Keyfactor Tech Days 2023

Becoming a 5G PKI

Antonio Pedone

Service Manager

Telecom Italia Trust Technologies

Agenda

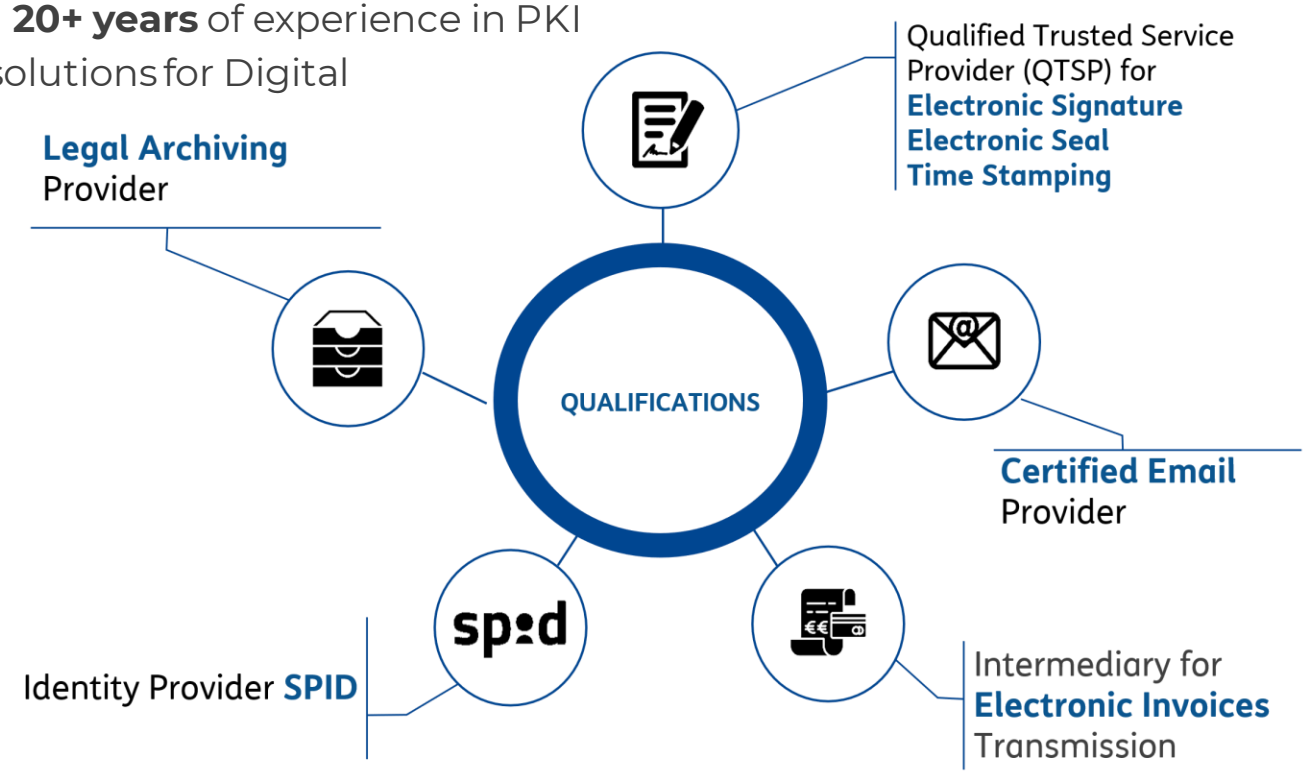
1. PKI participants
2. Mobile networks basics
3. PKI service model in 3GPP networks
4. CMPv2 in depth
5. Conclusions

The QTSP

TrustTechnologies

Telecom Italia **Trust Technologies** is a TIM Group company, accredited as a European Qualified Trust Service Provider, with **20+ years** of experience in PKI services and develops, integrates and delivers solutions for Digital Transformation:

- Digital Identity of people and things;
- Rationalization of business processes;
- Dematerialization, management and storage of data and documents.



All services are regulated by AGID – Agenzia per l'Italia Digitale, with the exception of Electronic Invoicing regulated by SOGEI Agenzia delle Entrate

The Customer

TIM

the leading ICT group in **Italy** and Brazil.

