c931a35150d1c
                       0c32c6b863872a23373057bec82e671986fad2cb15a0
                       6a9687a0ce923754138b4c54ba93c082c147cdf186c0
                       d5746cb6d54532a2afaaa701220342f6303ea7b66d99
                       42460722298e3bc2f0a612a22a986946737d057fbf3a
                       ce20cba6f97503fe03caa5c3974e8aaaa3c7ba62bc70
                       d1547ea9336ad15315cd8a2919b7683b568aebe54b38
                       5612f8829399d83aa3c2308c49a73379481a690afba6
                       36e14c7e6f31678c022b552b19a6b90b252a7122575b
                       a041c2daba8db6ab6cb9d13b5bb391ef0b48fd578e67
                       cab1d4d01cf4b492f136c9c4807b4a2479f35b255f23
                       4436d71a123b47384c1b6909b0d8c55575615a314178
```

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                        675cbc94e746a415bbdc912474042a93d776a89913a2
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                        309b882252c972ea2e06160e1537bb38eb97e19909e5
                        8a3f3aa007daba597d08ae46767beb517fab0124bb39
                        ba6eabaf131b9611a9bbb26c1c52556030599be5382b
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                        a1bcf1bacc87a642d676abe5826e3836aecc878d2d67
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                        708135fd030cdb34429ee0a19c782623f081c0564b7d
                        c0bd8c35b831672a8413754127a45ac7572185185f44
                        4f017640b8a4c0819927866332c45374c6b25b88416d
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                        604c637cb75805092cfa7b2921665e0803d182600e00
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                        b9afa12184e51d3db071cc671864f2ac51fc653a1b62
                        8173061068924f890b18acc74c4524240696bee4c099
                        552ec02354bf272c94b541b5f4495e73c18182712087
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                        e0a52f0b078eb20a6006cbf5591e393c19ecfb8e5435
                        a73cc0c5ce3a008f5053df1647293271e1366867232c
                        dbb8c58066c105701735f911db1ca2c1b07737467805
                        e304d243c733a77ce448b639c295392b1458b4a1a847
                        4ca2968e0c78917a2b255fc247fe493bd0d9bec24435
                        1890a895e470d298052750166b75a98a855549c386b1
                        40bc24326b044a469dfa660fe51a928271d011cd5468
                        2433f5583c5205898c216cf80cc5456bce0accf88628
                        00cd36661332261297ee9854d230b432d39c5ea66726
                        34a294c929e091329a37bb5f348f30f482699a88deba
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                        bd024be328490b703177b50ed619a9b293944f30bd62
                        119eb15486a6c3659eb0aa97e1832d82723627670c30
                        b546337428a7364ec49539709dad61943a545088c754
                        e27c857910713376b859e392d0554a09c04d29aa8adb
                        8754a491059903221d689fbaee7d0a714487053a812b
                        f22bd20bcc6b3aba85396dac337ad43e549404d6dc25
                        127b7520161074ae489fa456e180bfe4204c8880af1f
                        4e8b7297b98f669eb280d015df5d89d711ad8907bed4
                        e2e2af6466a2f61ad3e9f7685de61cf72f
   decapsulation_key = 0808080808080808080808080808080808080808080808
                        0808080808080808080808
   decapsulation_key_pq = 08f68b3e03568d1e99c5c2167cf41dba4a6077557
                          4d21a9c79414bf1fb67a547e91d5f36267ef061cf
                          681cbe41b9cb15c17ee52a3579a51c20397ba3bda
                          5ea72
```

```
   decapsulation_key_t = 617bcf266e71f9f9f3cf6c8dbe3d972bbd67e813da
                         026666cb44682207b0c453
   ciphertext = fefebc6f6f4dab06bd9b8d0a3a688b06e4b3ce999cff7eb763d
                80f6d288d9d8c58d240d8d217064c9848a1508726829e177a02
                b99ac33ac76e50a82d31e9f952098c4731a0fc35c9da8e9c87a
                f7306ee7171e3aee3a3d2d046bccc1594a9686a7749b906346a
                7c863d8dd34acced601a3953a05e8ceabf34797b4606eff63e6
                6fbdeccaf981c13660a8b8de661c5b753f73c7e2cbc733379c4
                d9c36b93b756f5becb1ed569d6db0b2d2b1102e6064cc4311da
                3030c3f1a1126df69fcd2c5c3084ee1cc75761e5358ac39c4eb
                d472caf4e555f8da38dba8ef862c92eacddec9c270b5c71274c
                15fc38674bebabdc7cae2444dec1e7977679578f051fe3ee9d7
                a188565d5fce8fbcb842b28a4d38d77eb37dac58099664fd1b8
                069ceef1e06ba95a39bf48f7098a9bff84f6f2df86643db5345
                5be4bfa4848d93caa1fc1398ac240d186bb3334bb5381c9d089
                ae3c8637deedeaa576e6b92cc7b66bd3a31f3c956b4aeb4eb68
                8b249cf9b57a56d3656b5374f806b02875562ea15fcb619395e
                c913026dbe5a6d488cf907745cc65dbc9274ccb5e2461b9e923
                862a67744c8b8ff19dda1068fe408859f89b5b8550ed08956ce
                2b5c9a617e7ef6022772a58b63bbdbf5eb057c4bdf30083bc5d
                e8a22628fd845bc6ebcfe27277d1d7f57ceeb7beb07a20ca446
                fc65a372929920792d2c46afe34be5a052ab43db9e0b3c2d024
                cb720e42bd20db4a53e5bb32a1356989b1d5850611918549e9f
                57001c9488b8eb12a36e85595ca45934fea1d601b42c67078a4
                fbe701496e443b49fc8822fad0c8fc3a25b3910a5158b380aa6
                78cda329e2cedaec1c4a32e51b4baf7091efa5edd6ae2aec450
                e15cfec1ced9a1d158c9f8f19e21155e4163eaecf7f01d16ba4
                95fde48f39645a44d3733ea265cff5d4f2129e3c83a6ca33a62
                23f855a91ad49776d64ecfae6878668efeeac930ab6fe918337
                0c61727b4049a1dff8579947bf16ad1c0e210524c4f5ae7548f
                3d3e532e694abed9303ff260178505542141ca980de12090eec
                01da3399e8e454934bb15759d348404d647bb2a409b9d8a9560
                21bdb85ddba1978593aa56d961ede3a707e7b0bb6f325229ce7
                54c702d9ebc35a2663c0ceec6b3d04ebd91a63854736ef4b601
                495c26aa4927b9ccbae3adc808b32571ff32288d46c2967a96b
                53e756027d5eafed7dc8d7d5337f98309ffd1a300eba2c02221
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                beba2e1ae70e8e857764d233e54830473fbbd2b173a34c16c20
                32d004fe19d35d8a5277824260f32ae501e24592916ea46ec14
                a9bc301fd0c900e33a1b24cd153a25afaa34ee26cbc9215fc6f
                a18972714aab79b72939b9f4d3190b9bd64282c0e630b6d8c67
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                7b06525e4e7897f63c82502f7fd77bae5a80a63c7436fdc8387
                787ee34a000ac1512c5bb3820dc6a9b49e04cc613ba5794df38
                23958d49fd749a63a84a2ca1f64958198670b2503c05ba2cbec
                10caf741cd39b256c53c703c59055bf7edf4bfd94f5243c590b
                fc4bc4f6cf8
```

```
   shared_secret = f68bded36ac9e412c34c747c45c7d35663769035fd390250
                   125dd1d1a9ba132d

   seed = 0909090909090909090909090909090909090909090909090909090
          9090909
   randomness = 6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6
                d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d
                6d6d6d6d6d6d6d6d6d6d6d6d6d
   encapsulation_key = 460393d6222435d92a68eb6b2384ae414ba04199ac14
                       e561f6711facf87180a4af6156a5cf589c8ec7983054
                       764231646f07c57ae4247de37bb73758a60b4d333498
                       5238563005ab337c6075b81416c241fce764505acd0f
                       e7b0fbb859e4172390e670089414107549ed298bca65
                       8a229079866b8b960a7c7fe46cc47a1773010f106b6f
                       5cc9c2f906465851a7716649b6a67ff073807cfc7be4
                       cac44cd1af6a372cb04161d4d39861780c6f62051dfc
                       c39c143dcbe49bbf5b58a8769b927173e4c7096c9131
                       0a91484cc80c55217b76124d0db0965f84bef016040c
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                       ca209a80cb2a94e4476aaeb7cd002929ef999095c893
                       624667ae2bc8712b20e35815599196de478f674b50e2
                       8313d7695ce2ba3dc02594171a1ba7a095a4351a0f33
                       06f51b4c09ccafea587693a9519f4b4976260445421a
                       865a400a63b0a03a8d9a35ce3335bec1912460e1a5b4
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                       1a22bfb6a2559b178db7a0aab6001ddac9250416ae5c
                       11c0a5a26a09d38518b28f8e3a7f2eb51e0d679f1d92
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                        907cb8b201bc3b9281eb51985e11cbb4b5250ef7ca13
                        c70674f395c52b177541b57b3aac77e382d5bc6e0c32
                        aade73c74a163c0f43a59c616d76393f39166de8318f
                        ef1b2c47075c19885ecea7b4acc674d1c72a2e4ca70d
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                        5fa1e0237cd90a13c7b759980262378d4a17b85c184f
                        84761e071a973784b1c30a9358b76a7af10727f36960
