KDDI Research
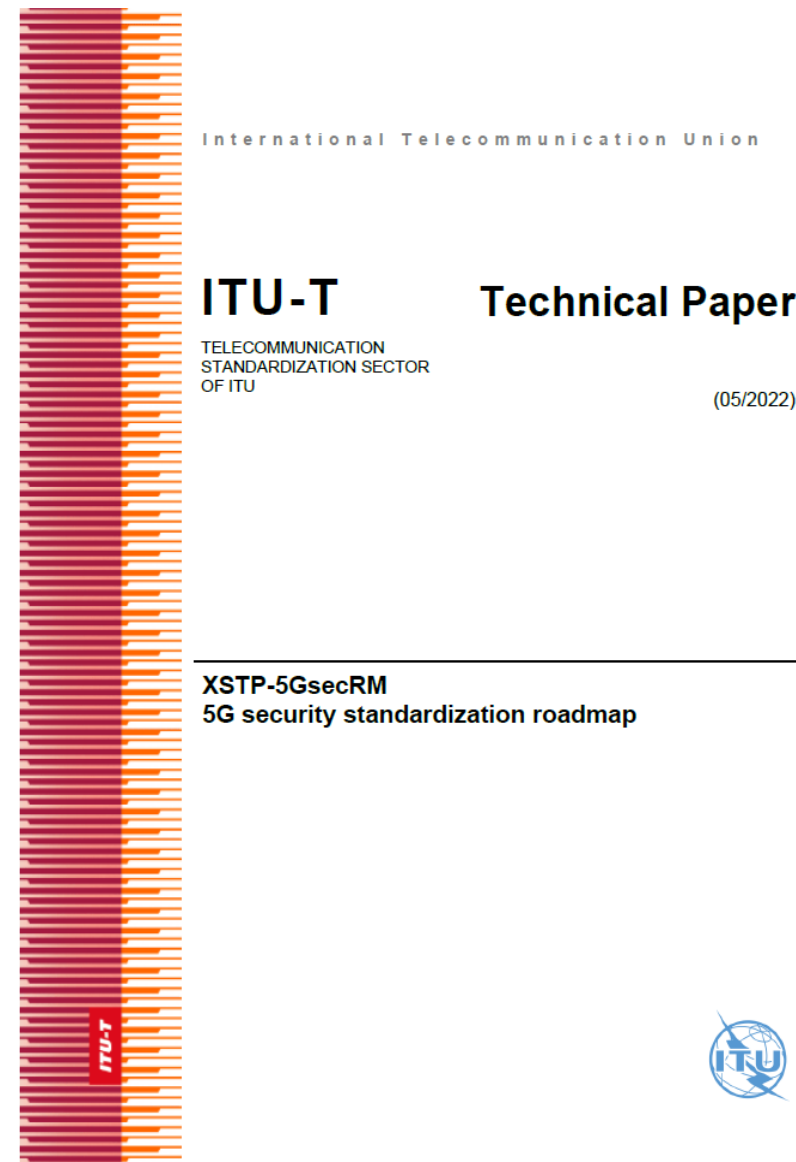
# 5G Security Standardization Roadmap

Yutaka Miyake
KDDI Research Inc.