For the purpose of this presentation, TIM is the customer who had the need to **secure its 4G/5G mobile network**.

In terms of customers in Italy, key numbers at September 30, 2022, are:

- **30.5 million mobile lines**
- 16 million fixed lines
- 10.5 million fixed ultra-broadband lines
- Over 94% fixed ultra-broadband coverage (FTTx)

3GPP

3rd Generation Partnership Project

It is a collaboration between telecommunications organizations, which aims to produce **globally applicable technical specifications** for third-generation (3G) mobile systems, as well as enhancements to 4G and 5G mobile systems.

3GPP specifications are used by mobile network operators and equipment manufacturers around the world to ensure that their networks and devices are **compatible with each another**.

3GPP topics are grouped in series.

33.310 handles the specifications for “Security Aspects” (33) and “**Network Domain Security** (NDS); **Authentication Framework** (AF)” (310).

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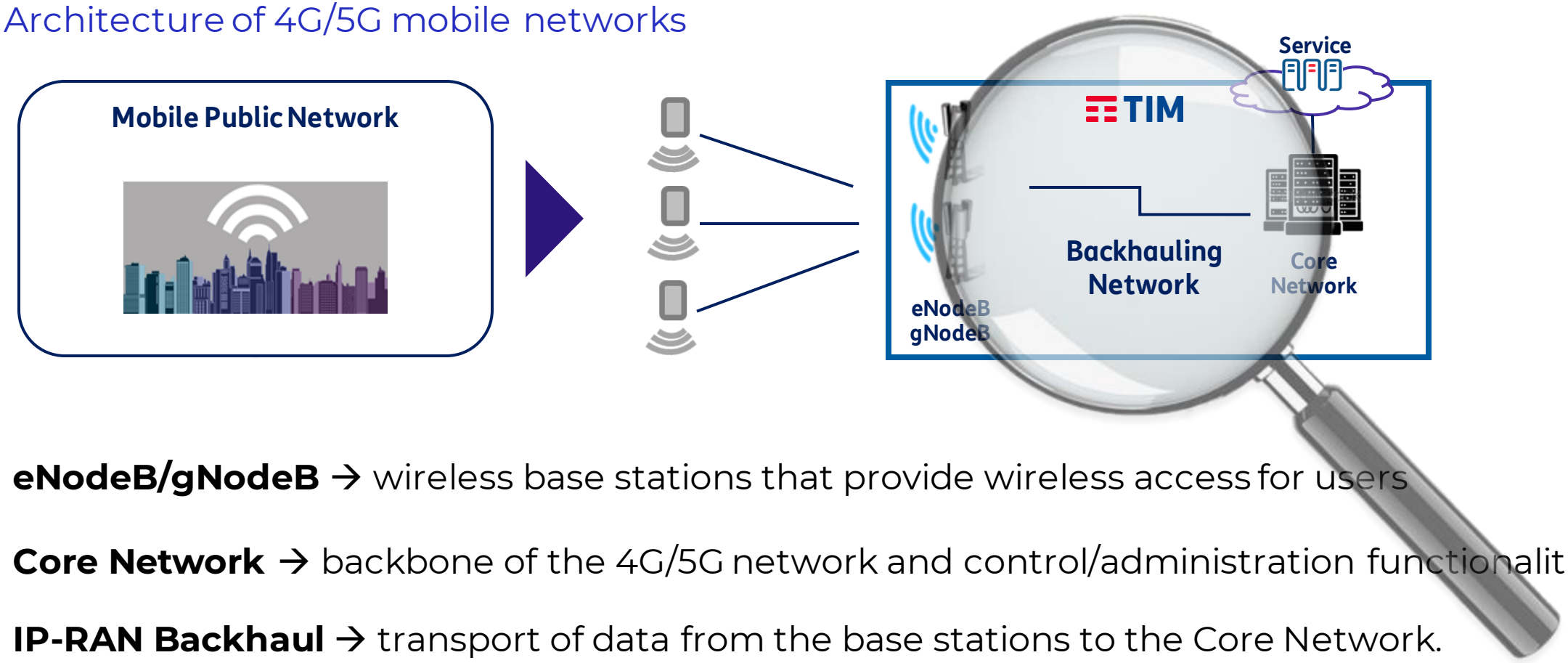
Mobile network background