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                        245982aea0b39c24a67effe65a91b211ad7334f8e485
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                        c6571f216fac52e35cd280e51aaf663281620467f7fc
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   decapsulation_key = 0909090909090909090909090909090909090909090909090
                        09090909090909090909
   decapsulation_key_pq = e4c190b41d18fe33b5710819eb4a962a2a6af9cd2
                           663d9766a4896481dcfc8b89687089a9797cf2f69
                           d058df1f690441dbccf3faa91ead65b8d4dfadd6a
                           a4912
   decapsulation_key_t = c23c5c61647a8f463e298ca6c22cbcc04527d7bfc0
                          c13ae6dbc7a51fd1c53fce
   ciphertext = a857a7425c6077dafaef133c62869e523a4b41110cededea6ee
                66b9a6bba634d92cb41d5fbef2ccd6f5f057951fe1b44e224cd
                2314c9ffcdf4c358979d6d065f1f12a51033640c07965e6d434
                2afd7b57d528786b398e13b6eca581b96fe77778d73bfa2422e
                43093f7c96434103b18cbdf0aa6549da8e169b66f42921b89ac
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                177ca6167c3a2af8dc38e3d708665824acf97d6d7b152bff781
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                fa515220e9937fdf8df271f69c8e3d6dec76152404d86243421
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                3d852aa15d6363bbd83cc24b1ea841e00b99dbe9f7b9fc2a415
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                34e6a4192466e63f0e185810665267a021896967d833c1f1086
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                0a436d33adbf29c2cef8704a41074ed16c164ffcd1c8f09a2f7
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                d8d25a28ea78620046b192ce46fa4c798c0feed181961441332
                6eb373e622834afeaff81aff308caaf835041fda26f6be02d11
                4ac02bd4ec06ef54dafaa88468d58a63e547121a9171f63a8fb
                d70c3e9bc50b1b6e9fa4178d86d59f974a24d6321e363d82be0
                29a12aebec8
   shared_secret = 05e5d7dcfd6531c9d937f8c0389d86e93d8955597b7d3ce4
                   4663411848161bd7
```

A.2. MLKEM768-X25519

```
   seed = 0000000000000000000000000000000000000000000000000000000000
          0000000
   randomness = 6464646464646464646464646464646464646464646464646464
                6464646464646464646464646464646464646464646464646464
                6464646464646464646464646464
   encapsulation_key = 3d209f716752f6408e7f89bceef97ac3885300453779
                       27644ef046c0a7cae978c8841a0133aac4f1e1a70272
                       77f671219cf58b85d29c8fec08edd432e787a3cf9936
                       fe0026a113cb9efb1d7214049527bfe2141ea170b029
                       4a59403ab0ce16760a8baa95b823cbb8aacdcc17ef32
                       775223c791e3740163941f9bb3f63346bef1c050c31f
                       932c62719429aff14c2bd438ab135bed692d56c77c04
                       cbbffd6335b578318b513771e84b14ea821262141ca0
                       06ccb8bf2500aa1008970f216fe7f1ae34125aa29049
                       2c069a189222adc322f97649c762c7d3128ad3bb2667
                       971d0744014bc3b67445cbcd0b3e7ea69fb1cb9f9c33
                       1f97487920187292926d04a25a2650abbd44982bb0c3
                       c6301fe6a61330d24d8a3c7021dc3e3392c79a139b37
                       613bba67a2984298507b84a4d61eef18acfb979af2d3
                       9caa4c0db4513815359d76fc378c63a7f4f3053b1716
```

```
                      8d0221cf0c2eec5514ba235f81d04d67c3b5c5180949
                      17671c26a7c046457533cc32844581277a03eb065c45
                      29a779a9a5878f2aac3f81db9ed3d8c9345697058cbb
                      99d379bca16d8fdb61d129960390524791b9d3e501b9
                      00bd1e5002e095be06c23f1fb212f5801f24b6b28c0c
                      5493d246d02aa29fa3acfbe15ac4e212eb0b6f69ebbe
                      a259a2703aa4c308224bdb741c65c7a5d4bff7882795
                      07bbfe513d7aa5694e7b3cdf62ab36432742d4a0ca9b
                      3570ba742fa803b46989c8526ea586cc4fc32866143b
                      79601725fa545fd280b404530318bbc3371194710b6d
                      74beaa629eb18a36a953b75915ae96999ba5c88cdc56
                      a46861c50032c9b630bcc1445a30878979bc55a2c095
                      5bf399b231203b90c651b6afe0e242b5a543250b142f
                      7291ed753d816098f7913302a8ce91641716623d4fc2
                      ac6772aa5f3674042b7c4a18a2186289a4ac4e200774
                      596ca03e6798c7506b984999db6ac142586bae0799f1
                      e776f9f5247dc574d8556ddf9bbbc4ca3643263457f7
                      4248010d62d4311268360aecb4902b450bf2050ecb8b
                      a7a92820d233f5a14ed31225a1d17ca6f19e825894cf
                      b1807d922cbd60761134be419144bcf72006366a4460
                      137ad9136c113f05eb54c409520edc72e4150cc3a24b
                      0f819eec11bbd19ca9645b0810a60b4a8a9e9c395539
                      6a1653955b047bcf4f98433c27236c570d75f809e44a
                      af2dc33665826351872c293350ab324518c8c0c80b52
                      1c80c81a56bdc968a5650315a830c8bb17532c62ccc2
                      3b1d46412c256b224fd4674491803501d0143125c757
                      7239689965b6989ca561793c0f85c62a9e13487da176
                      62a7188c70b1040a67ed4c3f85e74e3691822fb96314
                      d6134fe6a626b3cbe1461d62a7b573b2cc75579ffa22
                      967e36ceb2a1aa0b71875a22751d706b72ca9ecd0c81
                      00ad0aa58009a5c83fffe91759e6baa0a9345af99fe3
                      b69509dbc84032868844ab3f65bb1df8beadf36442e4
                      8e339c967023a525411544c789a2f04dacd06ffef783
                      02210450b931f6b4c32aab34a3f5260b810f4c9a946f
                      c22d3baabaa80ba8d9955d6dc35e8609b4256b482cdc
                      9d8977c1a47a354e7c527fdb1672e166917b95cd6351
                      820261daab361f8a2dcbb240c55abd6a8105e5291b42
                      7b566d731e6b7047189cff20d8b120e0b3e72472d1b0
                      086812200fd3698e23f06e4f4e08bbb54cc2f63601b7
                      f85accfeea2d17964c66b5194b0f08e18519faaee194
                      e3c102823062
   decapsulation_key = 0000000000000000000000000000000000000000000000
                      0000000000000000000
   decapsulation_key_pq = f5977c8283546a63723bc31d2619124f11db46586
                         43336741df81757d5ad3062221e124311ec7f7181
                         568de7938df805d894f5fded465001a04e260a494
                         82cf5
   decapsulation_key_t = e00b3f9d338de90488973787b0916a4a9ae8bebf4e
```

```
                        2bc07a7bc18f1a62215182
   ciphertext = d81018a94f8078e02105beaa814e003390befa4589bb614f773
                97af42d8e8150796f2c88a4efca81b8cf93c0ae3716c54ec1b0
                45e3875f38c2dd12d7f717bd7fb701a9fecda5ed8b764c9a35d
                4a5c1d8930f6071f653eebb2d1afa77debb8302d16f17e0f5f3
                920a71a4d49beafa0e1c7e443f8abca64a65a9e81a97e7357bf
                902573363c0e1a12e5228036828e3f759121fada92441fe334e
                85d79347e470d2fed945541d832c54baaa3cb7526c3853954db
                4f73547cc7c27fd38398bfa7704952cb841e38b270e4db7435f
                0ee22f57d7ad3270bd0c88e71b4b864cf2277c65daa10a6dad4
                c7abecd95cc4ebec39c08404b522e4ecc1545713f76bebd3b5a
                0f2feb3461936065dbd13f6a1f61e1b142a2af2e5a482ba2c50
                cf0317049c0b3bfd6d5e9240eba9111d2030fdea17e33b65240
                20d30b0c4f8069285f3a6ca267d287d01e827d8422bf5426e11
                688bfc73756af1841b1c87e126cb50c914b5b2b8673488ad3b0
                74cad77a3840eb12dd688f313ee1e9ff8c479a678f276356fc9
                d65e1d5b4c1e9855b4175db144f7767c12061769190fe6b5e51
                563b91f94d131a2b796bd2980ed0dab4ae7a7110e920007a757
                158a5eb8662cbf89ddffe9d8196821313cdc00108853fc4746b
                111d5b56da638d8ed2973918960f5dfe93ead3ae521e957cec3
                c8d843e8fce234c70ad055177f235439d6098bdd771b1cfcfad
                aab4f50a7378185c62409f383c8ff658c2a2af66498cfd81e96
                2766ac6b774e88424fb4f331837d0a28502708477caf8780a15
                6d723f68fca791e1cd2397bfc2b24c77c765d9b2af36f732d52
                107517efd8157b283b440a613f756c364ca108971a8878199a9
                3f260baec3e850033cc032c2e53f823576affb4d3b116e2d160
                49152c35aaa263ab376f0ad5ede6a749607a283e3016e62191c
                0e8fde33e718cd989591c9a205d608d99fcb8a7471603d716cb
                01b56328d7d880aec2851f4e6d8b5016c25647e9026ebb44154
                3e8012dbfcf078d4012b8c39184dd64f3821b4774ae4e36365f
                8baf2bd1f6667c017a1e65ff8a1554458fb3f367c02721752bf
                a56fc7fd566ae95ffb208f919ef12f4cf8a2fdd141a8df559bd
                db7b8d1f04ee6d4cf7805d142989caf216dfae985faaab9974f
                6d9f8aa1129084db8db912b1655f595ffbaa66491ab4655fd73
                4cfd4bb0c0289d4bcc8fc5e9943b351cb147c8db059a24004d1
