On the Adding NTRU back in liboqs

March 5, 2025

NTT Akira NAGAI

Summary

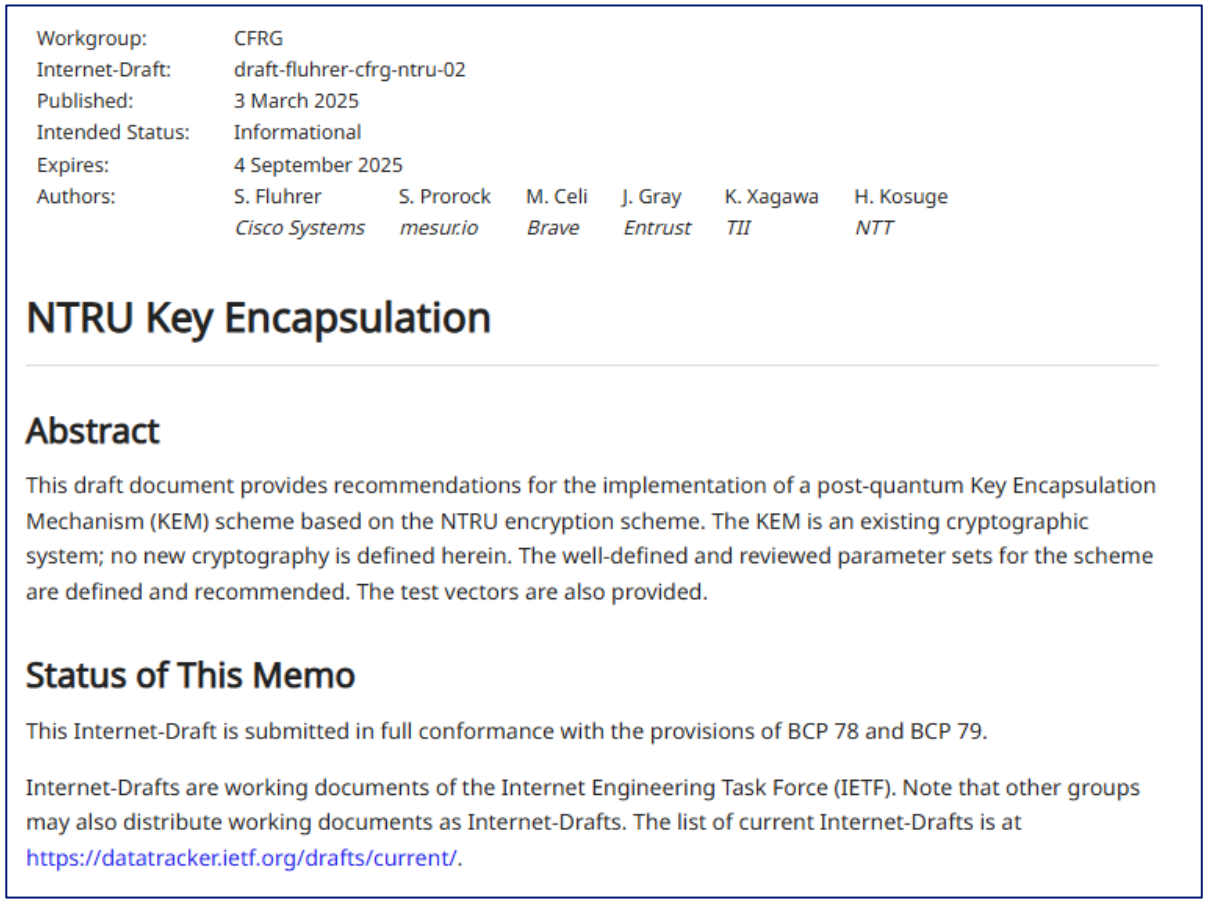
- Let us propose the **re-addition of NTRU**.
- NTRU is planned for use in the **IETF** and **GlobalPlatform**.
- There are also already applications (**software router**, **optical transport network**) using the liboqs library (NTRU).
- We will contribute by providing **faster implementations**, etc.
- **Maintenance** is also available from us.

Background

- Some companies are worried about the patent issues of ML-KEM, and we think it is important to have an alternative.
- After version 0.72, NTRU support has been discontinued.
- At the IETF hackathon, when I talked about re-adding NTRU to liboqs, I was advised to contact Douglas.
- We contacted Douglas, and he contacted John Schanck, but there was no response, so we requested that we would like to update and maintain NTRU ourselves. He suggested that we attend this meeting.
- Today, we would like to explain to you all, and we would be very happy if you could approve the re-addition of NTRU.