Architecture of 4G/5G mobile networks



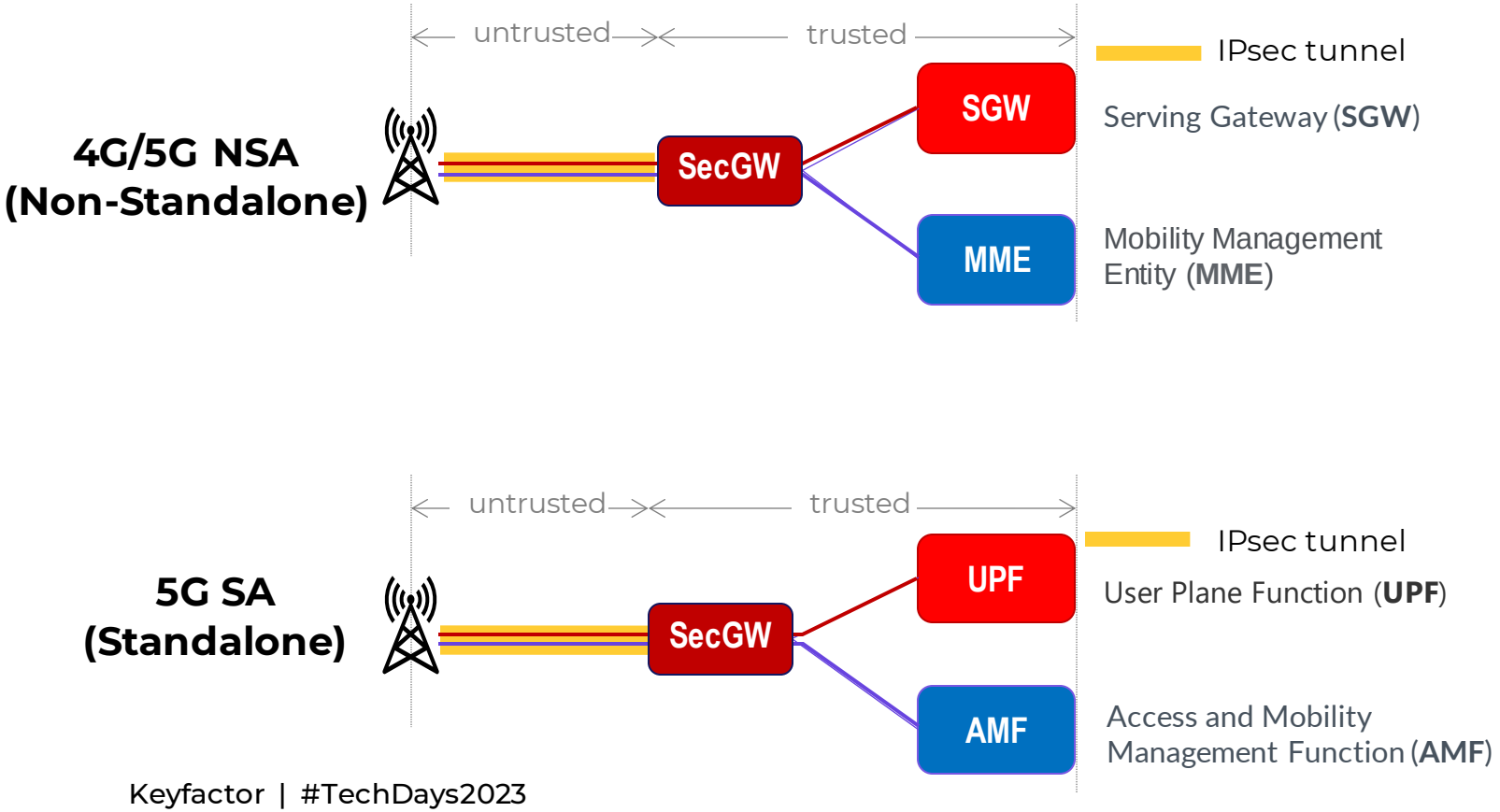
eNodeB/gNodeB → wireless base stations that provide wireless access for users

Core Network → backbone of the 4G/5G network and control/administration functionalities

IP-RAN Backhaul → transport of data from the base stations to the Core Network.