                c3e3bb4c14a881e5101acb736c65c5d579acb67ee85a560277b
                43338fe79d34b772c5da001da3b5a3383dd81319a0b4542e6d7
                e46eed5314cc70eb231de27b6e760db598ba19995cf69be0e44
                58e35f3f274aca2455d43fe3344e183c6dc47c857dbe9907b41
                e41006d91b25adcafc098fe66f7554be8dad493c4f4b1dbf7a5
                1464139db474afab5572f92a2232b59be56a72c0505149dae5c
                de1e602877037de7802b5f6fa47a4c9a3e52d6ca15339920254
                e9ffb53c7b834cc0288ed9905a1841e9390ea94a8898bd4c6b6
                d6027e4d43c7867242515bbeefe12340fc6b3d57762f8badb69
                433f9c6d060f85f5e5c6b6803a816d141c075f63541ad10
   shared_secret = e5ba94031ea6efd69c09c254f6d9783136ba6037e2d4c43b
                   cccf19d6f3f4343a
```

```
   seed = 0101010101010101010101010101010101010101010101010101010101010
          1010101
   randomness = 6565656565656565656565656565656565656565656565656
                5656565656565656565656565656565656565656565656565
                6565656565656565656565656
   encapsulation_key = ec7b50cddc8360f98b189bac73d395ef947b37d84538
                       86a253269f7b18b9eb78c1b63212471a0f979793f993
                       6b3f496f4b5394ea69c2a35729f91c688f6bbbb864cd
                       5e87108676c4014c2ba98204f911becae33a71e832ac
                       012bb827578810955f8c6e2d26c0b17b7ba574990884
                       546ba58bf6785721f3854f434cfea602e8595c71642e
                       8d4c70934b7e54c638f5a13e1a136bc86565e6b40abc
                       163ca65650baf953de7bb99b138ac1b695023103c9b4
                       17853c9d42e54fdb816174659d85a783e3d4613db1cb
                       baa63fb667a4a636804b6c4ae821ac5d6556688bab1d
                       c10d6779b485c63c0ddacb91837c4ff3402e62141880
                       72b4186a39c65bde524c683c95d3c8b65e37104f551b
                       6a3602eda50b787182d703ac6a221428b4553e3b99c2
                       b251ef642e31256c329b21d1246a71456fce700d7f50
                       cfe5390a1c37bc133809f102c22914a1402c205c0512
                       b733afeea04411ca5ebb0bca9392b1ee23935eb19602
                       4732daa2a1f79358e6e74b73c965a9e74778dc692144
                       2b19328f6216a5e814ccc0639a863a437a614def5a61
                       f38852151011b04a37bbc78c1eba4d8d1b3a1622a0df
                       f74d25c731abb2a5fe5919f835bd3dd97330cbb7dba0
                       b74260c963402160c4017d92256a3713c9e77ea0f490
                       1accbd38715511784c9ec287dd85a769e081854b32ab
                       a9322a3840f6065133228c41851afcb40ea509cfbb86
                       145fb8853ce14c649691136b8660b0077f3b2f9da82d
                       483c1414c39a9777665899131a8336fb828480986df1
                       02628d10b54239cc20231457d4bbb7016f76029661f1
                       4ffd3532e2f8494e1613430730ab915683c3c8c4db2b
                       4373a3057a097e23333605398b15cc4d6ac3fbd0732f
                       21026bb0cd51fb738a740467114e7c66256b830022f2
                       8c028392cff8013d617c77a47bbda11c4a522f8f2b49
                       f2822cc06338605671fca4518df9b3c506532c9cca31
                       75330f8733ce11cb3fd8b95239ceebc9483cb68bff43
                       b622911fcf4a9c57c226caa38bf0b081535999f57301
                       6b14563ec4826dc281dbabc633868a1d903d59207fc6
                       62a293735085c01f40b5b56cbb795ecabfad709d611c
                       ac73eaca579768213c18c969c59be58fcef6bdd8a851
                       92907cd0773f81eaa24be07e0d620e9685acb0c6b0f5
                       4b47dffb510384241c4b733fe08dacb2852b2b74cc01
                       4e974a5e9db35d80d7b83ad31da1487a0170ba7fbc1c
                       551a6f1eecb572084180b256962748d5e3200b731ac7
                       c3928585a153b167c92a48cd91668c773707c054af16
                       aa7bfacaa161a620600e8d08cc97601a53391da0247e
                       5fca60cd1bb65ec0417177a9eb78cde5aa1dfae34e94
```

```
                      8417b3cc0b223803f5f40e8ae3a382848ff80c418582
                      4076423ae4c137bd30bd81f04095c20a01e0a49f664f
                      8f2b7f6bf6a990993cbc0596a514ccebc578c6418e82
                      5903ae11ac52831c6a48c67727409ed7274eea03eef3
                      2094271b02d4535563aa4924a2666871a4b690540c78
                      b06043bca31ca4e42a03650ecab74792017217d10615
                      d0acdee124e3222c90d79362207e4f7779e097501cf1
                      40b1a3431ee0cf27b23a50373d59976d82b5b1ce165f
                      4aa1361157afad564081c85777584dd6058a1a4663b5
                      3234d7264fbac6877351d1928c6780f77d4720933727
                      1e305370df9aeffb74d7c75de55c006e2b2a979aaa76
                      aaed9e76fa61e2a0a9aff50c054b3f819ee2da1cc913
                      4008b9f5ec05
   decapsulation_key = 0101010101010101010101010101010101010101010101
                      01010101010101010101
   decapsulation_key_pq = dbf77c8d79c80ad6b0763d42a3fe53f0f1dc03022
                        0c2e3fedc2aa903abfcad08330db4ba490ccee095
                        988d9355e816055cf986e280532d47cc19f2240cc
                        23419
   decapsulation_key_t = a20315485f73a3c17e18a3f155ac33e9a980896b2f
                         17dc7f96a9495d95840560
   ciphertext = 600ecf4026683898d0e339eeea9ebd437a4a802952bf32bfa32
                6b48eb74946d0cdd5437e70df4b6b7acbf79efe60ddcde985ac
                fd8c2d23775e1ecc54eb6ee03dcc9b4aac150172737831adfaf
                0e63a4782bad2a785b9c39bf5e34640ea3da447efc2a03e23a3
                37ad1f542c32c2eb46f7b88d0bfba87d8efe8cd4456e6f21bee
                bcf3dd502b53d537395750ce963d289eff74621545d4a5d9262
                bd14b3dddd4ef880e65cbe8f2f8aad826f57f727a60aaaeee8c
                69e89af6c539fd4f267c44bee8b5385a460a7c8e4a809959df8
                6c1136ee23e7544cfa7524c6c04ed9ec29aed307b5dfd0108f2
                9294aceeb517a098b8cdbad5911bc75e96258bbf38a20288c69
                11b2346f842c0943bf8e9c34a0a8e518e92c8761c6efe6b1d3e
                a8aed9b2c4feacfbf3559f3a5e46e4dfddf81936183d4d1f9c8
                c1616b14db2057435ad71655d743fad4987a19e821d0ac666ff
                3e46b7cc0e90b85e1966962279a48afe2e9bbce89c819a8ba52
                476af074a071495398bd497f4d4f34026025452975cfdaa3e7e
                183a962bda009108221ecb20d218c42e38774019d2dc3262127
                8b5e88f99b62a9e746d16c1691ccf3e7e9185c3c493e7617f45
                1f632c161fbe6d8ac3217f10ed4bfeee47e4960ec4a53e4852c
                a0241543848422044a67567a83e09d8e74b9d11af17d53c4956
                5ca53deda7c4df076a3e1b6368b1931d81db93e87f75bea6924
                a321376fe73b5a5b07b80a98dc3ab8d14732540f1b4b7176e27
                4a905d453eac1caafe2bfe4e6c904556ca91b01b2302215ab3d
                fe6b49f46963df632a9e7cb8439cd5ee56a1f8e2cd3faae5d8f
                3462d0ff931f5038cfa70259d963163d6163ef22b0c32081bff
                2763e98da87817048d4ce755e5d2b1cfe7d6eeab0fdbe766c95
                f125537a04bcf99026f9bd5be3b26b9b7614f132f6747dd6d96
                009a85ae6cbb1a14b9231099b67b04d7849875b6492f3b6482f
```

```
                8bdac305f7ec29f28ef4739934c6a7a2800fbdbff6eb2237d6a
                085ddfab8519db1d2b1e63aa6cb9b3b044278947dc3bcd329aa
                427d13267f93a6cf2aee8a2ab74d4288fe0b676ea85586834ab
                57e863d4805703eb8bf6e71fbb11a386e7b64a0d661dbd05f5e
                2924f1419bc799a089d44dda9066c6c503f8c80be8daa99bd48
                338daeb4911acf19328103c96f40a77ffd827d52294ba21ad1d
                52fc27e8b12ad65887024f41e63fcfe654152676ac363f2377c
                5b0b437e075897e33dd8d57227fc5a536629efad998a2791031
                50e7d47e4b7d11a0d649d146c6560c48c9c0c56c811cfa6f3f6
                2cf717ae571597bc297deed887672d8a8cec2929c2b55b95f26
                bd5d10ef30c0c4a6295d5ca601538f5a20ac1064d2f4c2a078a
                f1b1629a0c203ad047125eb9dce0d1260eef19cd4ad8ec5d73a
                01ba23e266cc6dd266c5a81af58ccf1b5ce0440efdd1fe7bb42
                177679b5e5095ffa0d453bc17b8921008531c2d096a3a4a4856
                3370462a59fe1faff2a81603f2d09ca2e0beac44204a4e03aa8
                52745b1747bb6c424206ae093ecb917897fb41b1fcf75c1227f
                a08876056a5ed07ac44fe0c116ec2de80b8e523959d7824
   shared_secret = 750300db25bff9620e893c2c6fcab9bf04d7f2e543b5b394
                   20485626fa274908

   seed = 0202020202020202020202020202020202020202020202020202020202020202
          2020202
   randomness = 6666666666666666666666666666666666666666666666666666666666666666
                6666666666666666666666666666666666666666666666666666666666666666
                66666666666666666666666666
   encapsulation_key = 08118d8819772292c976ec971ee3039195800c823544
                       484595cc63450b9db9414330419208c509cb62626067
                       a8fd8259160105b6d8a4023b056f5ac2d6159fa5f245
                       f00c719539a4601466f6b45b2a68bdb0db7424d4cad4
                       75a8d68b0d6e086c3f012414e22900f01179e8c90a8b
