**3GPP TSG-SA3 Meeting #123 S3-252984**

Goteborg, Sweden, 25 – 29 August 2025 (merger of S3-252719, S3-252636, S3-252759, S3-252841)

**Source: Nokia**

**Title: New Key issue for PQC SUCI Protection**

**Document for: Approval**

**Agenda Item: 5.2.1**

# 1 Decision/action requested

***This document proposes to add a new key issue for security concerns of adapting PQC for SUCI protection in TR 33.703.***

# 2 References

[1] SP-250858 New Study on transitioning to Post Quantum Cryptography in 3GPP

# 3 Rationale

To enhance and adapt the quantum related algorithms and procedures to existing SUCI protection. Making the SUCI in both 5G /6G, quantum safe against attacks from a Cryptographically Relevant Quantum Computer (CRQCs) implementing Shor’s and Grover’s algorithm.

# 4 Detailed proposal

**\*\*\*\*** START OF CHANGE **\*\*\*\***

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[x1] 3GPP TS 33.501: "Security architecture and procedures for 5G System".

[x2] SECG SEC 1: “Recommended Elliptic Curve Cryptography”, Version 2.0, 2009. Available at <http://www.secg.org/sec1-v2.pdf>.

[x3] SECG SEC 2: “Recommended Elliptic Curve Domain Parameters”, Version 2.0, 2010. Available at <http://www.secg.org/sec2-v2.pdf>.

[x4] 3GPP TR 33.938: "3GPP Cryptographic Inventory (Release 19)"

**\*\*\*\*** NEXT CHANGE **\*\*\*\***

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

CRQCs Cryptographically Relevant Quantum Computers

ECIES Elliptic Curve Integrated Encryption Scheme

HM Home Network

PQC Post Quantum Cryptography

SECG Security Engineering & Consulting Group

SUCI Subscription Concealed Identifier

SUPI Subscription Permanent Identifier

**\*\*\*\*** NEXT CHANGE **\*\*\*\***

# 7 Protocols expected to be updated for PQC by 3GPP

Editor’s Note: This clause contains identification of the protocols with asymmetric cryptography listed in TR 33.938 that are not expected to be updated by other SDOs in a near future to use PQC, e.g., MIKEY-SAKKE and SUCI calculation, security threats and alternative solutions for the 3GPP procedures if they are not updated to use PQC.

### 7.1 Threats

Editor’s Note: This clause contains security threats for the 3GPP procedures if they are not updated to use PQC.

### 7.1.X Protocol #Y: SUCI calculations

Editor’s Note: If only SUCI calculation is considered, this subclause may be removed. If other protocol, e.g. MIKEY-SAKKE is studied, this subclause is used for each of such protocol identified.

Cryptographically Relevant Quantum Computers (CRQCs) pose a threat of an attacker using only the Home Network’s (HN) public key and Shor’s algorithm to easily obtain the SUPI from the SUCI.

As per TS 33.501 [x1] and Table 4.3.2-1 of 3GPP Cryptographic inventory 3GPP TR 33.938 [x4], the SUCI calculation is done based on ECIES scheme. The ECIES is specified in the SECG version 2 [x2] and [x3].

Both UE and network generate shared key via asymmetric key agreement procedure using elliptical curve cryptography (ECC). This key agreement based on ECC is prone to attacks from quantum machines, resulting in threats to subscriber tracking and privacy by the identity theft. An adversary who has access to Cryptographically Relevant Quantum Computer (CRQC) can break the asymmetric cryptographic algorithms like ECC

Since PQC based SUCI calculation is not defined by SECG, 3GPP should study alternative solutions for SUCI calculation due to post-quantum threats to existing ECIES scheme.

The following requirements apply for securing subscriber identity during transition to PQC:

* Implement protocols that combine both traditional and post-quantum algorithms during the transition period to maintain security against both classical and quantum attacks until PQC algorithms mature and are fully trusted.
* Protect critical keys (e.g., Home Network keys) against quantum attacks by adopting PQC-resistant key management and ensure that systems can quickly switch cryptographic algorithms as new threats or vulnerabilities emerge.

**\*\*\*\*** END OF CHANGE **\*\*\*\***