Backhaul secured by 3GPP

Architecture of 4G/5G mobile networks

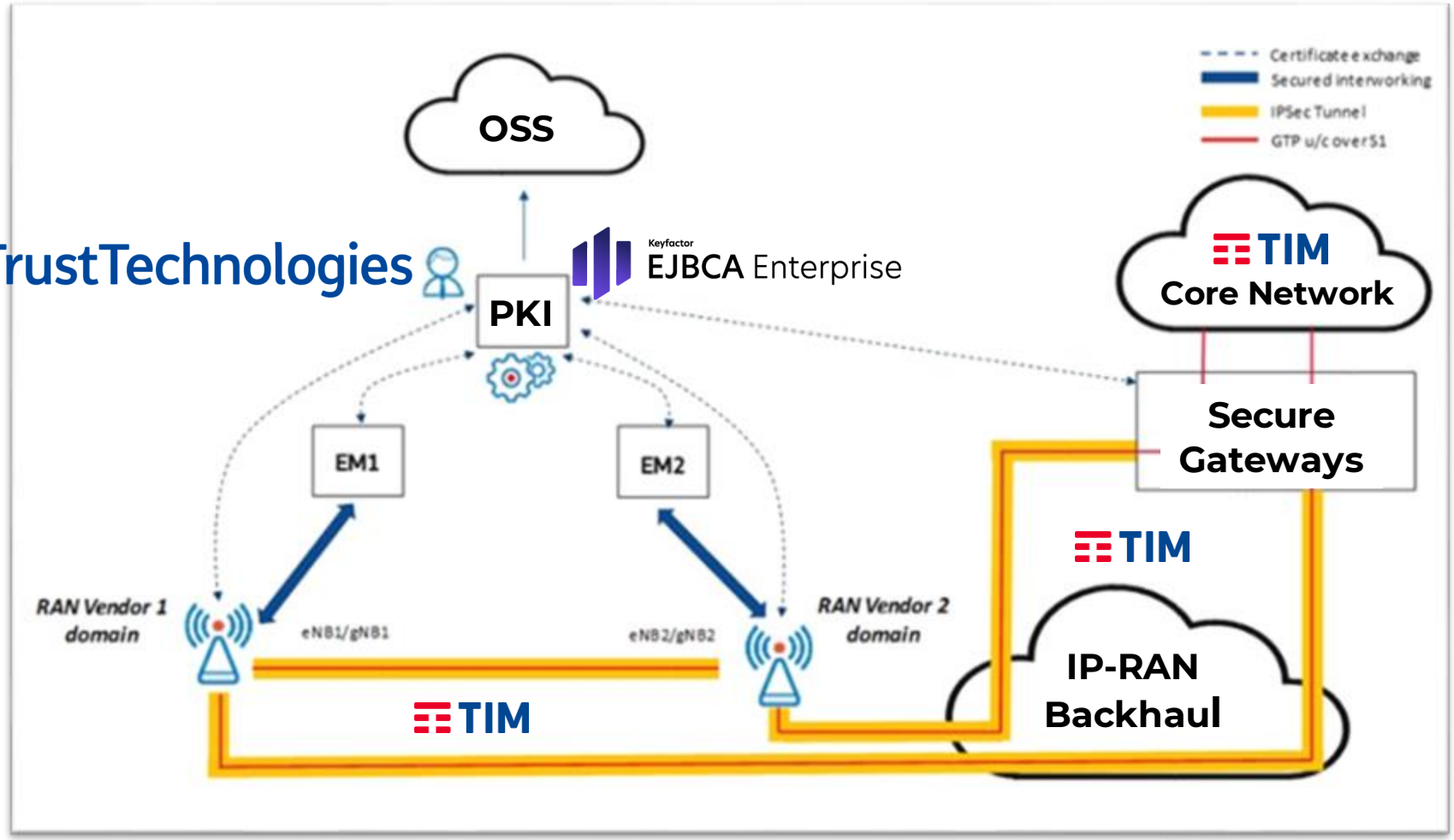


*Without additional security, the interface that carries user data has authentication mechanisms but **no encryption**.*

3GPP requires:

1. *Use of IPSec Encapsulated Security Payload Protocol (ESP)*
2. *Authentication IKEv2 based on **certificates** issued by a specific CA (**Operator CA**)*