                       a1d285cdcc7c7ab1c7064e2c15233acee183a1075c04
                       f092a5e3676b1ec06d15d348e7781346ec95806a5e00
                       f64d1e101bfb28bbc6829372f32bedcc0de9a70a02e5
                       08b760422505481709bef10697fbfa219b99a815f47e
                       4bacab0e789ca1e414db529deb043bd8521c2d456a06
                       2a65aeba2a40dc6b9ce02474a71fdf852f343b22d211
                       0519955b964382e74a3cf78586eaba353b98228b0268
                       f8480b02c4b4ee208198fbc472117c4be567858c097f
                       b0869a40588418973c58753da845e36c0adf39c53ea9
                       c8ae24c343bc87bcc3be69ea40d9490592ec99e9a853
                       f4f22b024a1b15962b049a62bc198706e310c8524c51
                       872718d76c6db25cd824a1b75a94a7d341ca40be1283
                       b2111b687be69d38b7297a90384b0c0269ac911cd803
                       84b326357262ac13680dca37ee18477ab23e16448805
                       676adbe1a5b7732e73c0abc3c5188e6c7ada3c1f1f12
                       4663e83ad5899674253e9bb15f39908ba4917dc11025
                       f7504425a305848661c38cb09a82026d20c9bd23949f
                       285519db298418718023c8d7e37a5bb1062951b43252
```

```
                        49aad59acc06b10161416ccc78db6c6c3f685ad3d9b4
                        916c622163017f9662da4234bab8b8b1e77290867d48
                        c28a2cb33c7d2c7874c2be936ca0d6ba907d6a823fa2
                        4a18c56cc124209ea488ce620c18d00ffc8b8f0c11cc
                        5850c30b3a0fb7faaf6e526f9b08972207a38f760bad
                        1824726017a30634fd239ebda59651b4c8162346bb36
                        52dec39f56626547829ffbb052a5a6930f2700fad33f
                        b1eca8bbc40fcfe778189398b5527a09a24a53a958e5
                        c25353951b78d85916457c1c5046e497ae0fa24810e8
                        2d360050e4fa1bf55b719ab8a080c23dcd80c0d4915d
                        8458652d476f50f3a5b80ba6ffa9a76bd9524dbb39df
                        7826cc507a9d31aa29b6207eaa52b3e224259c4931b1
                        ced9b97a42e6745752ac0603917a694d7ec95145094e
                        d089008af675fe51b2b79970abc282dcb632c1fc3dab
                        85ad14893d0ab63b9e21a368845e872bb1468aa25255
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   randomness = 6767676767676767676767676767676767676767676767676
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   decapsulation_key_pq = 49b46321ef5a24c1c036750879c0ad29dd08607d4
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   decapsulation_key_t = d20034c38088ae9e3338d75e1954dd00001bda6103
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   seed = 0404040404040404040404040404040404040404040404040404040
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   decapsulation_key_pq = 79f1b2ce3b601ebf5ba31006e5a8e4c86cd58148c
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   decapsulation_key_t = 432eab0f3a8eeb77c6b0000b9292c6e163914078c9
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   shared_secret = a638747e2b93607e6a651d528435afe07e8733ccd150507b
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   encapsulation_key = 33393446a76c2c01b44da5696d8452b29ab7b9178776
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   decapsulation_key_pq = 749fe3a6fc429b2369d9e8191f72d4fd3b292f2f1
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   decapsulation_key_t = 730def4e090b60c056e1a9b653f479af7398bea957
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   ciphertext = 6dc476cbc91fa3895cfd69bda5799b95b7c0dc87e5c78dec9b3
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                5ba04442a74b5e0035df3d8877266a4241e650a86ccdfb0c6ce
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   shared_secret = 0594af7fe7a398ffe68f37a9f73506d6a3f7fd82b24e26f4
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   seed = 0606060606060606060606060606060606060606060606060606060
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                6a6a6a6a6a6a6a6a6a6a6a6a6a
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   decapsulation_key_pq = f7d6c6a46a9c534d6ee0532938a99f0c450da4935
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                           5b73ed69a557afa27839191b8e71214ef9ef97e9d
                           9bb99
   decapsulation_key_t = 0a925a53f7ceaaa373f3f8ecf9c2d9eaeb351eaae4
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   ciphertext = 56a06e6443b53c24f647cb6798257899ea1c49cbfd4c4e3e54d
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   seed = 0707070707070707070707070707070707070707070707070707070
          7070707
   randomness = 6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6
                b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b
                6b6b6b6b6b6b6b6b6b6b6b6b
   encapsulation_key = 0e12760b95266a50a52bc6ba3df697c1261d3ba51098
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                       66b1a2822f269e8ea904a667cfe6f7035aa83cd9c041
                       efc38d23053ea6d754c550cd5d1936d4e74ea047c4dc
                       f757de9550972c82abcbad83c32838c18451240c0907
                       a573451dc746bc491c143d14837af83c4f4b1f5aaa59
                       bd5a2b03c144ba6ccb445bce2d384ab4082327134212
                       8a2b7eb68624eba59b3b2b57d9a4ac7b630d063400a2
                       75ad71b6b08a8cfe93a64d368cef666a4d208b8f39c4
                       42400c1a7c467765857641 7b5b026d99cb80e01428be
                       00c720e220a2705936a62d6e737900bd8c3d0b464ed7
                       650dd7c84c250dd73c7536abbb4013809927ccffa539
                       1bb254294c7be0596dd29aa37445957b2aa88dfc5444
                       7894773a34e8e87b05520c9c2ab4dfd69cdd9a52c7e9
                       352a3ab94c07a26d468f10b2632a6a524e06234fbb20
                       08f17cee6a59efc51b4c483fa5264c9fb325e9d7b9b6
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                       c8b964cfa7346948cac1000d840488c3d211b4e7d463
                       ddb15551862f01d77e87b60899e25164cccc814caa5c
```

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                        0555f5413ffbdcb5101458a26061560463ab33cc2174
                        c61f5861986b55d6206612f386c996561b51b63a11be
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                        f4bb39437195c6b98cf81a071a70f26b0ea61628fdbc
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                        b969eff9e9e356faea1c9cf69659599b22f57b8184a0
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                        57744c424673
   decapsulation_key = 0707070707070707070707070707070707070707070707
                        07070707070707070707
   decapsulation_key_pq = d7b4cf68d3f1b711924ccded71a241faf8162f7ef
                           6ce748370a10e86b94befc198683377946eb96641
                           eebf10062c6dde3a010a09b2ceb1145210a9c17ee
                           fc5b7
   decapsulation_key_t = 19d62650372cc18fd0109cd6394d638ebeb5f4cae8
                          36ca4aa56825e9056e3ad5
   ciphertext = 892f7a7985caf0c231b2b35e3bc7de3e5a4739b72d3f9be342e
                326c0173d55a5089ebe9826c834792a3236800eecc2612b4d92
                ecfdbed013a6bfcd4d1ffe5c4150e7257a9e7c0b2e0cbee757f
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                c86b5debe03aaf796c76a5825cc78667189e0e37f4a1c3dda77
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                f321137a9ad5b27e344678a79e386e402236124753e6dfcba0d
                d0dd97017461c2fe039c72e9d0073676f0749d8cc9bcd6ae0fa
                6f14db0b52575845c5b59b82aeae93c8fa1bcec6edd081517d6
                f2d3ed91575b2dd7b5893f3dd755d842bcf3e8d14afc5c236ec
                66236b33ba875953633eaa23afe2974d00179b72d117d9b8dee
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                c125f81c8c91164cbe8477058ff9e380604da9c2ac1b061853c
                2e4e979811bebb99948911dab9cb03d7c4975461d8e723bc415
                a3912fe1108de37b32b49174b722022c80dfad2881ad1db9f1d
                6d06090cb1421d3798fab2df0f4408c11d07be121ba66b406a6
                bcd892cd499e35e1c2c20c15c87ee0e79612cbdd04576955bf6
                1153eee2798c26e4d6d3050f3de5f6771add0495459e5300bb4
                e139839bf6a4206d7865c159d1ba9bd566e73d9a085007681d3
                307040c58616f369c6f2baa54fd59b4e27b806513ff678c2c6b
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                b74c458a3bd6347c6a82640f4041f0168690f8f68f2cfaa4205
                969fb4dc9ad42d26b3fc2ba5bb08b322d0203118666b665e204
                1fbef0ee957f73f60fec892a65316d3f733112ef2a19c79c259
                5ad99a4d0c98cd148326ee8f2f7b79a161333302268c4270a96
                d5d67e3503b688a332f26543ce54c3dc3817ddd616624ef715a
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                2c97a90e76217c317f1890de7703d6009a218e75037b68c6d34
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                9b9779baeb8b279916b6ad0eea9ffc4afc1bd907673203413b6
