M-PIN AUTHENTICATION IN VEHICLE TRACKING

WITH APACHE MILAGRO.

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- APACHE MILAGRO IS COMPOSED OF :

1. A SELF CONTAINED CRYPTO LIBRARY FOR IOT.
2. A MULTIFACTOR AUTHENTICATION SERVER
3. A TLS SUBSYSTEM BASED ON DISTRIBUTED TRUSTED AUTHORITIES

https://milagro.incubator.apache.org/

APACHE MILAGRO: A DISTRIBUTED CRYPTOSYSTEM FOR IOT

PKI+Password authentication is just fine in normal environment.

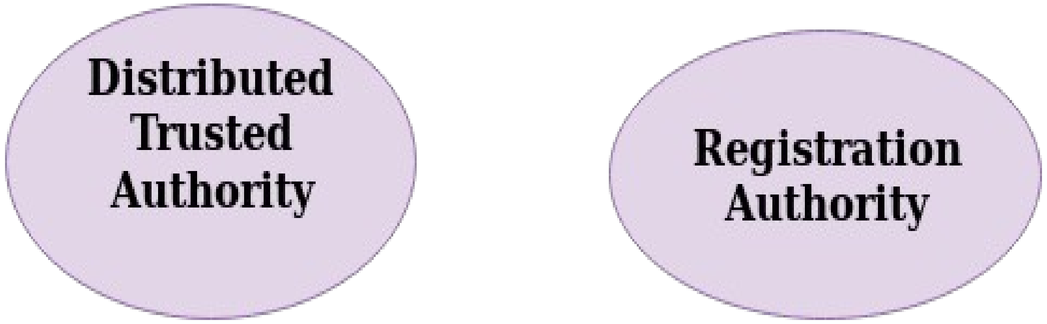
Our concerns with PKI in Internet of Things Environment:

1. Securing private keys in any device.
2. Updating Certificates before expirations in each client.
3. Dealing with certificate revocation.
4. CA are expensive. Our market has a lot of small companies.

AUTHENTICATION STATE OF ART : PKI + PASSWORD

HOW TO CHANGE:
THE ROAD FROM CA+PKI TO DTA+RA

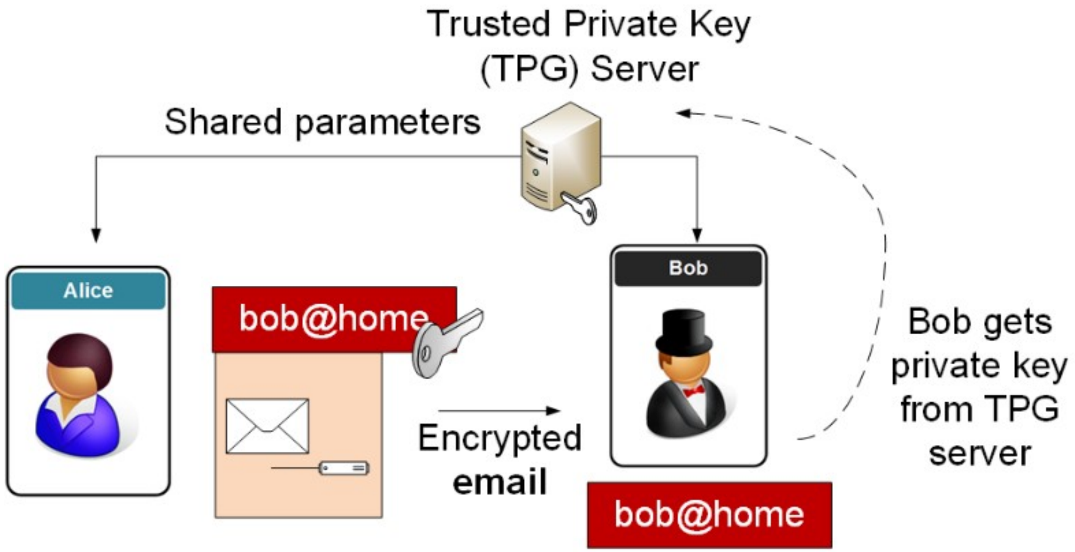
The idea is to decompose a CA in two distributed parts.