PKI Service Model



..and some number:

- **70 security gateways**
- **55.000 base stations**
- **5 different vendors**

“

Better if done by a PKI specialist”

The QTSP

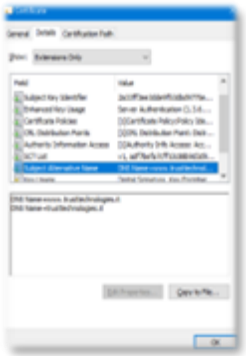
The **eIDAS** Regulation covers multiple types of electronic solutions at the European level and provides one single **framework** for electronic Identification (eID) and **trust services**.

A **QTSP** (**Q**ualified **T**rust **S**ervice **P**rovider) to provide qualified digital certificates under eIDAS has to guarantee at least:

- Infrastructures with physical security facilities

- Processes, procedures and compliance to rules and standards

- Deep knowledge of x.509 certificates profiles and HSM management



eIDAS Subject Identification

Subject Identification is the main duty of a CA.

With eIDAS, services identification can be done in sevaral ways

- De-visu (physical presence in front of a local Registration Authority)

- VideoID (remote identification using a dedicated video operator)

- E-ID (SPID) or Digital Signature (using existing Qualified Certificate)

The downside

“

I’m used to deal with persons, how should I trust devices ? “

“

CMPv2 does all the work for you ! ”

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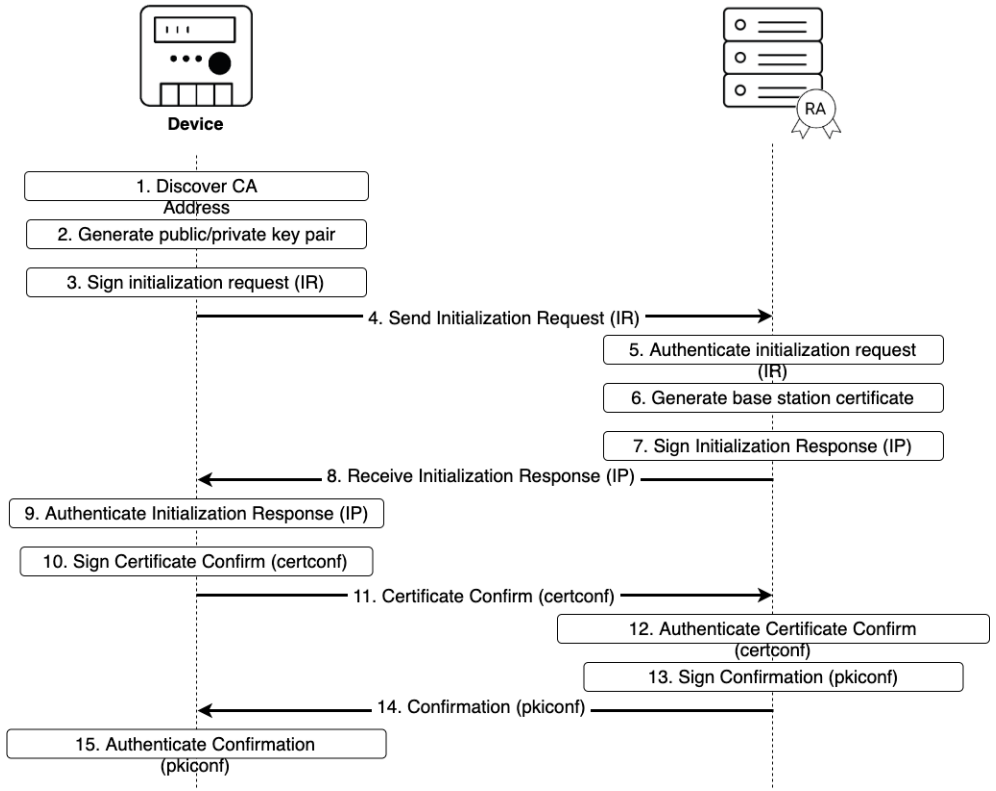
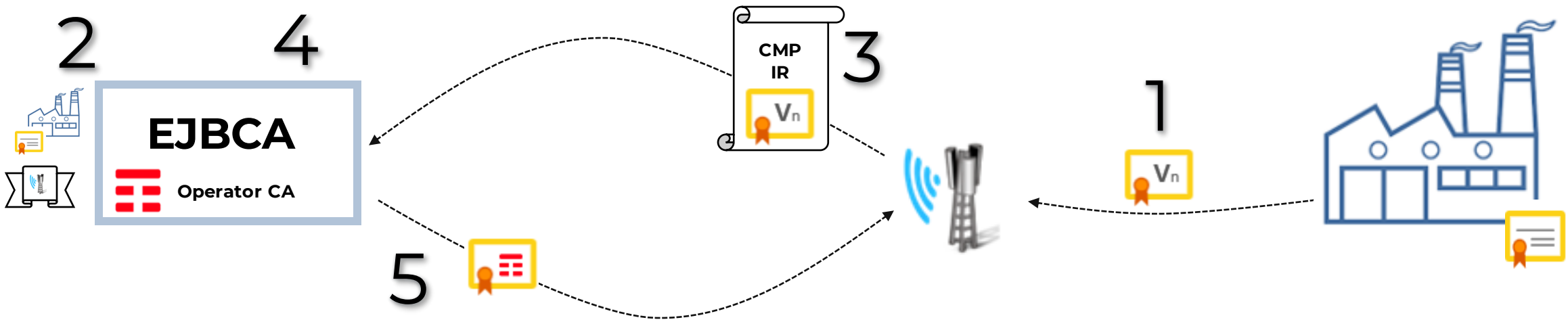
CMPv2 messages