                09b47ee0fdce780e82a6987d63887c285da97609736ced5fad8
                faeef141d8d0344d70ab0795a6668fae59aa65d411107631415
                112288c7e3284e26b5dcdabf6960821bb74c79fbc6fa73da77a
                4220943e86cdaf4a73e1c5bd918eacd53f6e085a694b9337385
                b409bb1f8604ab2b9bbd390f69cdf50ec28462fb3f0798f9fe2
                c39f3823bb41cd3effe70bb5c81735be46a143135c58454
   shared_secret = eae6cff2b4d6971efa91c6333986693db4f5c46207af27ce
                   6f5964c0eb4aef50
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   seed = 0808080808080808080808080808080808080808080808080808080808
          8080808
   randomness = 6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6
                c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c
                6c6c6c6c6c6c6c6c6c6c6c6c6c
   encapsulation_key = 003180282264d14206367c682c2a282a58c114675507
                       95801e36393cc16e49f565bac995ab504448d4840b85
                       526e836ca6d641f151bd50897e1f9a5f6c718a61f97f
                       866b364a217c87e52cd28765ab18bf3c931a35150d1c
                       0c32c6b863872a23373057bec82e671986fad2cb15a0
                       6a9687a0ce923754138b4c54ba93c082c147cdf186c0
                       d5746cb6d54532a2afaaa701220342f6303ea7b66d99
                       42460722298e3bc2f0a612a22a986946737d057fbf3a
                       ce20cba6f97503fe03caa5c3974e8aaaa3c7ba62bc70
                       d1547ea9336ad15315cd8a2919b7683b568aebe54b38
                       5612f8829399d83aa3c2308c49a73379481a690afba6
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                       cab1d4d01cf4b492f136c9c4807b4a2479f35b255f23
                       4436d71a123b47384c1b6909b0d8c55575615a314178
                       675cbc94e746a415bbdc912474042a93d776a89913a2
                       102efa9377b85b0149075eaae72c6aac3d91c74f71d3
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                       309b882252c972ea2e06160e1537bb38eb97e19909e5
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                       604c637cb75805092cfa7b2921665e0803d182600e00
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                        40bc24326b044a469dfa660fe51a928271d011cd5468
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                        bd024be328490b703177b50ed619a9b293944f30bd62
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                        e27c857910713376b859e392d0554a09c04d29aa8adb
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                        f22bd20bcc6b3aba85396dac337ad43e54945218a81e
                        f4d5e62b8608e130d9278612d248353ce8338d4ae997
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   decapsulation_key = 0808080808080808080808080808080808080808080808
                        08080808080808080808
   decapsulation_key_pq = 08f68b3e03568d1e99c5c2167cf41dba4a6077557
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                           681cbe41b9cb15c17ee52a3579a51c20397ba3bda
                           5ea72
   decapsulation_key_t = 76a574362e7f03f27cc6f4288e046d753df47649c0
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   ciphertext = fefebc6f6f4dab06bd9b8d0a3a688b06e4b3ce999cff7eb763d
                80f6d288d9d8c58d240d8d217064c9848a1508726829e177a02
                b99ac33ac76e50a82d31e9f952098c4731a0fc35c9da8e9c87a
                f7306ee7171e3aee3a3d2d046bccc1594a9686a7749b906346a
                7c863d8dd34acced601a3953a05e8ceabf34797b4606eff63e6
                6fbdeccaf981c13660a8b8de661c5b753f73c7e2cbc733379c4
                d9c36b93b756f5becb1ed569d6db0b2d2b1102e6064cc4311da
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                fc65a372929920792d2c46afe34be5a052ab43db9e0b3c2d024
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                e15cfec1ced9a1d158c9f8f19e21155e4163eaecf7f01d16ba4
                95fde48f39645a44d3733ea265cff5d4f2129e3c83a6ca33a62
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                0c61727b4049a1dff8579947bf16ad1c0e210524c4f5ae7548f
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                01da3399e8e454934bb15759d348404d647bb2a409b9d8a9560
                21bdb85ddba1978593aa56d961ede3a707e7b0bb6f325229ce7
                54c702d9ebc35a2663c0ceec6b3d04ebd91a63854736ef4b601
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                beba2e1ae70e8e857764d233e54830473fbbd2b173a34c16c20
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                a9bc301fd0c900e33a1b24cd153a25afaa34ee26cbc9215fc6f
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                55d291e33dc3cf6b6a740b565b1cc292f2cef3b8cc6a6f13a3c
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                787ee34a000ac1512c5bb3820dc6a9b49ecb1b04fb2b34113e7
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   shared_secret = 83ec9c8227c5306cb0e60bdf12678a5de9e24fe51855290a
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   seed = 0909090909090909090909090909090909090909090909090909090
          9090909
   randomness = 6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6
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                6d6d6d6d6d6d6d6d6d6d6d6d6d6d
   encapsulation_key = 460393d6222435d92a68eb6b2384ae414ba04199ac14
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                       8a229079866b8b960a7c7fe46cc47a1773010f106b6f
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                       624667ae2bc8712b20e35815599196de478f674b50e2
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                       62e5f02eee849f29d39bc15b58ff58b252581adbb17a
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                       f309c5b265d038aa6f994e8de94da384321fc65bda70
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                        4a15216451465f9d44b7e8a9b7e6d356e8a399e7eb39
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                        ab47a28e9c40042b29cbd678f7ab65353807d41993bf
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                        0f2b992c99b604f7b2a3269a49091a3a56dc8b78487a
                        d9ac24e36c97d351855ee1715083a3e9c32f52f735a7
                        6cb008714fa83bc70e4caab72c485ac8431cc97cfba7
                        27fcc0af9c542d7d9199bc4b50a9ba83db77c7dc206f
                        da0547e2795a8dc36fd1b33d2ddab089d95eb16b15da
                        94a74ed8b7e8daadf8180721e0a1e31002497c83ce17
                        47fbe78cac291ffd967f23f47a8a30485aa352cfd4c6
                        907cb8b201bc3b9281eb51985e11cbb4b5250ef7ca13
                        c70674f395c52b177541b57b3aac77e382d5bc6e0c32
                        aade73c74a163c0f43a59c616d76393f39166de8318f
                        ef1b2c47075c19885ecea7b4acc674d1c72a2e4ca70d
                        28325f12cc33ac19aa9c5e5ab31c7ac6933c1a0a7906
                        5fa1e0237cd90a13c7b759980262378d4a17b85c184f
                        84761e071a973784b1c30a9358b76a7af10727f36960
                        f21c6e078d33fb528373a436fb237f87317b81c04926
                        245982aea0b39c24a67effe65a91b211ad7334f8e485
                        8a3b7d0ef21b3e443c0cb64e089408006b103f3841ca
                        b70b046b98e2c8aed94ad683208e265424b077389c2a
                        c6571f216fac52e35cd280e51aaf66328162012edaa8
                        8f37a3f6e9c0c89861d6df5d8a3a453cca19d8746cdb
                        ee424f00c338
   decapsulation_key = 0909090909090909090909090909090909090909090909
                        0909090909090909090909
   decapsulation_key_pq = e4c190b41d18fe33b5710819eb4a962a2a6af9cd2
                           663d9766a4896481dcfc8b89687089a9797cf2f69
                           d058df1f690441dbccf3faa91ead65b8d4dfadd6a
                           a4912
   decapsulation_key_t = 00ee28df5d8544c9ea9a79badcf995f43af90ef255
                          b64b6ca0c8d194528f7152
   ciphertext = a857a7425c6077dafaef133c62869e523a4b41110cededea6ee
                66b9a6bba634d92cb41d5fbef2ccd6f5f057951fe1b44e224cd
                2314c9ffcdf4c358979d6d065f1f12a51033640c07965e6d434
                2afd7b57d528786b398e13b6eca581b96fe77778d73bfa2422e
                43093f7c96434103b18cbdf0aa6549da8e169b66f42921b89ac
                8267de35446008948d6026a0bcbe61357e97c7fe7a95337dfa3
                177ca6167c3a2af8dc38e3d708665824acf97d6d7b152bff781
```

```
                451c587a282adce031b3efa26b6d8bf4b49733c03dcc4300076
                049e278d3cd872174bc374d77038c75203ba45d30bd4110b623
                46c3f0bb1d8563d0e2d58cac839fa693ca96a56eeab1aa4d26c
                c95e013674eec4f8f08095059f081a0d4dfc0735653f3097f1a
                37da334007082ba6619844547e0d3296669eeceb02ecbf0c5c5
                a88d5d1c432398361529e0d91a628e568cd9a18cb3e8ca41315