IETF Activities

We are collaborating with other companies to promote the standardization of NTRU in the IETF. We have published the specifications, including NTRU test vectors. We plan to give a presentation at this month's IETF meeting and request an "adoption call."



Workgroup: CFRG
Internet-Draft: draft-fluhrer-cfrg-ntru-02
Published: 3 March 2025
Intended Status: Informational
Expires: 4 September 2025
Authors: S. Fluhrer (*Cisco Systems*), S. Prorock (*mesur.io*), M. Celi (*Brave*), J. Gray (*Entrust*), K. Xagawa (*TII*), H. Kosuge (*NTT*)

NTRU Key Encapsulation

Abstract

This draft document provides recommendations for the implementation of a post-quantum Key Encapsulation Mechanism (KEM) scheme based on the NTRU encryption scheme. The KEM is an existing cryptographic system; no new cryptography is defined herein. The well-defined and reviewed parameter sets for the scheme are defined and recommended. The test vectors are also provided.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

https://www.ietf.org/archive/id/draft-fluhrer-cfrg-ntru-02.html

agenda-122-cfrg-02

CFRG - Crypto Forum Research Group
IETF 122 in Bangkok

Monday March 17, 2025, 13:00-15:00 (UTC+7)

https://meetings.conf.meetecho.com/ietf122/?session=33810
Jabber: cfrg@jabber.ietf.org
Notes: https://notes.ietf.org/notes-ietf-122-cfrg

Chairs: Alexey Melnikov, Stanislav Smyshlyaev and Nick Sullivan

13:00 - Stanislav Smyshlyaev, "Chairs' update" (5 mins)

13:05 - Nick Sullivan, "KEM Combiners Design Team: current status" (5+5)

13:15 - Vasilis Kalos, Greg Bernstein, "Blind BBS and BBS Pseudonyms" (10+5 mins)

13:30 - Patrick Longa, "FrodoKEM" (5+5 mins)

13:40 - Chris Wood, "Anonymous Rate-Limited Credentials" (10+5 mins)

13:55 - Deirdre Connolly, "Hybrid PQ/T Key Encapsulation Mechanisms" (10+5 mins)

14:10 - Yuchen Wang, "ECDH-PSI" (10+5 mins)

14:25 - Rohan Mahy, "MIMI franking mechanism" (10+5 mins)

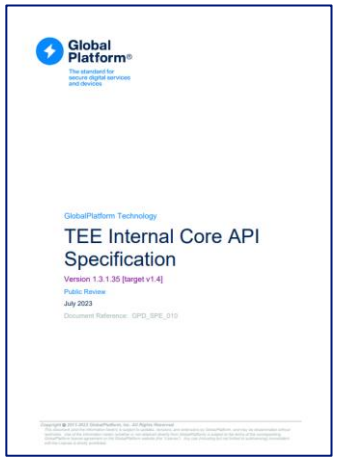
14:40 - Haruhisa Kosuge, "Advantages of NTRU compared to ML-KEM" (5+5 mins)