CMPv2 (Certificate Management Protocol, specified in IETF RFC 4210) defines protocol messages for **X.509v3 certificate creation** and management.

- Initialization request (**IR**)
- Initialization response (**IP**)
- Certification confirm (**certConf**)
- Confirmation (**PKIconf**)
- ……



CMP – IR authentication



1 - Base station pre-provisioned with a private/public key pair and a certificate signed by a **Vendor CA**

2 - Issuing Operator CA configured to **trust** the certificate of the **Vendor CA** and the **DN** of the base station

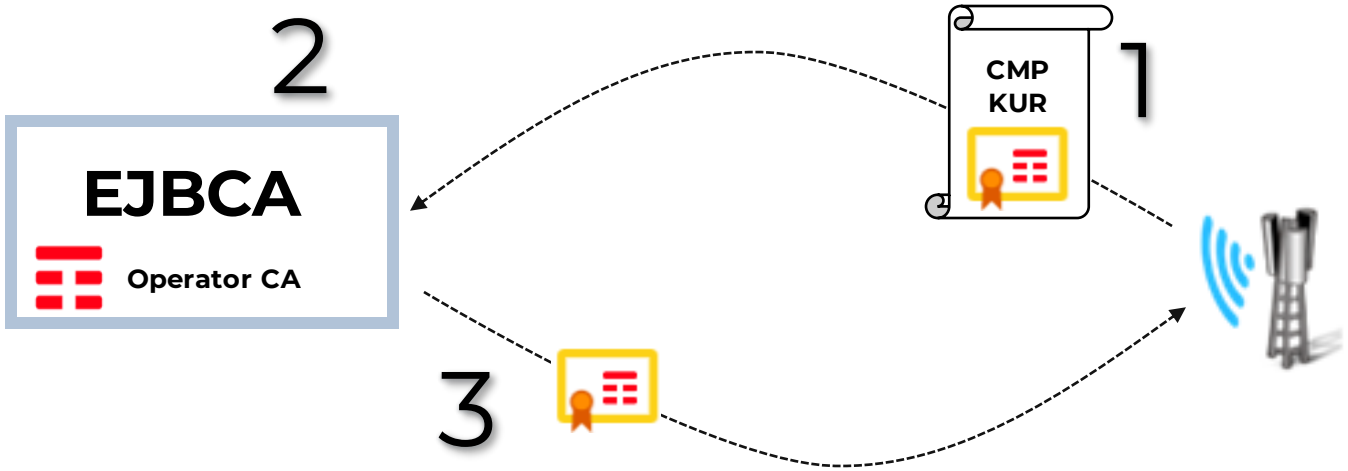
3 – Base station signs the **IR message** by the vendor provided certificate/key