# 5G Security Standardization Roadmap

- **ITU-T SG17 published '5G security standardization roadmap' in May 2022.**
- **This paper includes the following information.**
  - Standards related to 5G security from SDOs
  - Documents related to 5G security from forums, associations, and organizations
  - Categorization of 5G security topics
  - Gap analysis in 5G security standardization
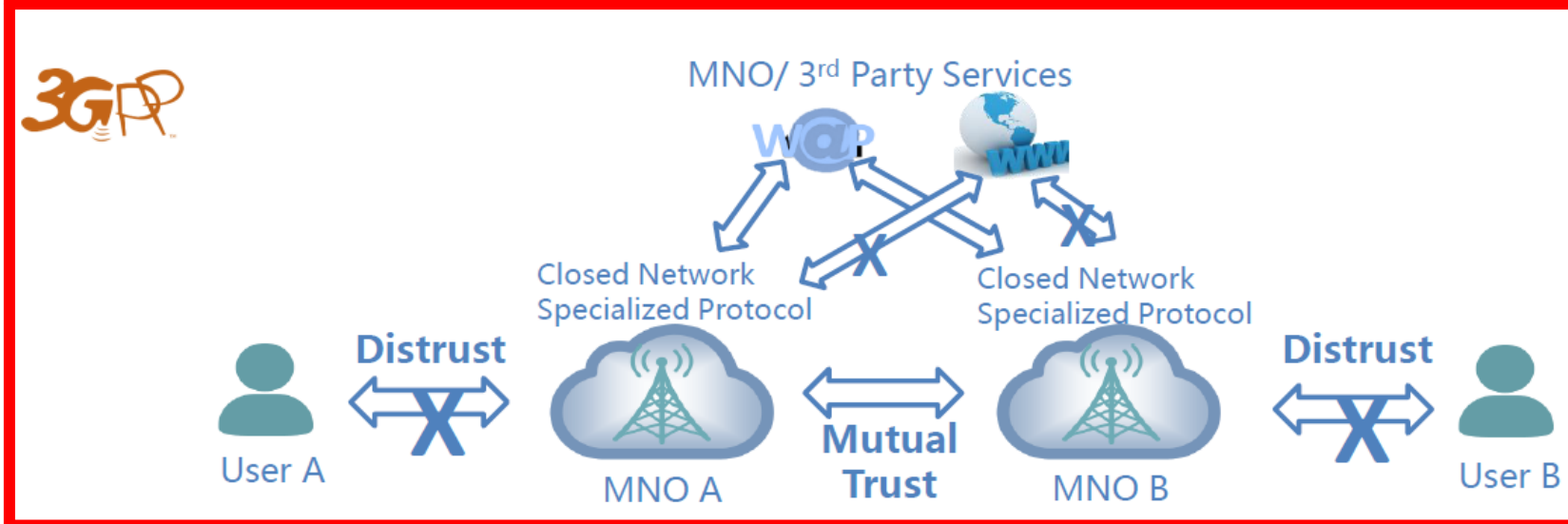
International Telecommunication Union

**ITU-T**   **Technical Paper**

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(05/2022)