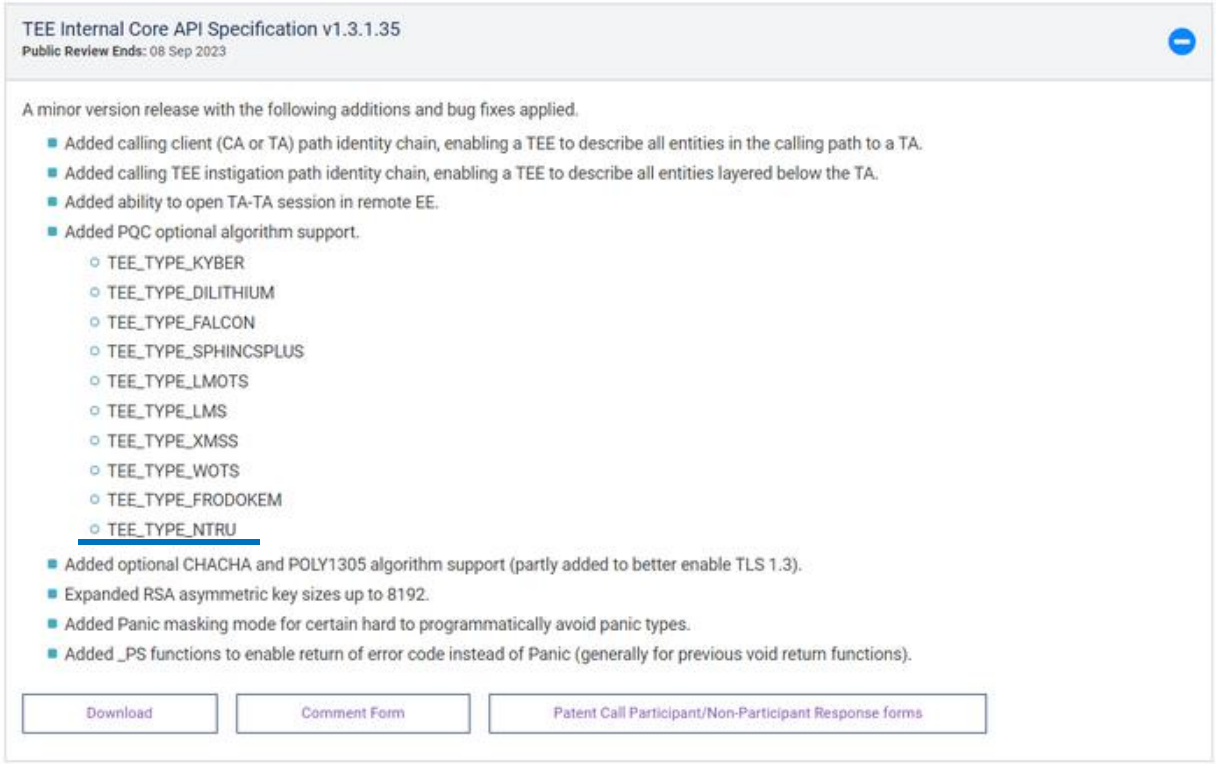
14:50 - Michele Orru, "Sigma protocols and Fiat-Shamir" (5+5 mins)

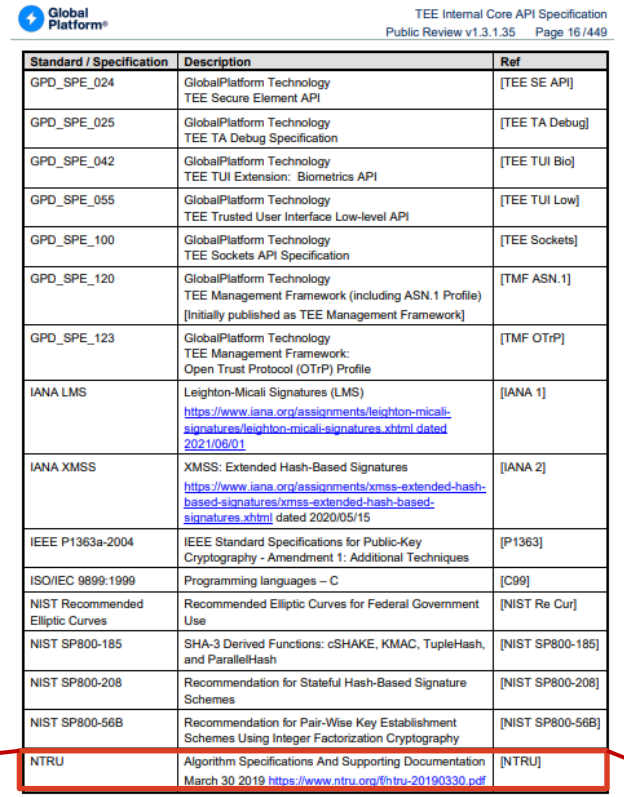
https://datatracker.ietf.org/doc/agenda-122-cfrg/

GlobalPlatform Activities

- GlobalPlatform (GP) is a standards organization for the management and security of secure components/devices. It does not standardize the cryptographic mechanisms themselves; it specifies the mechanisms to be used.
- NTRU will be supported in the Tee Internal Core API. We believe that NTRU is suitable for resource-constrained environments, such as IC cards or microcontrollers. For this reason, we want to standardize it in GP.







https://globalplatform.org/wp-content/uploads/2023/07/GPD_TEE_InternalCoreAPI_Spec_v1.3.1.35_PublicRvw.pdf