4 - Operator CA **authenticate** initial certificate requests through:

a) Validation of IR signature up to Vendor CA certificate
b) Proof-of-possession of the private key
c) Validation of Identity (subjectDN) of end-entity

5 - Operator CA **issues** the end-entity certificate and sends it back to the base station

CMP – KUR authentication



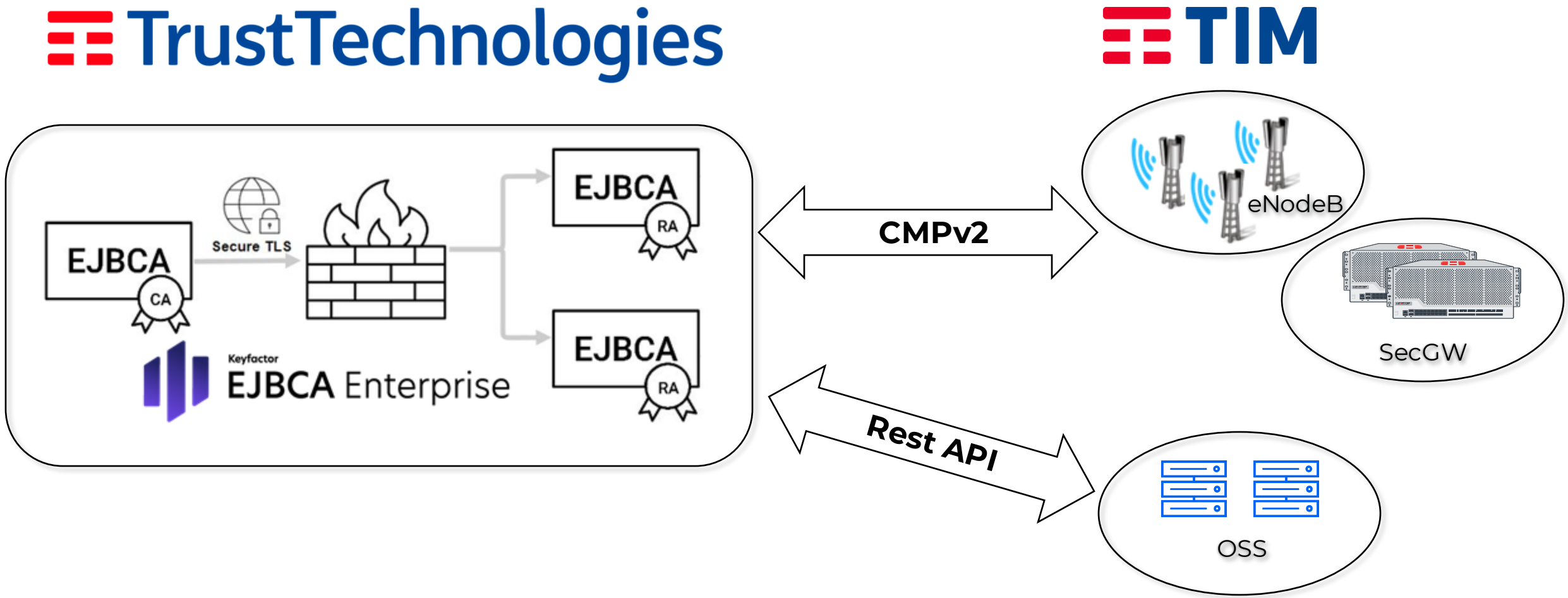
1 - Base station signs the **KUR message** by private key related to the last received operator base station certificate

2 - Operator CA **authenticate** key update certificate requests through:

a) Validation of KUR signature up to its (Operator) CA certificate
b) Proof-of-possession of the private key
c) Validation of Identity (subjectDN) of end-entity

3 - Operator CA **issues** the new end-entity certificate and sends it back to the base station