RA controls legitimate public key pairs in the System. RA is custom designed for each application.
Each **DTA** (Distributed Trusted Authority) assured the EC public keys with a master key.
Generally we have a set of DTA and the client use a part of the master key in order to **avoid a single part of compromise.**
Replication of DTA is enabled by a group of trusted professionals.

In order to succeed we need:

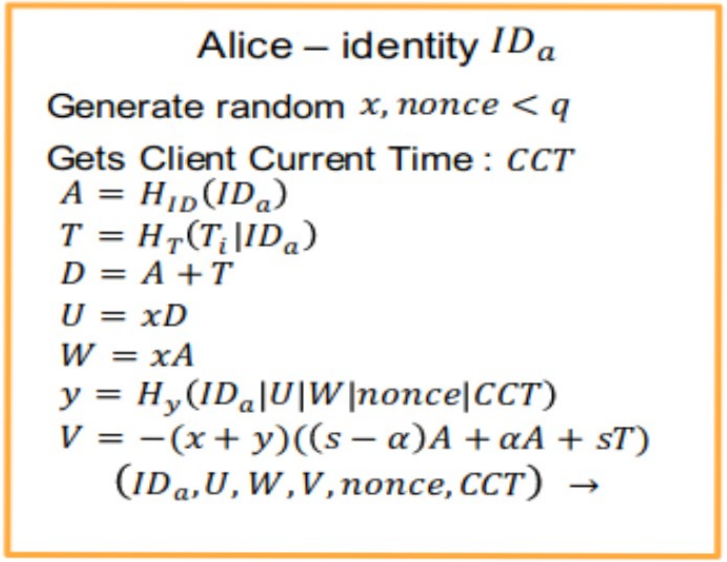
1. A mechanism for secure setup.
2. A mechanism for auth/revocation. Time Permits.
3. A mechanism to have a master distributed shared secret:
    1. Secrets are point of a elliptic curve.
    2. EC enable composition of keys.



Identity Based Encryption

HOW TO CHANGE. FROM CA+PKI TO DTA AND RA

MPIN PROTOCOL: HOW IT WORKS.