                ccbd8ff9cbbc0677150f2e06274ec9e2733f3111cd4f1b900c7
                a3a80b517a7d6917fd0753f59e8bf03267e3a43d60e1857d492
                2cd0f14b6d28602792dbfe2b4488e807023ff4a8b65f75fe1a0
                826d5ff490bac7be071b9545f6e7ee758caf460e7e92e52eb83
                dcafb5bedeecf44a5f5ef23690bd83aa5ed2ce0420c697dfe4e
                aeff5d64be78fd3d9c96f66fcfbe015d8a1e75e93eed734c267
                fa515220e9937fdf8df271f69c8e3d6dec76152404d86243421
                1bd1e4b53cb9951c48b796fbf4287d3386c65217b41f2c414da
                ada2023c43c08f8b6edbecc7f750968c4f16c3c983a95d73c25
                d3cd4aac5bd5941fa376e1934436acecf9bb9bd4409d0944d39
                3d852aa15d6363bbd83cc24b1ea841e00b99dbe9f7b9fc2a415
                063865b43ecc9db0a95336820d40ec4d7325d5066eeb2a144ed
                3c27f5072c9a2e596d395bd069fdb8871521a08d0e9c1810467
                a271b4067a54d9d81eca8f26d18acb41a7de599aab1f79ddd01
                28c07e44cf2ccef72368cb4474db47ef43917940a80d05aea5e
                8c933a0ef8a8516a6dc2a50df273288d97a9788629f001e4874
                34e6a4192466e63f0e185810665267a021896967d833c1f1086
                45a5d17334d5dde8fd617c786665d7df9762b8ec0676af697dc
                a63e62b597aa2cf89c558accc872ce9a1277f88c5ac160b2d13
                a27de6b4027353adc3bf596d3d6527532e66225fa53e2546f6c
                eb240435bb93d10e4677208e990f622276d04ab8f2e4ce2e518
                0a436d33adbf29c2cef8704a41074ed16c164ffcd1c8f09a2f7
                52c098caab09da3db75d84ca510542c3adea1757a553bf53657
                f03feec803950747c8ddceeb31bd658072f01b7972df731af5f
                f53bf8a8361cc918c6a00693134fe6e385cc70484d2e3e6d365
                c14fbe6e2332eaf86b7afb8da619dd4c13e86f62ed63da3b998
                95d6ee47b440e16a3615f341d4be41239336b02017481968173
                2503f275bf8bc494c251e5448ff32bffb3fe0787482b796c37f
                d8d25a28ea78620046b192ce46fa4c798c0feed181961441332
                6eb373e622834afeaff81aff308caaf835635de5eb039fc126a
                017b9e789e1db721cdd51f7ed3f5515d18e2f4e2dd7851a
   shared_secret = d1b5f13316ff420d4ca22c9a8e3f93d27f735d1da53ebc97
                   9cce23f9747e3261
```

A.3. MLKEM1024-P384

```
   seed = 0000000000000000000000000000000000000000000000000000000000
          0000000
   randomness = 6464646464646464646464646464646464646464646464646464
                4646464646464646464646464646464646464646464646464646
                6464646464646464646464646464646464646464646464646464
                4646464
```

```
   encapsulation_key = a10bc8b554cd51980cdbbccc3041420fd320fe8b74c7
                       a84278c63c17070dc231b61ab269b9d677d920261186
                       654b4571f51797d5c342b8070bc6c92bca16adecc631
                       e4e94c7508b111730c749c73e2d6a6f97155cb269ccc
                       06a71a21bef3d269463c935048a7f4636c7b32007370
                       9023f7b04d0530571a9a6f718280870bb63875d3f599
                       bc229b95869cd5bb5d26640856d40b828198fdf2c099
                       998ffdf772e462336c521cd326b5e4997bd95c135c57
                       bd02c7afa80a2923d510951778ee5125b2aa18f90445
                       453b85789224725b259279698ac9426c882baabc38d4
                       fb3a3f6831180918b9825e0e418154d78aebab5e7e70
                       66e69b2567476bf1177fe079a38298be6f01b098c338
                       51ab25312b52e32a5750c2b73d293c0b810473b310aa
                       f062f19914c7377b2e90388f575bf5e6853453b95a74
                       aa18d62d4ae37e6996a48ab5217488a92d7b01e315c5
                       0b68204143792afc4f8367c0ce065ab32014bdb5515f
                       e0594608aad1218994724afaaaa2df0355f46666b6e0
                       2a387b6d3da4713edb610bb048c3a2078b800e9ea483
                       f2009c96d24c71b2cbc8e1200c0277383c5c27895e29
                       8c3607701ce58702a91903274a041408234cb0021ef2
                       b1c5131419b444dc84b89d147d1fe43c43f676d90673
                       5d9ca2a59c2232d97fd4aa1ae2bb3d1b170ca553cb25
                       74954fdc6689fac623cbaa31982d82424d5a564fef7a
                       8ba51b44df15053b2b45bec4aa1ed49929123daf7541
                       75c5938258c608b24d062042ab4bbee5e553a5ea6275
                       21738ae5ab2e06bd98b020787b2f5fa51eb4c46c2bf9
                       0e55a49560340667f88ac41432b7f551dfd98c037c79
                       f79b41b985a8b1f51345550cd816714362040778c43e
                       378a288394bd028c8c31b5a904bc4a5648a596035cb3
                       8f0e276e12c9a96f8425056b05a136642dd2cb754630
                       36485ba1a50539e420e1e31dfac529cad6c68ec06746
                       749473e050a4ac92b7199beceb239b6c12c8e716b666
                       07aeca64a5850b01f99d0b176a7759781ed77cb1ba40
                       d17ac5c6cb06c942c002c2cf6efcb121f10ad2a45ff7
                       81426e7104cbdca73b81865ab22b00ba834355ae485a
                       262f354248932c2be178369a3dd7e2428fdc379346ab
                       2b754c43db657460cb09c5c48b5810cb7a5c6156cf87
                       440c9e36a4869a8ac458b382fc178915a9ce1bcdda7c
                       48807c207e656ffb80bf33e32bc8c7b20ef60572612c
                       eac99ad1c56ce5a764b29b74c17a5b510b1afcb18a1a
                       fc35c12ac213725325f9b7a2eb338fe4c0080c31a58a
                       995db7027d900e78544887f90ada467d0e383c119c53
                       99310bc6735874e8804ff6c2bae57f2c3357cb627033
                       c12a5924b20ce5abf113172bd2b77086cac543811793
                       bba71734c9f005ac2656460bc30a442b388725758a62
                       3e37ba6e293abfb84f344229f373c214ca776a7c05ad
                       c465fed93b9cf77f0022ab71f1adde369dd8f420a58c
                       057c14cc18dc47da7c12b086473eab419652967001c4
```

```
                        e42a381c8ba539a875d21a9945133bab9bc1e53a600d
                        e77cbfb2aeab6b19ced4c6eaa8998ee6a1577255f713
                        2d80a32d6c0c6ec44c9c4b28699a645bb0bc958e0027
                        5077925309519b0824c7000dfa61912ec049063a067d
                        00b059053e508a5bfee63473869c8a8510af898cd757
                        2854f5c38af96f5f97a7372632ea7bb4b6fb831c612a
                        f71191ff9806b379bcd43c6059b7b1f953741444af71
                        3c155d962722b947aa23a32a89b356a6a7508aad6396
                        8c1dea78ff18aac27a89aa7b42b0d7481dd3cc649421
                        e51397782218ac5441760ba51a0328d66b436fec32d7
                        aa4d68e0cad1bc14f7241c903480f809983fc2c30d93
                        138cf63b59bc737ac08192893d039187a811bef3d320
                        9eb7b8d1e05b5b251cef760a210b2732867ab32049ba
                        3c354e3858aee7b71df792924730d8e842e484122b50
                        677b0a306e61cf21b62091da18b937192936a09e5a41
                        8cf78b666157dd477af1c36a12320129522840e37094
                        1157808782a5335b0ac10d70e1beafd401074b84b982
                        6cc58aad217bae0f419b2da896133272d8f22c6f420f
                        cc738fccc1082fc93c7df0994c6bcf2cc8a29037b6bb
                        2b4bcef4b0ee8caf8506bc5ecba082a56806c1cede0b
                        944338a69a668254c1150ae05030e256b2b67661ba02
                        7d97576da613ac8c7c29051f1240b96b0c127e264d5e
                        1dbbfe9561a567d5c9103673b446b3ccea6c5f7f34f0
                        9348a5d4a58b04b126ea94a76854750a6cc7f39f26e9
                        116f801631a6d5a9342f29fd1e9f2a8cd94f5ee2aa39
                        c2b28b18ab32b24a5e72f5583ee68cec341a26ad74ee
                        c95d41887cba8d0ebace7a20bf5e1ca9d42df75ff673
                        cc6414fecd69f9b31869eb666e9e0b
   decapsulation_key = 0000000000000000000000000000000000000000000000000
                        0000000000000000000
   decapsulation_key_pq = f5977c8283546a63723bc31d2619124f11db46586
                           43336741df81757d5ad3062221e124311ec7f7181
                           568de7938df805d894f5fded465001a04e260a494
                           82cf5
   decapsulation_key_t = 3a7e3d89507d4755dbc7e714abb64c98df93f64073
                          78fda8433aba8d3dd2e3847b37c23cb6997d8ec560
                          8c56372bff0c
   ciphertext = dc63d18bb9715fb6e3ba71cb439fcd3377a75305cc9b144e675
                8bf5794a272e6b4a0da33234c0ac1bb5b4e60e4c82eb1fb780d
                59e4e4616641a0595ba031e3ae69d971dcd5fff14e21731a8e1
                a221f46c7820d214630b707fa1b0de3a484698f3d49e0a75f12
                12b8c42d330dd909f15eac0402f19ee77fba9447e1c44304b0d
                8c371c17c5549fdbdec1e0a2e7be9f577d7a4b5b2618d9ba67a
                b95a0297cd5c5a13c89cc5a57cbd9a8ae38d66455c9a3d2bc55
                b498775fee2f6dc224d376d5f526a8354c8ed724f60337e900b
                85627972383e1fd987d407a8834005814a4fdc94c947e5f3471
                459288cfb127952b3208f10c914200bbaac5fcebd2bc9e28484