XSTP-5GsecRM
5G security standardization roadmap

ITU-T

# Background of 5G security standardization roadmap

# Security for 2G and 3G

**2G
（GSM）**
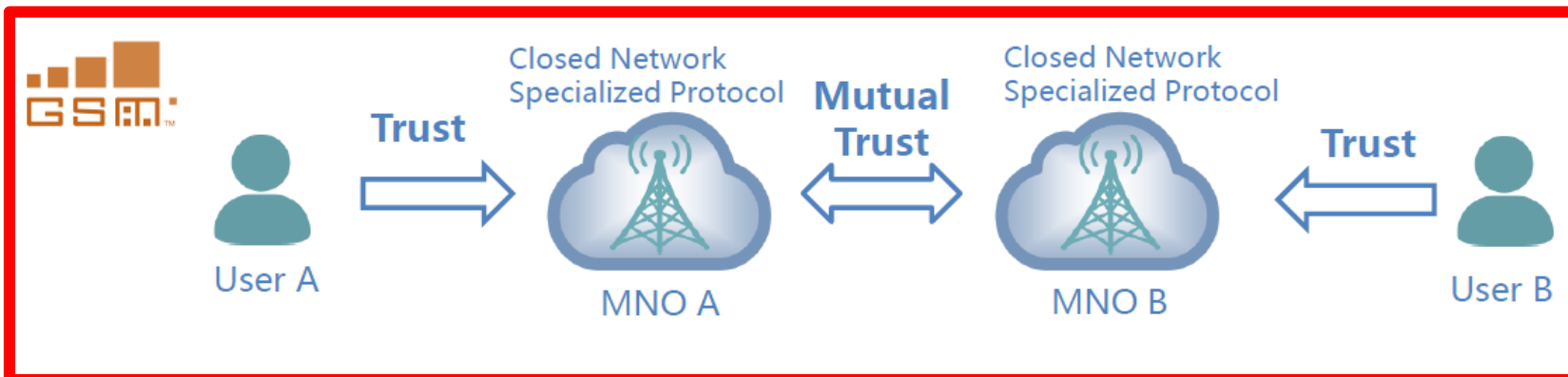
**3G**



Ref: from China Mobile presentation in ITU-T 5G Security Workshop (March 2018)
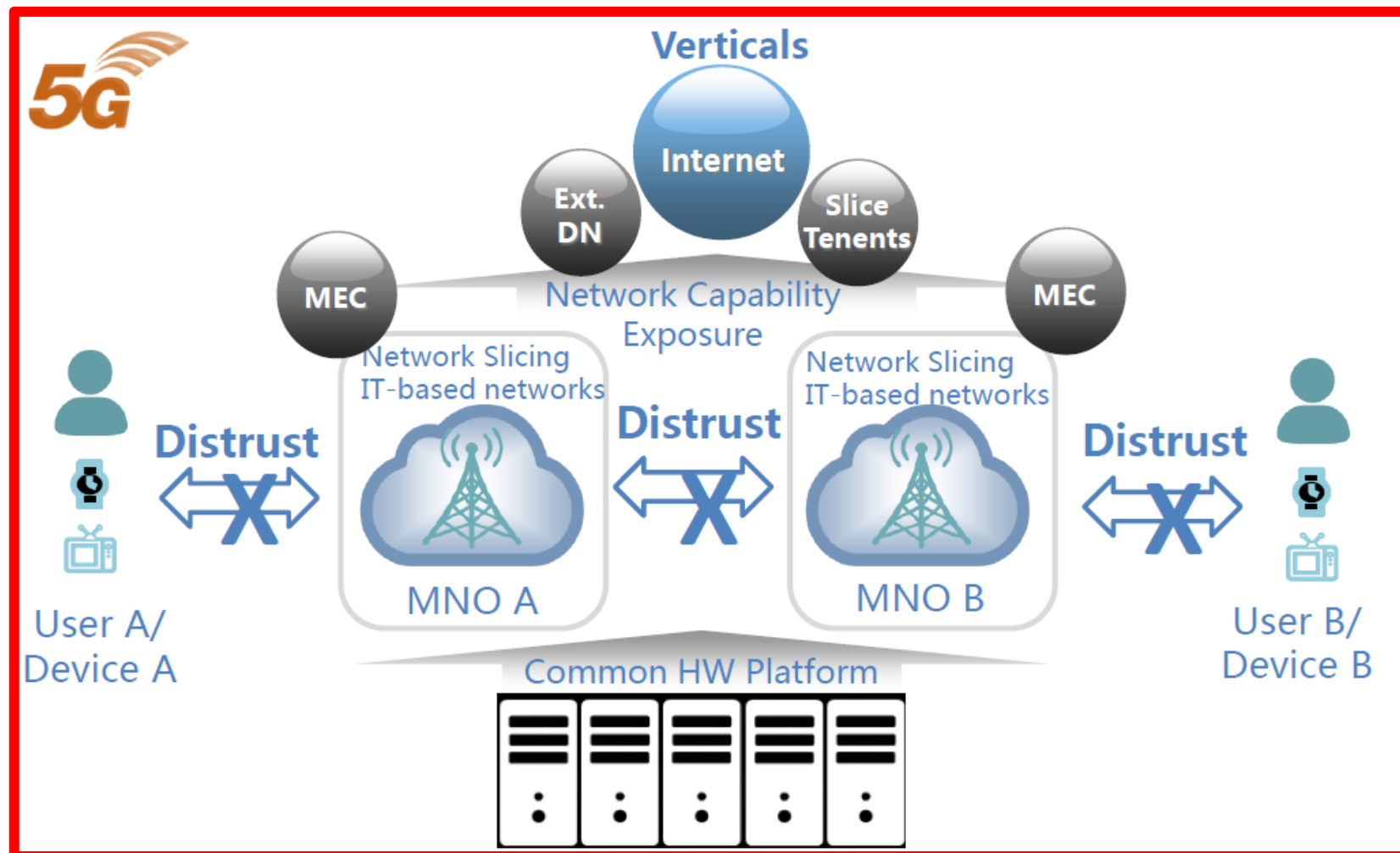
# Security for 4G/LTE