Alice – identity ID_a

Generate random $x, nonce < q$

Gets Client Current Time : CCT

$A = H_{ID}(ID_a)$

$T = H_T(T_i|ID_a)$

$D = A + T$

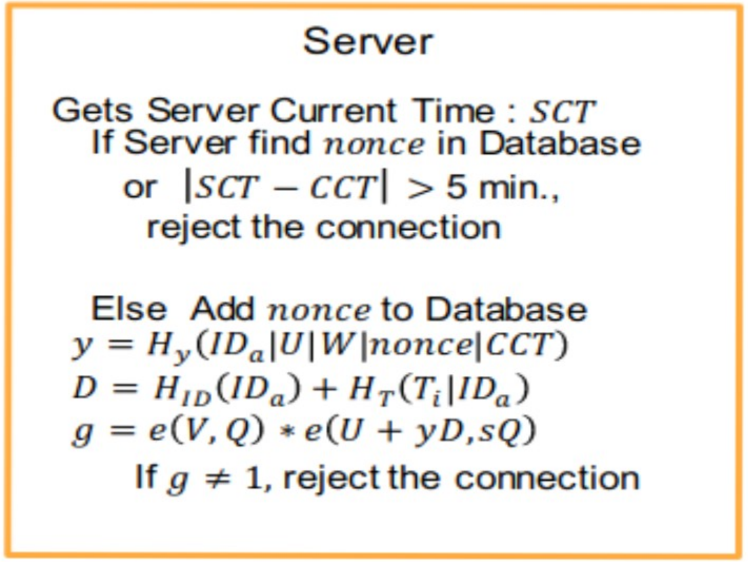
$U = xD$

$W = xA$

$y = H_y(ID_a|U|W|nonce|CCT)$

$V = -(x + y)((s - \alpha)A + \alpha A + sT)$

$(ID_a, U, W, V, nonce, CCT)$ →



Server

Gets Server Current Time : SCT

If Server find $nonce$ in Database

or $|SCT - CCT| > 5$ min.,

reject the connection

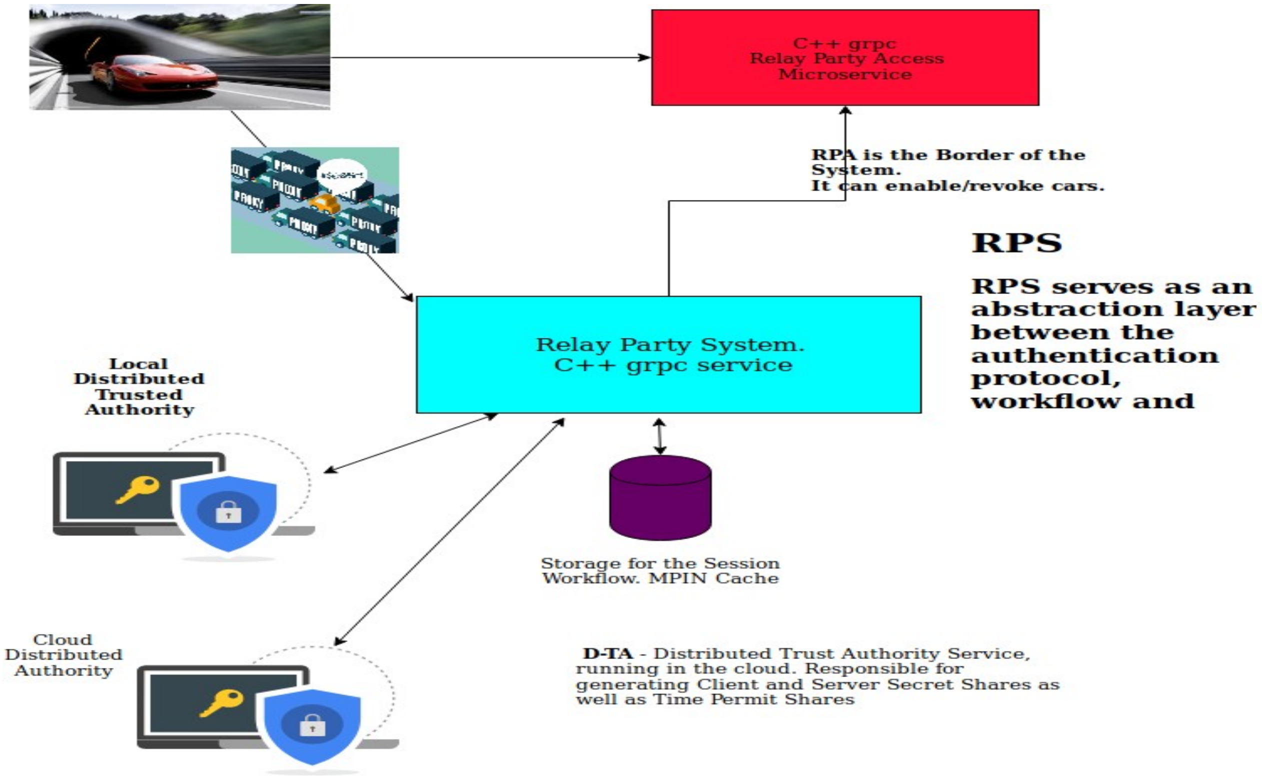
Else Add $nonce$ to Database

$y = H_y(ID_a|U|W|nonce|CCT)$

$D = H_{ID}(ID_a) + H_T(T_i|ID_a)$

$g = e(V, Q) * e(U + yD, sQ)$

If $g \neq 1$, reject the connection



C++ grpc
Relay Party Access
Microservice

RPA is the Border of the System.
It can enable/revoke cars.