PKI Architecture and Roles

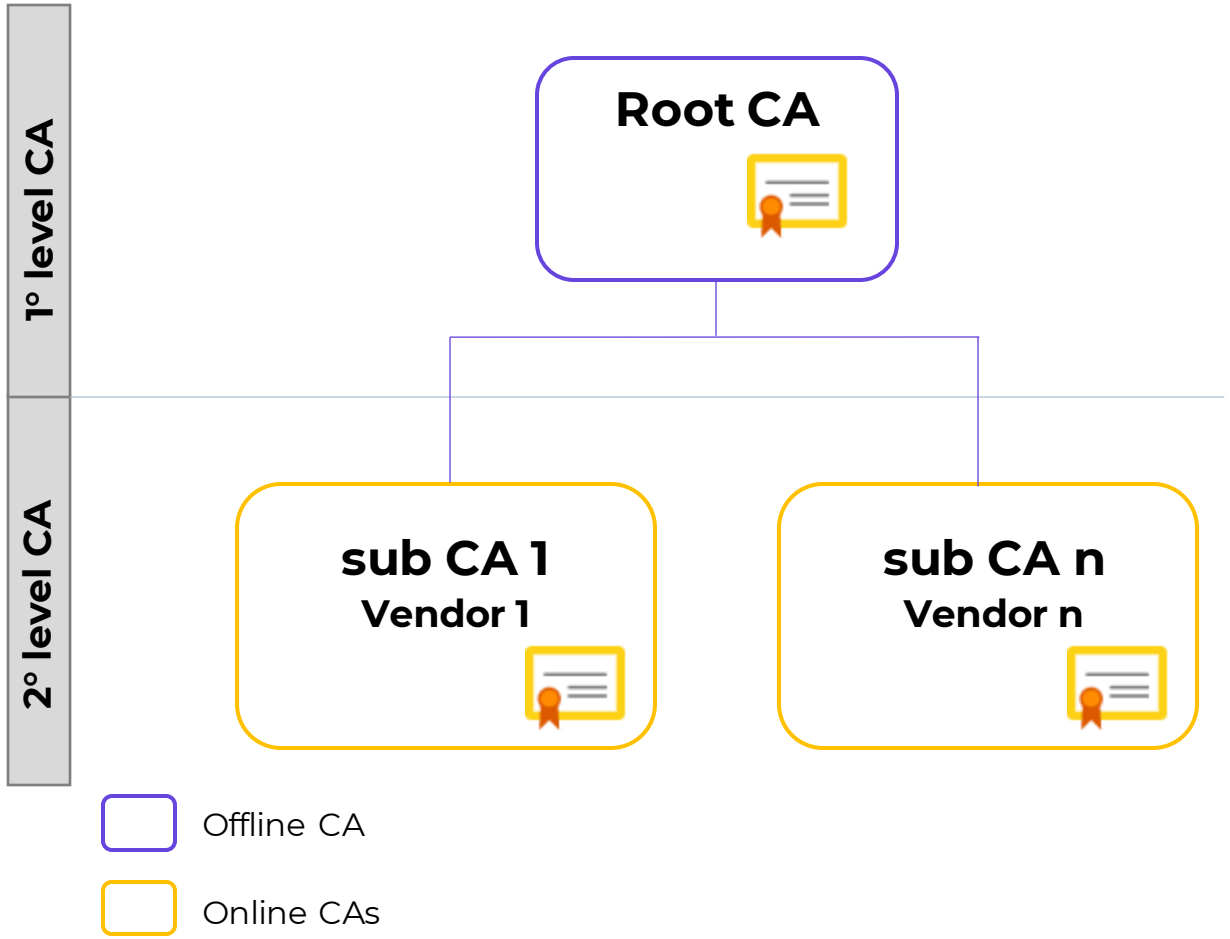


PKI Hierarchy

Operator Root CA

Operator Issuing Sub-CAs :

- Vendor 1 (***Secure Gateways***)
- Vendor 2 (***eNodeB***)
- ....
- .....
- Vendor n (***eNodeB***)



“

In an increasingly complex world, we all need certainty”

- Speed 20 GB/s
- Latency 1-4 ms
- Mobility Up to 500 Km/h
- 1 Mln device per Km2

Mobile Private Networks

Iot services

the same PKI service model can be applied

References

[**CMP**] IETF RFC 4210: "Internet X.509 Public Key Infrastructure Certificate Management Protocol"

[**3GPP**] TS 33.310 Network Domain Security (NDS); Authentication Framework (AF)

[**eIDAS**] Regulation (UE) n. 910/2014

CUSTOMER STORY (available on PrimeKey website) "*Powering 5G innovation through security, open standards and flexible integration*"

Thanks for your attention !