**4G**
**(LTE)**
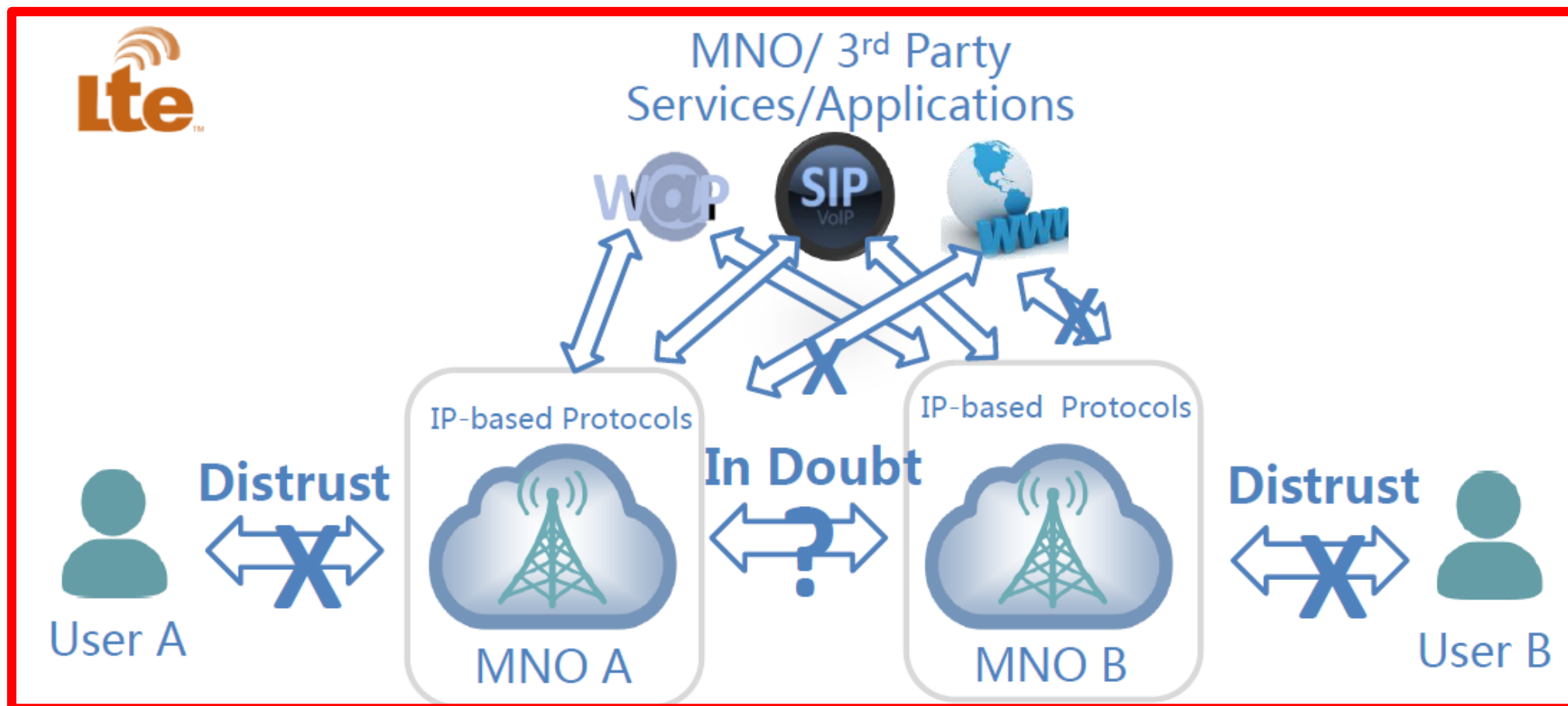


- Monitoring and filtering mechanism are required for communication between MNOs.
- IMSI information may be leaked by using IMSI catcher.