RPS

RPS serves as an abstraction layer between the authentication protocol, workflow and

Relay Party System.
C++ grpc service

Local Distributed Trusted Authority

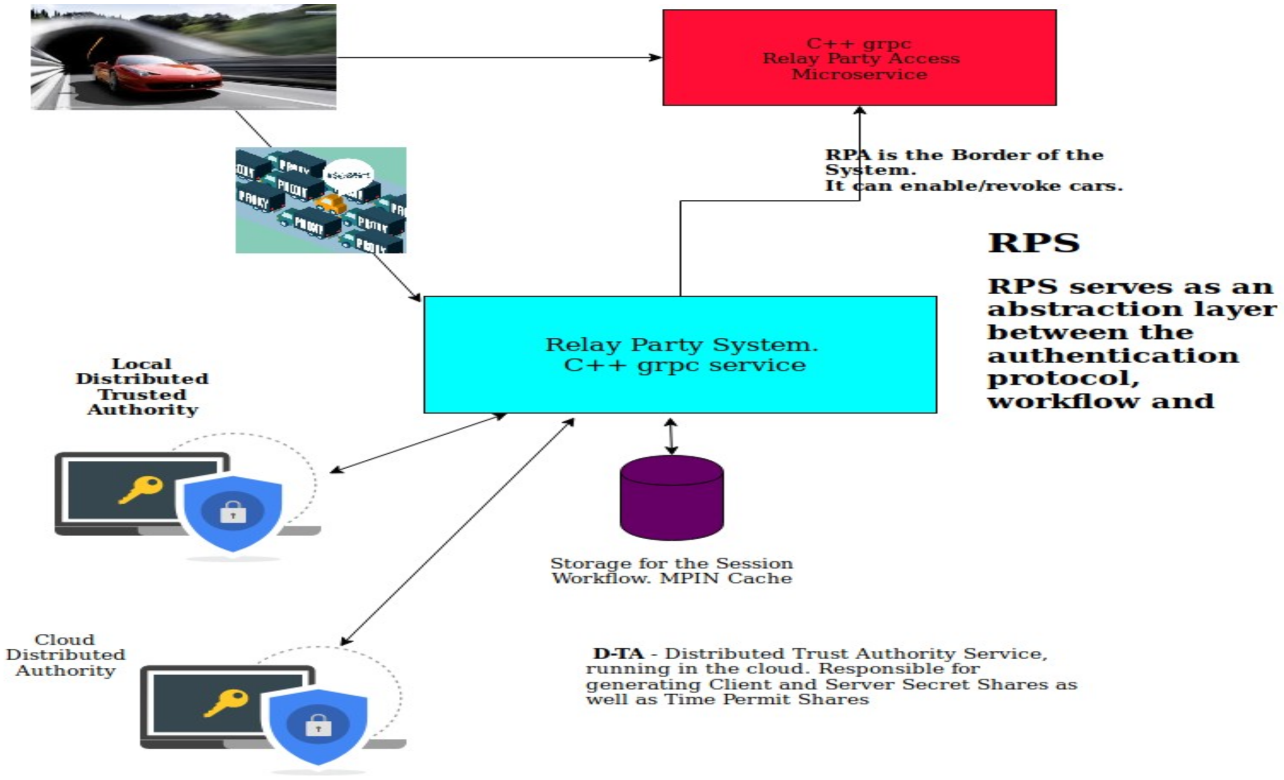
Storage for the Session Workflow. MPIN Cache

Cloud Distributed Authority

D-TA - Distributed Trust Authority Service, running in the cloud. Responsible for generating Client and Server Secret Shares as well as Time Permit Shares

CAR TRACKING AUTHENTICATION SUPPORT

MPIN VEHICLE SETUP PROCESS.