                92bab17b9288ca8b81d1c2ac9522dcc0b6d5f51e10f3afbb5d6
```

```
5fbf919edef6323c4e92c6b0690c10db25a9182de9e919ea1b3
e65ae6150635d5180ebd7d23a2264828bc3ee1fd34dba1924ad
0db30c747e05baa9148f1a032769c685e04665fd802a79c4624
f69a9198a426eac1b217d903cdacf8844e73365f3a219a700dd
a27edf6bea33602617c5fd105b301b884bfaaa1163b791ec09f
82523fef65c87b75ed063ceb127729b82c8712e1f41b547d095
f55ee71f3f8b47a306cb5d9bdd817854c74a42eebf934a1136d
ea3fbc546ad8ce51b3171913722f08b0261d197590342bfe410
8dcb08c62a98610cbfb8d3b2831f56dcac2220e29a5811f38f0
824f21a6cbebc64fd89a09b110dffbe03799ffc74fe565c80db
f6a66acd7bfd14cb90acba03405a7982d4c1c68caa75f8b72e4
dd6401d7dce4db4f6b820a7886a604b66b4e5b9eea5e5eddc2b
ca458a25977bd1f02874c5d9daf2baf56b3040f24ce7fe14cc1
4d61c7960db4decb37d9779c8e36d69a7763066d8c1149312d2
6887a693dc222daa892dd00cd8f3a558cf605e4c65c011c2e9f
0d671ba10af2bb90ee0351ae5078eb7878399ec9eb4ace87a68
269618bda12a7aed6fda0385496c5d10ac36b35255f4a31edfa
8a2c516b65c63431013ed4909ec7a787a5efb9d3c3887b80ac1
8a44934b6559bd8a84b18e86fa1b0b9e1d9f92ba495ba5595d8
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954c37219bff4a49894a8aa37f940a40f4ec942c281e6c47ea4
08199927a724ff1c7460fc8fd47a98d0c9d4d1f07994d8084f6
e084935ad7c2985282fabd5ca13b942e10d35278f4ff4cb1cb9
6f3c862410e79144a46b4db1a3c3d4d63018ec5c01ca48cb670
81482e7d434b4abe5fa3071f2fbb533f745602b0da6183b28e6
c5dfa42dab7ae0bbbf7638e106be1bd7312cba399e08c96dbd6
9a128a2face2d4a02951533a25e82fe63d0aaaa2e8c75150215
c93ab06c22f9cab8d1cae7424f8baa09b3260ecfa3c7c8d55a2
76b4b317f72ec86b1b145a63aca83ef8c1204d8ab0c96ea3f74
2de39db47020616e139285814f188029ace4587f14cf12b5ed8
1086d8213cf8cb578341e04e16f519b77ff4c2644a5732639d6
58d0c4eaf992bd7dbd5011b700a5fa63dc1b24a84a3c80656ba
b5705dc3a74312c80e8bdb24a7ac6e27bcb8c07ece62c6e5777
dd3dc0657181f440c7524d907dd27950bcb252aef7f8cbf453c
ee3fe3143a665072c787cea76de323aa41537df2f3a40a518a6
94b918953bde8d57084e32d3b1fdcf9d153e73f02624beaf6eb
e23e6828a6a489583494f3cd790fc96bb6f5d8b198402965e2e
668e6581e7cf1c8a47a92198388f2b4cd38df660f0ddd48ad12
6819c4435af3a12c89113d778ac544fd8079cb8aaa97d2ff1b6
08da574c4dcd87f4979390de3be405f0e47788dd0b016628050
79fd73c64e9278c036544add3694c838bfcfb08c8a5efb09549
442123eaa59fa30fbb9198105f6be00163bac076193f6721c53
9714108bbfae167f5db8085c5838618f32a968bbb25c40645a1
7c17b9bec64aea45832eec5adc25b53e677f67566fbf5ce2d91
93a06bd9b477e601d589b25f422defc49105252cd9ca6adcbb3
6be8a01a8472b4d463f655be14ccff9b0571a2048e31c14b9b2
3e2d43fafa3f85ece6fd41896cc5c68993dbaa926f285ec94c7
2887de9564881d735c05f83aa474b3d4cd133a630ac63850771
```

```
                cb5270f6cb7a391170d66af3e4901b6eb0253f3f34ef57d6bab
                d97aa99ce718c3bcb53ff13d4028a0c943bb9681106ce176242
                cccb75df1d3f8d3706e5b068b04661f73f1b3abc7c466641401
                cd572477e9db21963ccff97951d6757ef99c79b7a0a165ca53e
                0b3251acac416eca0a11265e242ee458be389c46d138059a72f
                c973e55e5515c828a2b1ed4135854febbab2698663711de93f2
                5a1712ce17c5b6f
   shared_secret = f96a71adb5cbba5b941d0c7263640f07ab23a24ceb12790a
                   d9a6f9fce15dbc88

   seed = 0101010101010101010101010101010101010101010101010101010101010101
          1010101
   randomness = 6565656565656565656565656565656565656565656565656565656565
                5656565656565656565656565656565656565656565656565656565656
                6565656565656565656565656565656565656565656565656565656565
                5656565
   encapsulation_key = 6a0684b22b798e76a4407b87f6b7540d7ab75460692a
                       8a91070456ed6457281542abb01adcac98daf4a62f3a
                       81dc7962b6a23cc6624d96cacf0e5c8894651ec68067
                       92f1c9b457211567515a65a184fcb27c86bef2b21523
                       7c119c9b29d205c0a4171b70c34da35427547497f827
                       c8642031964b10b12aafa6c0278d9917cbb39e3c7b20
                       151c167331764b447ea7097131fb4f36814d16290c3c
                       ac0759381747b4a5a8fbc170f8afb865c2962339988a
                       cad6a17cfe12aa7102aae24124537b1042c979cbd1a0
                       3e8a15261bb9476100360a2588e19ad3dc6f124b6567
                       c25dc00ac4a4f515a23086b5035625a88458e121ed80
                       5143b8bccd95b08295bfedc2bcbe947f755272852311
                       09c7a197ab406f6c8b5e927572a766f5d2b6a83816af
                       b0513e81a02049a166778774714b7d121c6fb6461891
                       02923683b68abdb2fa11bed51a5dc30f0df593fe4a45
                       9ab2aa8eec26d69525b790001b820545656b0517989c
                       5243f6e313c08720b9052c624b9cf382b92341ab3cd3
                       1007d68353077df88126e3762e8478359778bb3d1416
                       3098c5dd35b9b9d87c5e6874004d126ddc8839f48cfb
                       6a717737010ab66188c24314fb0104c6c14895a42b33
                       781afc01f84214897c7f7ea48662f18e1050513d91c8
                       3337c10db5cc7cfb78d86b615d5b1c74062cfb5162cf
                       d2499e31a6e3e8cadc6cc2066215fb78a1b986a1be20
                       86c73a5142a35923b61f76a1b669f2690d3857c3d903
                       d9a6647d9b2d3f545703075f7b3021225c7daab74b4e
                       327496a9ac8088418de6ad08ba4b3a57967c6c4963b8
                       7ec1012f1356051537ceaef13956dc134dcab19729c3
                       fada994aa706c4832ce47b0479b51c13995eb6d895a7
                       045df0d8b696f3a8a529a1abf8bd66e91e6af46d7473
                       07cadb76e7191d2ca90c8519394d3c41524089247258
                       014bbf1a1b8add2709f50480d5d08b4d9a64688321c6
                       cacc03115d30e09d016a1704db4689545b3802a07f4b
```

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                      3fa82142bbe8940c7ac15f19c3ee20bdfac11bfe8b26
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                d3e63f03e8f3fd6dbe001fa91048ae6275f94c7072a3c022252
                9127f00b2a3a8b8101c076a37c4e267a89e65614e57fa048e1e
                d73b32c7a6cec285abd2f4cf04393e506d3448dd85ac2014794
                624436a95303289313c4ac0a33a557ae7ae8c40b712b730238b
                b96555db3923aff
   shared_secret = 5e728a0f876a8652887b33d5f7c3fbe226d903d6995bcf3f
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   seed = 0303030303030303030303030303030303030303030303030303030
          3030303
   randomness = 6767676767676767676767676767676767676767676767676
                7676767676767676767676767676767676767676767676767
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                7676767
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   encapsulation_key = a7a3aa9b70890e37309eaa5b38333f8ca91ef7b72c01
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                       1709a2150aac314a815630c408fc5944004ac3709a5f
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                       a3c25937766e1c8f02b66a7e95935022161472420086
                       678d507dcd660df1212ffcd84c80488e33a269d192c3
                       f09a1ba6a2bc5a5061cb32c7c18958902bb767d6bda6
                       563023d7ace28bb0c7642c839547e46103c0c5311e5b
                       ab4f41aeb16abad34a0a92465c5aeb7085d88659a175
                       c6e717b4778ff3ea8d19e6c793d5ac41b0532a043b6c
                       3826352090b47a33a2b0567d555bc7484cce1120b45a
                       55a9aa148bf135045c941805bd4243a96c2c7a9fe51a
                       a8705c0da35b6f6689e0578ade37c2ff134d7e366ce7
                       492b7905497502159a964cf7b1b87c1186d79892256a
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                       29d7a42c6057d26506b910599b10925562c02e743545
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                       70642ff5facd9be5085e99a31a7670c33c5ba991cb1d
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                       5d0a87a0a7bdfe435ecd0714e07439eb04076f654d4e
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```

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                      a12a423c32f23670762c8ef95a63d4d5ba20fac2eada
                      0abd647e2d77157e8cc7ea2c901b3a873e5b017596a3
                      0f66606ed85e452437fad731186aa9acc4c508ad2a4f
                      246fcc0326ea60a0341c81a88c588e0fa10e146db47b
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                      364a7ac8a723ddc53a09557c9261dc6bd416f1a6a934
                      aa3f4f2c1736cf029149383442bface03b28a8cb8935
                      6e56b396d2adf8d016b405d46d52f9be2adaf158b99d
                      4d95bb2b26032d9b317fcf92437cbe
   decapsulation_key = 0303030303030303030303030303030303030303030303
                      03030303030303030303
   decapsulation_key_pq = 49b46321ef5a24c1c036750879c0ad29dd08607d4
                          89bd7eaa5869492759d994d875e0beaac3cf90df1
                          b3f1e0dd70357a5bafaec8a36fc2d9b72edf3f57f
                          9db20
   decapsulation_key_t = ac4d9041874d97a6b86f575c0a0cd1d7b5f83e8de4
                         352592382afa96507848ce950c04d165909ae5f4fd