Ref: from China Mobile presentation in ITU-T 5G Security Workshop (March 2018)

# Security for 5G

- Communication between MNOs is protected by SEPP (Security Protection Proxy).
- Protected from IMSI catcher.

Ref: from China Mobile presentation in ITU-T 5G Security Workshop (March 2018)
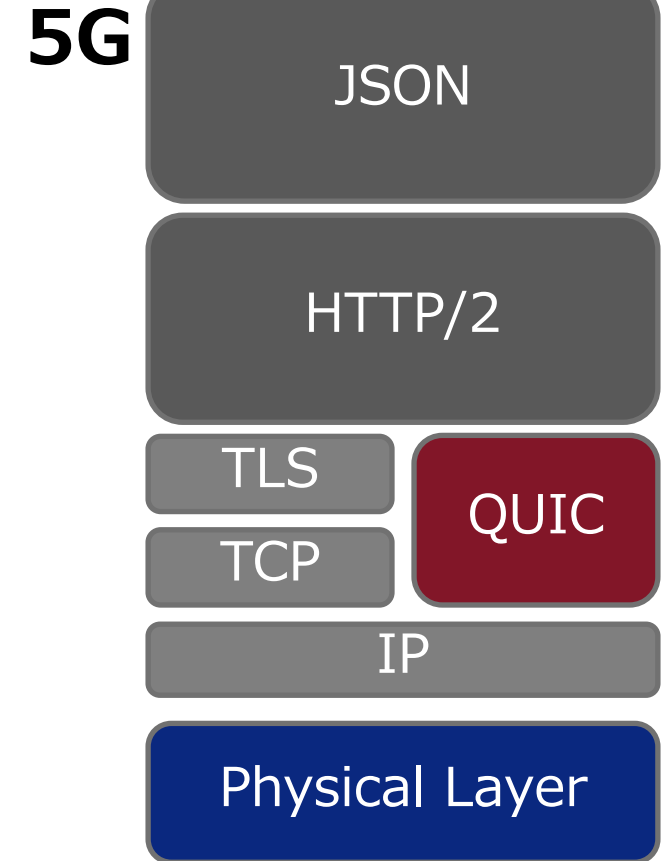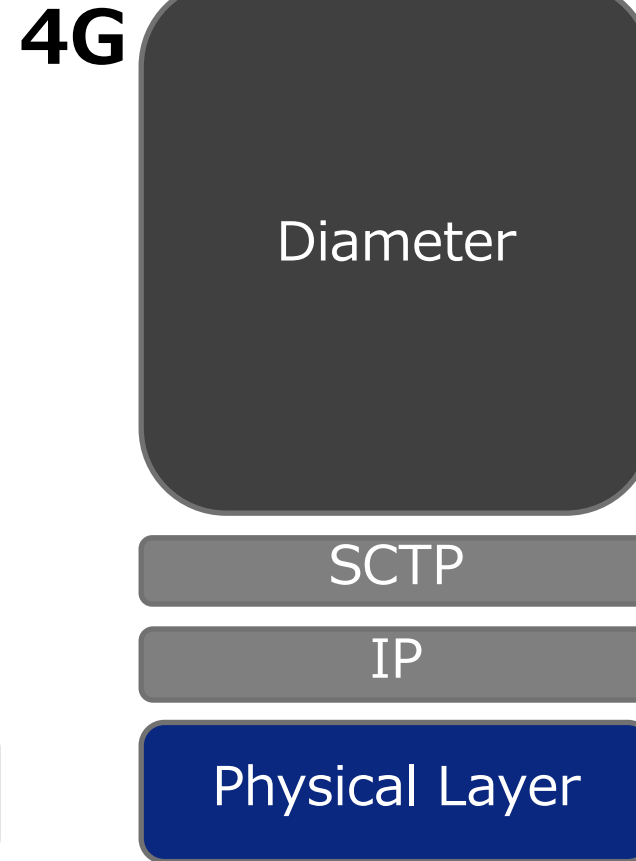
# Changes in 5G environment

## ■ Network functions
- SDN (Software-Defined Networking)
- NFV (Network Function Virtualization)
- Network Slicing
- MEC (Multiaccess Edge Computing)

## ■ Network infrastructure
- Virtualization
- Open-RAN, O-RAN

# Use of Internet protocols

- 5G core uses internet-based protocols, such as RESTful, JSON on HTTP.
- Internet experts including malicious attackers are familiar with these protocols.