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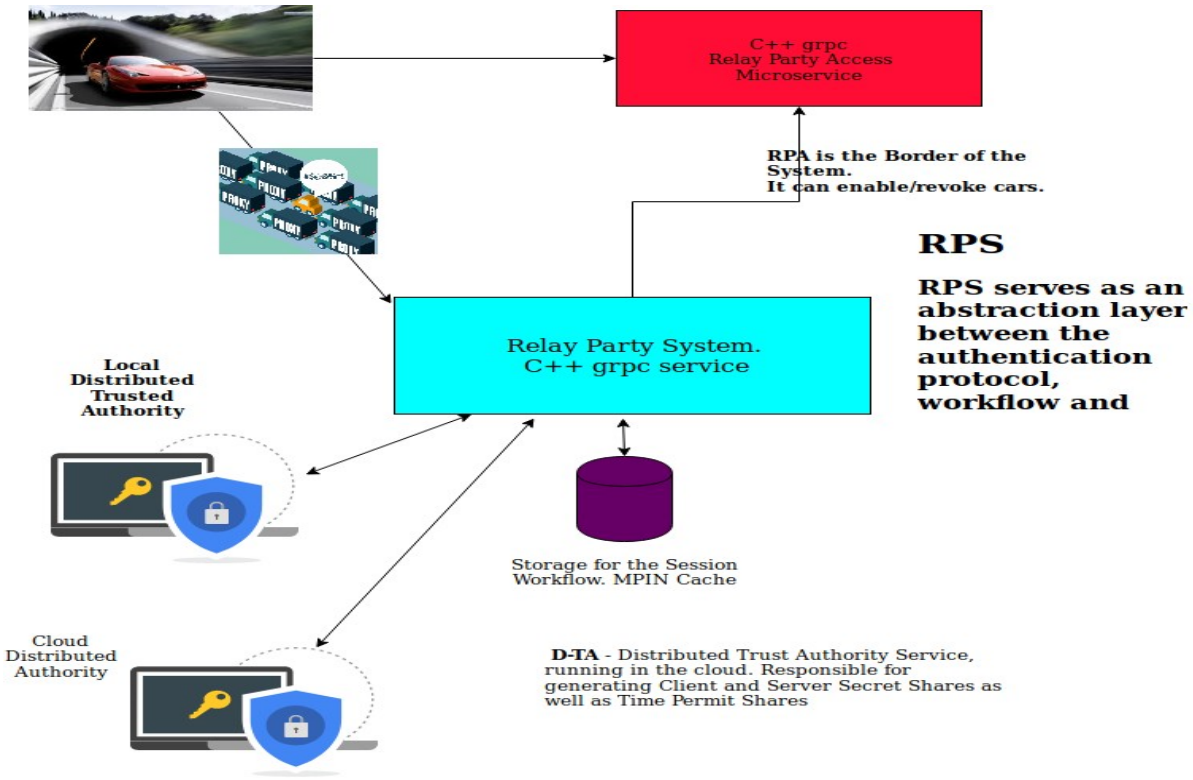
The purpose of the Setup:

1. Verify user identity.
2. Get the two shares of the client secret and combine them.
3. Create a MPIN.
4. Store the MPIN inside the car.

After the setup we can proceed to the authentication.