NTRU	Algorithm Specifications And Supporting Documentation March 30 2019 https://www.ntru.org/f/ntru-20190330.pdf	[NTRU]

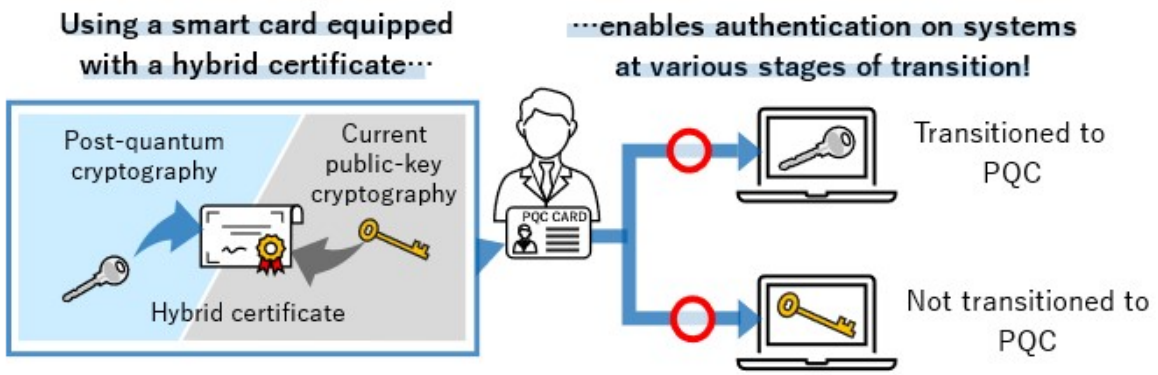
FYI: ML-DSA has already been implemented in IC cards

Lattice-based mechanism is expected to be used in constrained devices such as IC cards.
The same can be expected for NTRU.

PQC CARD®

TOPPAN Digital, NICT, and ISARA Develop Smart Card System Employing Hybrid Methodology to Support Post-Quantum Cryptography and Current Public-key Cryptography

Facilitating a smooth transition to post-quantum cryptography to ensure the safety and security of social infrastructure



Concept for use of the PQC CARD® using hybrid methodology

https://www.holdings.toppan.com/en/news/2024/10/newsrelease241007_1.html

Industry adoption: software router “Kamuee”

- NTRU will be implemented in Kamuee, a software router that provides fast and secure communications and is already in commercial use.
- The Kamuee team is also working to standardize router functions at the IETF, and they plan to use liboqs as their cryptographic library. They are currently using liboqs version 0.72 for testing, which supports NTRU.

100G Router version

- Hardware Price: Approx. $40,000USD
- Supermicro 7048GR-TR: 4U Tower Server
- 100GbE (QSFP28: SR4/LR4) x 12 ports (6 slot)
  or
- 100GbE (QSFP28: SR4/LR4) x 10 ports + 10GbE (SFP+: SR/LR) x 4 ports

Workgroup:	SPRING	
Internet-Draft:	draft-watal-spring-srv6-sfc-sr-aware-functions-02	
Published:	31 January 2025	
Intended Status:	Informational	
Expires:	4 August 2025	
Authors:	W. Mishima	Y. Fukagawa
	NTT Communications	*NTT Communications*

SRv6 SFC Architecture with SR-aware Functions

Abstract

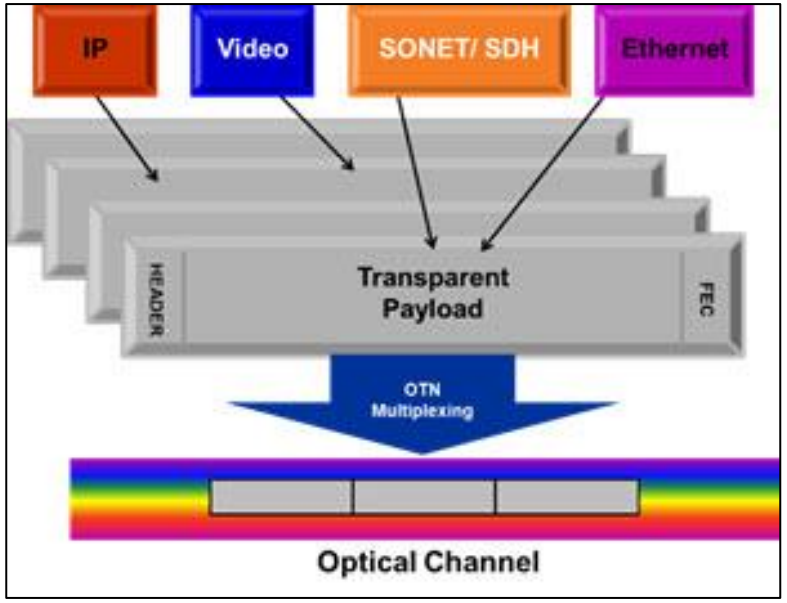
This document describes the architecture of Segment Routing over IPv6 (SRv6) Service Function Chaining (SFC) with SR-aware functions. This architecture provides the following benefits:

- Comprehensive Management: a centralized controller for SFC, handling SR Policy, link-state, and network metrics.
- Simplicity: no SFC proxies, so that reduces nodes and address resource consumption.

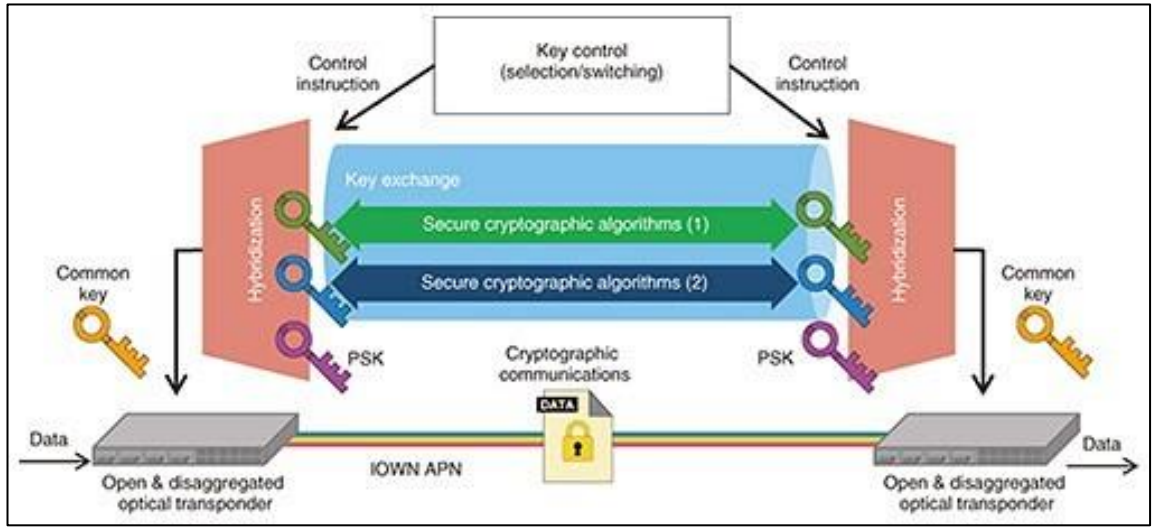
https://www.ietf.org/archive/id/draft-watal-spring-srv6-sfc-sr-aware-functions-02.html

Industry adoption: Optical Transport Network

- Defined by the ITU-T, **Optical Transport Network** (**OTN**) is a digital wrapper that encapsulates frames of data, to allow multiple data sources to be sent on the same channel.
- Our company applied hybrid mode to OTN and testing currently using liboqs version 0.72



https://www.ciena.com/insights/what-is/What-is-Optical-Transport-Networking-OTN.html



https://www.rd.ntt/e/research/JN202302_20961.html

Our Plans

- Implementation will be based off of John Schanck's implementation
- Planning some implementation improvements
  - About 20% to 30% faster Toeplitz matrix-vector product (TMVP) based polynomial multiplication for encapsulation and decapsulation.

		HPS40961229	HRSS1373
TMVP (proposed)	keygen	4,378,071	5,649,592
	encaps	151,795	109,235
	decaps	206,129	300,504
Toom (current)	keygen	4,866,283	6,129,491
	encaps	187,182	156,283
	decaps	306,927	438,446

Comparison of CPU cycle count (mean)

  - Masking implementation if necessary

Maintenance

- We can provide maintenance for the NTRU part.
- We have also merged NTRU into the latest version of liboqs and are currently testing it to confirm that there are no problems. We are ready to merge it.

Thank you