**3G**

| MAP/CAP |
|:---:|
| TCAP |
| SCCP |

| MTP3 | M3UA |
|:---:|:---:|
| MTP2 | SCTP |
| MTP1 | IP |

| Physical Layer |
|:---:|

**4G**

| Diameter |
|:---:|
| SCTP |
| IP |
| Physical Layer |

**5G**

| JSON |
|:---:|
| HTTP/2 |

| TLS | QUIC |
|:---:|:---:|
| TCP | |
| IP | |

| Physical Layer |
|:---:|
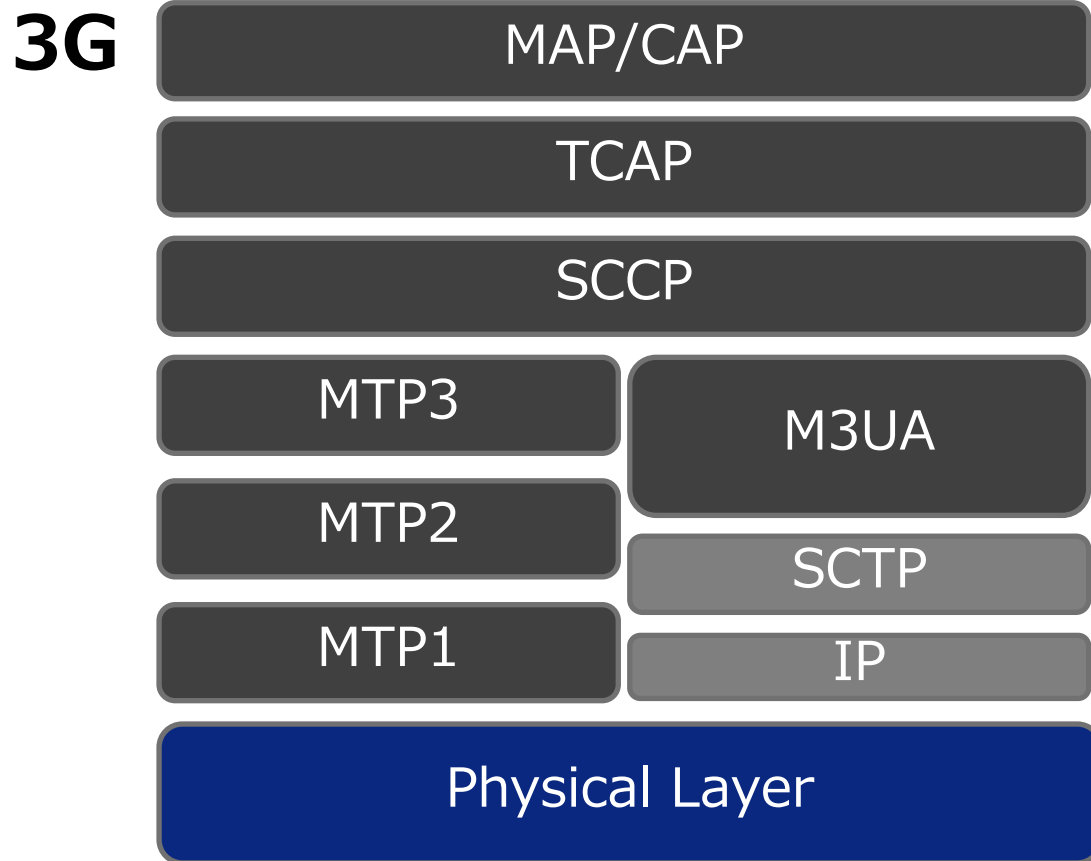
# Complicated network

- 5G network is operated with 4G and older systems.
- Various new network functions bring complexity to the network.