CAR TRACKING AUTHENTICATION



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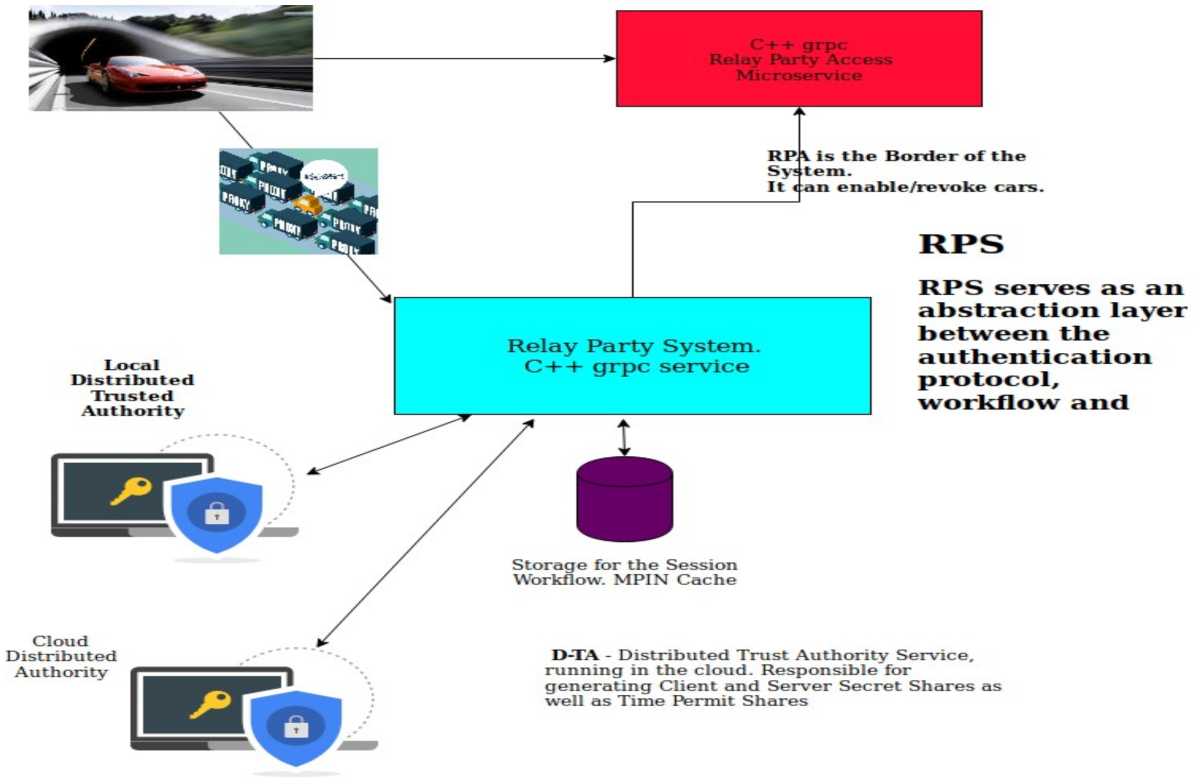
1. After the Car has been registered inside the DTA system, we can proceed. We assume that the Car has a valid token and a client secret used for signing messages.
2. The Car Initiate the authentication flow asking for a Time Permit to the for the tuple car identifier.

CAR TRACKING AUTHENTICATION



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1. The Vehicle initiate the authentication flow asking for a Time Permit to the for the tuple userId = (vehicle model, variant,brand, driverName).
2, The RPS consults the RPA if the user has been banned.