                         704d9959b3ae
   ciphertext = e6d40ddf8ba0b0a4a08042ab0a9c0915b51e330251fb8dfe8bb
                1bde64b387785de977142587424bb00533be0429643d77c8736
                ed8a1dcc6a8d8f6a5e5c1aaf619344eb42cb56d135b18c1eaaa
                5e87be1ce67eebdf514399f2161f6c2a38d597550e1e7490951
                938c80909063d9b6dd19434c8aef5f2ce5b4a4d393ac36c0c8e
                287647f6dcc584b8ab14c6f357a19fd535ca7381a76e58e6095
                adb0179be4a19114bcc0423f604826f5a8d813c52ae802b7bef
                f1edda7ba0f301b552e916e650808323dde239be8dd561da9c8
                d07986d010219eb364d15788084725ca425218af2722a51c574
                1e81cb787fc60ae97e3edcd3e683b3dfebf2a8a0269c737b5ac
                44a03342257de219627d4b302914d09d9aafb95388098631c3c
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e81c0edfb7c293622868d0e080c019c9c34efd4bb8f3fb148e7
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fe056dfa935d565ce33bce416ebe9937206fcc78237ce755b1f
b22c3a4ad0601e84495765f7d8b48a7e4c421a881c21b5a7796
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                4ce0e94e428ba8c4d4de25b644140cab513687dc242732f07c2
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                75b3a617603637340424bece9c2c5a96613c7400700a5ddf275
                fb67cff8aa488597a675cf8e96443f639cd1a3fb8d02e9e119c
                b0f5e8da9402dd8372c20ee73ba2d3e4a38cee4f54aa1e1f716
                04df005c7323025
   shared_secret = a181d0d0c7d76f94ba86ad73b0e3cd43e0054bb17ce4025a
                   93aeb9da8a459947

   seed = 0404040404040404040404040404040404040404040404040404040
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   randomness = 6868686868686868686868686868686868686868686868686
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                8686868
   encapsulation_key = 27160bd008ab6864b35c32ceec05a51637cd44560833
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   decapsulation_key = 0404040404040404040404040404040404040404040404
                    0404040404040404040
   decapsulation_key_pq = 79f1b2ce3b601ebf5ba31006e5a8e4c86cd58148c
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   decapsulation_key_t = 2e5dfd616c72bf2050fd3b930c83e0adf59416895b
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                        97cd9597aae3
   ciphertext = 94bb545f2e6e3baf2b0a9bfe14dfe38c34d73d7a2512ae51b8e
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   seed = 0505050505050505050505050505050505050505050505050505050505050
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   decapsulation_key = 0505050505050505050505050505050505050505050505
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   decapsulation_key_pq = 749fe3a6fc429b2369d9e8191f72d4fd3b292f2f1
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                           85ca9
   decapsulation_key_t = cdbbacf0898b6eb7033e1690427327d227ae74993b
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   randomness = 6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6a6
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                    c5669d788c479cb7fc8a743bd23228c02753ea619152
                    3d09180d0bdc944ee37ab0e83d39d5802cd20e21c8cc
                    ab7033320cadc2104e29bc4d1612a38638cd39f299a0
                    b95caafe5fc95956d82859b1f37ce95d3fb88d024413
                    7561cd922cc404741105a6265ead6291ef0d09c0360a
                    c9249404104f09142ae579c06a67e22c7f2a28988c63
                    0630d4aa75c1f0a4d79790494247c963088fc7622f03
                    e92c34f6babfc2720c089a1be5a641650c92394331a2
                    8c0d49e0443bf8e1c962a3e1ad6f2a
   decapsulation_key = 0606060606060606060606060606060606060606060606
                    0606060606060606060606
   decapsulation_key_pq = f7d6c6a46a9c534d6ee0532938a99f0c450da4935
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                      5b73ed69a557afa27839191b8e71214ef9ef97e9d
                      9bb99
   decapsulation_key_t = d923f4ac7a9434face57a0abe72ed59e731d586d11
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                     08b0fe65a87e
   ciphertext = aa5a25b8315b9e6c940207124c6f2ceb59a295b7683fd6762d9
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                e6a9da86011af4e1402be1e3fb8e83f26b7454de4fb64b9724d
                90ef8f5b7213acdd079dfd75e8b742ee3d161404f0b600e5906
                baade188d3bc192842dfcc3693709f8d3b0dc692874c7c45425
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                fbecbeabf67e02e2679e3c5e504b244c947b5c5baf7deacd0db
                2b07408e2841c44bda8e71db1e3e496d2c1fe51333bf1c353dd
                bacc71633f6896f048c22c09cabc39bdb641c87031c2eeb1c3e
                3acf7b81ff157067209aaee97af94932d849666fcfc5c740c23
                2f9863e6180e97f
   shared_secret = 48a677acb7c95c2c97b4ccff48698d31daabf4367f0916f1
                   9892fb8f2301cd86

   seed = 0707070707070707070707070707070707070707070707070707070
          7070707
   randomness = 6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6
                b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b
                6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6b6
                b6b6b6b
   encapsulation_key = 36f2b5d9481ba9714e75c63de35c4d847ab513d440e0
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                       773643c57db8ec4c8b6a43f5488e29e509274722bc89
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                       d50965aa0caa4627337290549d9aa2f23b63e84c7075
                       c98f4a342d8fd4ba96357576ca49d991b98ca497d54a
                       3a4a984d0aea4bd61a187f639957e27b1e69b549c923
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                       10824c08a4f02c9821aa3019a45654dc40574b9cec01
                       a758f2c9e2a94b73d982a671c54cd8ad6ae95c6f3713
                       807aab89162dfa68734b6657aa47212c8a17fd45bbb1
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   decapsulation_key = 0707070707070707070707070707070707070707070707
                       07070707070707070707
   decapsulation_key_pq = d7b4cf68d3f1b711924ccded71a241faf8162f7ef
                          6ce748370a10e86b94befc198683377946eb96641
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   decapsulation_key_t = 7cfdb92bc9ec9646b9b56fd75e11fb0fbea20532e2
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   ciphertext = 4dc3b02448f339df1362f71a0929acbdfb2a0425f54adc2f98a
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                68c8b971ec61f52
   shared_secret = 364f0637f4fe3b847aa7d51207b35e7e36ce4503529dcccc
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   seed = 0808080808080808080808080808080808080808080808080808080
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   randomness = 6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6
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                6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6c6
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   encapsulation_key = 438844d7cbc33abcc0c58337f8e8c084c0795812ba66
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   decapsulation_key = 0808080808080808080808080808080808080808080808
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   decapsulation_key_pq = 08f68b3e03568d1e99c5c2167cf41dba4a6077557
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                         5ea72
   decapsulation_key_t = 3c0cdbb9ae2aeb5bae5be3eea1f08a1f8a6d8d599d
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                        c36074d8c92f
   ciphertext = 4aaedad0befe99ae3e9d21c745135279dbafa79e9935f328ecb
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                227b37c32a00ca4b25623396ffbdbf95703203ebfef5b07a450
                591792fd0adbb1277655fbc908ba0952758b74610f8152d8e59
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   shared_secret = 17bce549979580e4b285540376bd6e57c61571765c4498dd
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   seed = 0909090909090909090909090909090909090909090909090909090
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   randomness = 6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6d6
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   decapsulation_key = 0909090909090909090909090909090909090909090909090
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   decapsulation_key_pq = e4c190b41d18fe33b5710819eb4a962a2a6af9cd2
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                           a4912
   decapsulation_key_t = cd862ad691c59185b104dc26b2a0a630c5722b568a
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   ciphertext = aacb765d071dd63516706b226b20856e386e89bc8225d8b9235
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Authors' Addresses

Deirdre Connolly
SandboxAQ
Email: durumcrustulum@gmail.com

Richard Barnes
Cisco
Email: rlb@ipv.sx