**2G/3G SS7**

HLR    IN-SCP

STP

SGSN    VLR

**4G Diameter**

TAS    HSS    PCRF

DRA

MME    CSCF

**5G HTTP**

RTC    UDM    PCF

SEPP

NG CP    NG UP

NG CP    NG UP
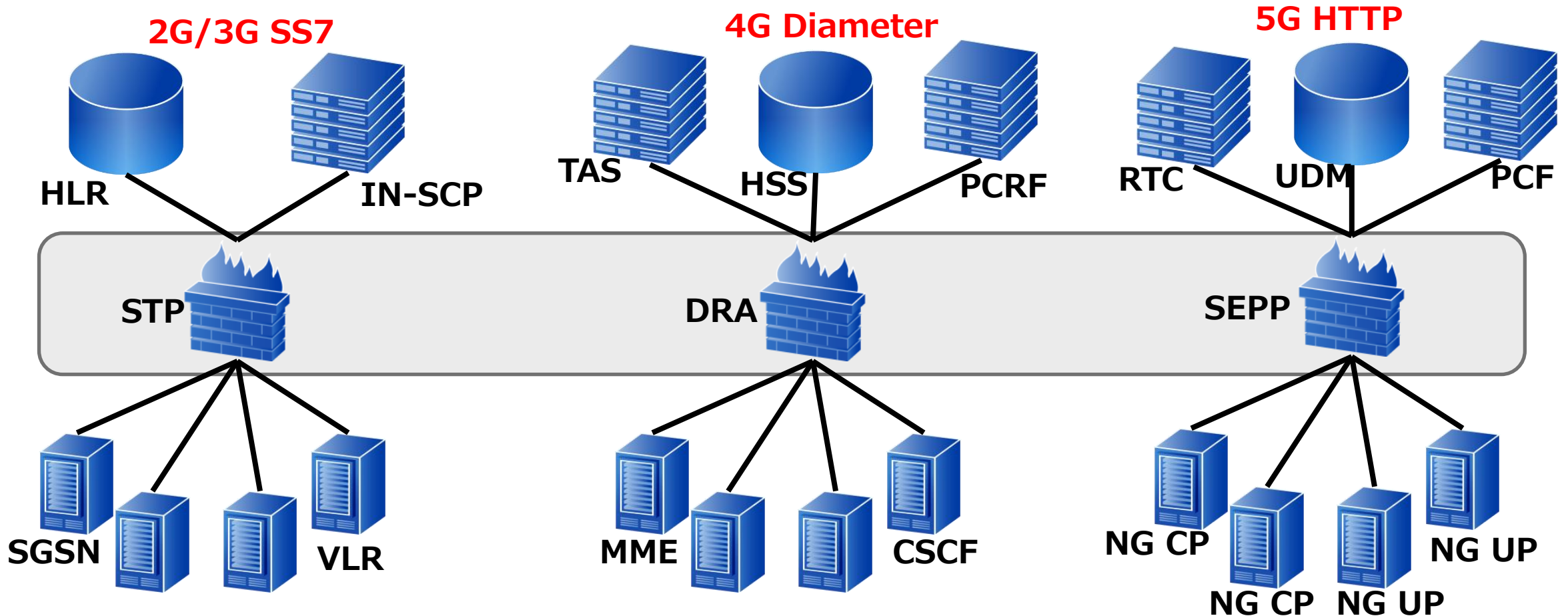
# Change of Network Environment ⇒ New countermeasures for security

| Changes | Items |
|---------|-------|
| **Network Infrastructures** | ■ **Virtual machine technologies for communication platform**<br>■ **Use of open-source software**<br>■ **Exposures of network interfaces**<br>■ **Supply chain risks**<br>■ **Complexity of systems and networks** |
| **New Functions,<br>New Technologies** | ■ **MEC (Multi-access Edge Computing)**<br>■ **Slicing**<br>■ **NFV (Network Function Virtualization)**<br>■ **SDN (Software Defined Networking)** |
| **Exposure of Network Functions** | ■ **NEF (Network Exposure Functions)**<br>■ **3rd party applications for MEC** |
| **Enhanced Mobile Core** | ■ **Adaptation of SBA (Service Based Architectures)**<br>■ **Use of Internet Protocols (JSON, HTTP/2, TLS, TCP)** |
| **New Services using 5G** | ■ **IoT**<br>■ **Connected Car**<br>■ **Smart City, Smart Agriculture, ⋯** |