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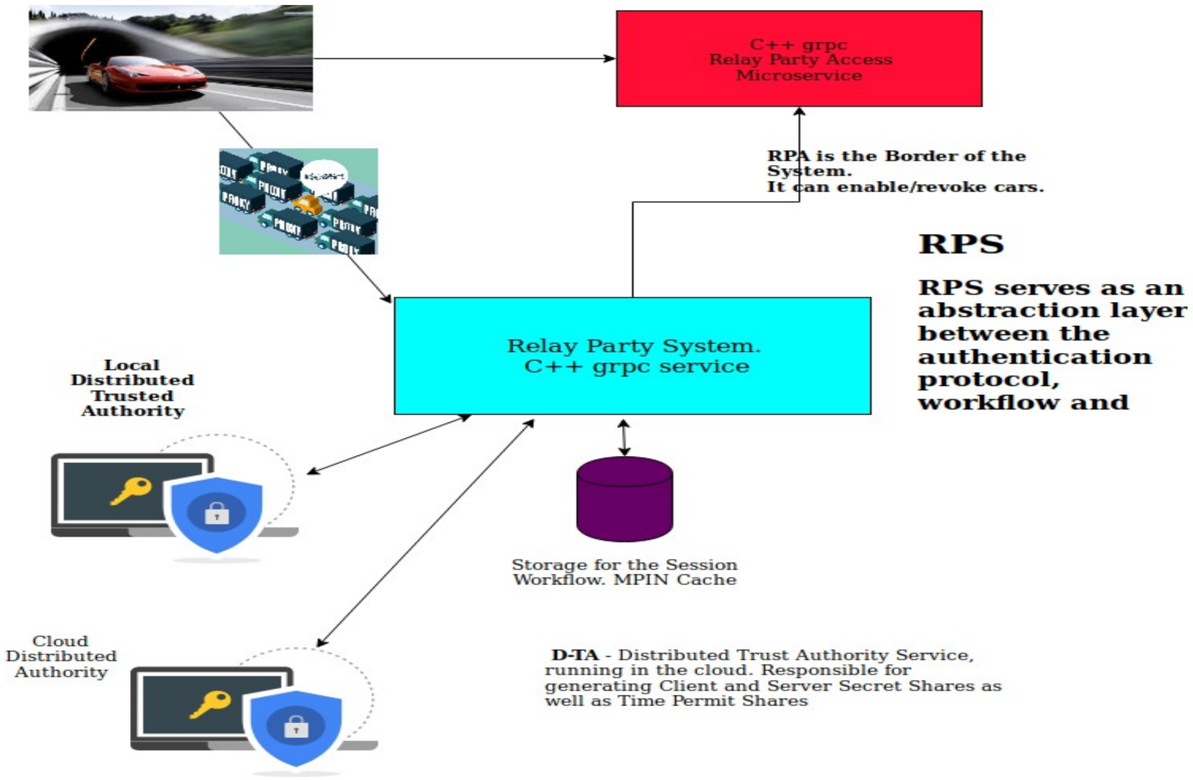

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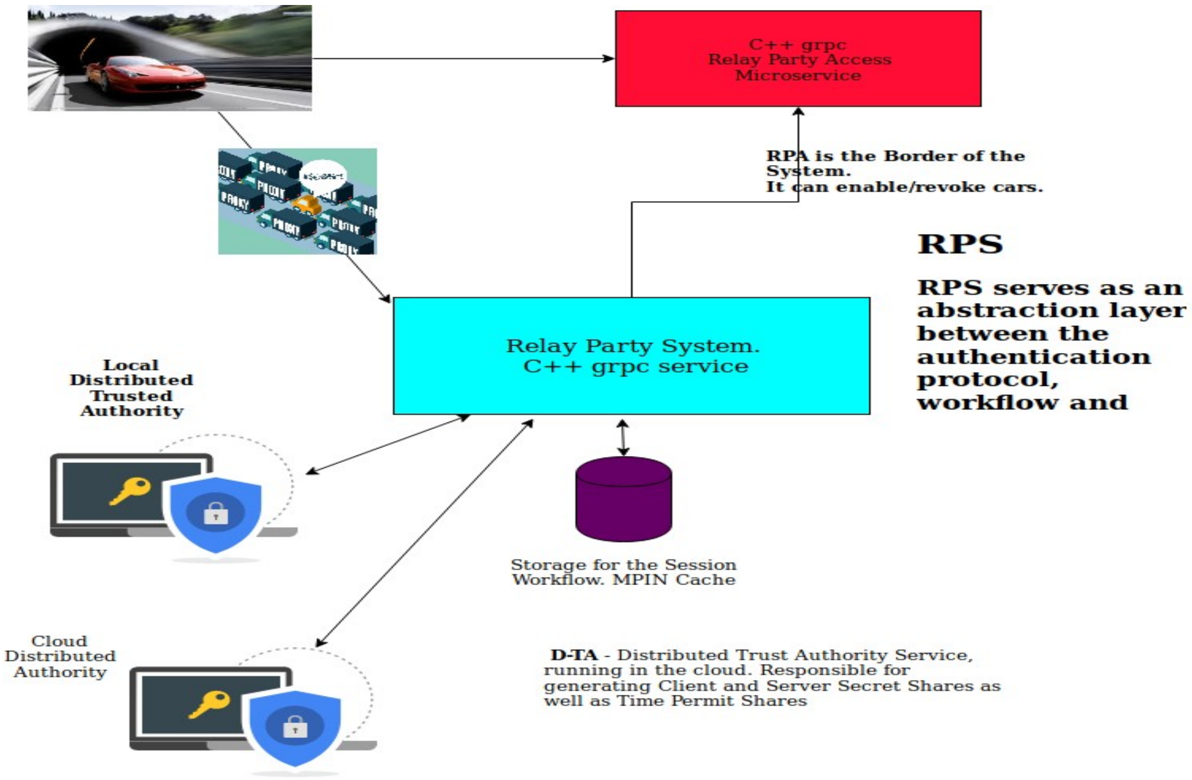

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4. RPS send back the time permit to the Vehicle.

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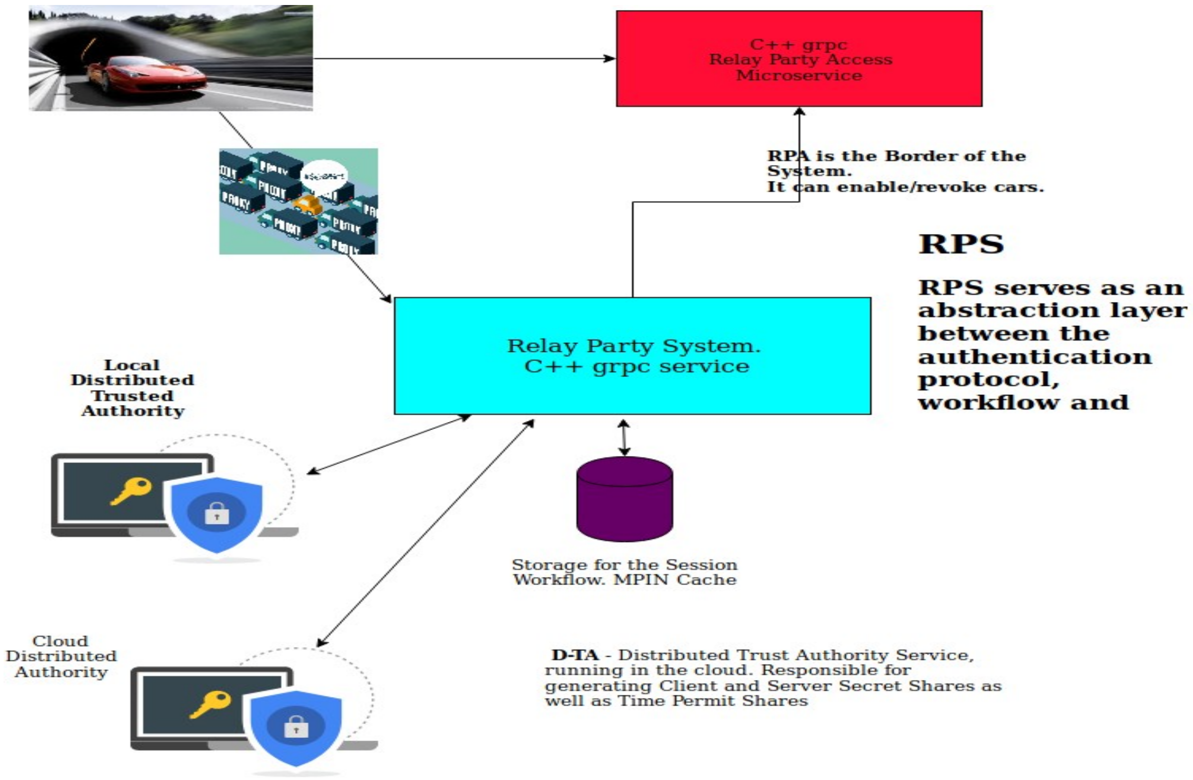

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3. The RPS consults DTAs for the composed time permit.

4. The RPS send back to the client.

5. The client starts the MPIN protocol.

THANK YOU

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