# 5G security standardization roadmap

# Overview of 5G security standardization roadmap

- ■ **This roadmap is prepared to assist in developing 5G security standards by providing information on existing and under developing standards at major standards developing organizations (SDOs). In addition, it describes the overviews of 5G security from standards perspective and gap analysis.**

## Target organizations



ITU   3GPP A GLOBAL INITIATIVE   ETSI   IEEE

NGMN   GSMA   enisa   NIST

## Target topics of 5G security in ITU-T

- • Common requirement, architecture, guideline
- • Security for use cases which use mew functionalities for 5G
- • Security controls such as organizational controls, people controls, operational controls, physical controls, etc.
- • · · · · ·

| Related Technologies | Categories | | | |
|---|---|---|---|---|
| | | | ITU-T | |
| | 3GPP | | | GSMA |
| | 3GPP | ETSI | | |
| NIST | | | GSMA | |
| | ENISA | | | NGMN |

**Analysis**

# Purpose and listed documents

## ■ Purpose of this roadmap

- ● Identify 5G security activities at SDOs, forums, governments, etc.
- ● Analyze 5G security standardizations
- ● Find direction of 5G-related security standardization works in ITU-T

## ■ Number of listed documents (As of May 2022)

| Category | Organization | Number of documents |
|---|---|---|
| SDOs | ITU-T SG17 | 16 |
| | 3GPP | 64 |
| | ETSI | 20 |
| | IEEE | 1 |
| Other organizations | NGMN | 7 |
| | GSMA | 16 |
| | ENISA | 10 |
| | NIST | 3 |

# Categorization of 5G security topics and document types

| Category of Security Topics | |
|---|---|
| 5G core network | Interoperability with 3G and 4G |
| Radio access network (RAN) | Roaming |
| Radio access | User equipment (UE) |
| Network infrastructure | Service based on 5G network functions |
| Network slicing | Security controls |
| Software-defined networking (SDN) | Fraud |
| Network function virilization (NFV) | Non-public networks (NPN) |
| Multi-access edge computing (MEC) | Others |

| Category of Document Types | |
|---|---|
| General, definition | Guideline |
| Common requirements, use cases | Certification |
| Architecture | Others (e.g., technical reports) |
| Technical specification | |

# Standardization matrix of 5G security (# of docs)

| | General / Definition | Common requirements, use cases | Architecture | Technical specification | Guideline | Certification | Others |
|---|---|---|---|---|---|---|---|
| **General** | 6 | 1 | | | 3 | | |
| **5G core network** | 1 | 1 | 3 | 8 | 2 | 11 | 1 |
| **RAN** | | 1 | | 1 | 1 | 1 | |
| **Radio access** | 1 | | | 4 | | | |
| **Network infrastructure** | 1 | 1 | | | 1 | 4 | 1 |
| **Network slicing** | 1 | 2 | 1 | 2 | | | 2 |
| **SDN** | 1 | 2 | 2 | | | | 1 |
| **NFV** | 4 | 11 | 4 | | 3 | | 3 |
| **MEC** | | 3 | 1 | 1 | 1 | | 3 |
| **Interoperability** | | | | | 1 | 1 | |
| **Roaming** | 1 | | | | 5 | 1 | |
| **User Equipment** | | | 1 | | | | |
| **Services using 5G** | | 8 | 1 | 4 | 3 | | |
| **Security control** | 1 | 1 | 2 | | 3 | | |
| **Fraud** | 1 | | | | 1 | | 1 |
| **Non-public network** | | 1 | | 1 | | | |
| **Others** | 3 | 1 | 1 | 1 | 1 | | |

# Security topics for ITU-T

- ■ Common requirements, use cases, architecture, guideline
- ■ Requirement for managing 5G network system component
- ■ Risk/threat analysis and countermeasures for new use cases
- ■ Security control for organization, people, operation, physical situation to operate 5G network system
- ■ Security for 5G non-public network
- ■ PKI and corticates management for 5G system