

# Blockchain for MAAS



**The Ninth International Conference on Smart Cities, Systems, Devices and  
Technologies  
SMART 2020**

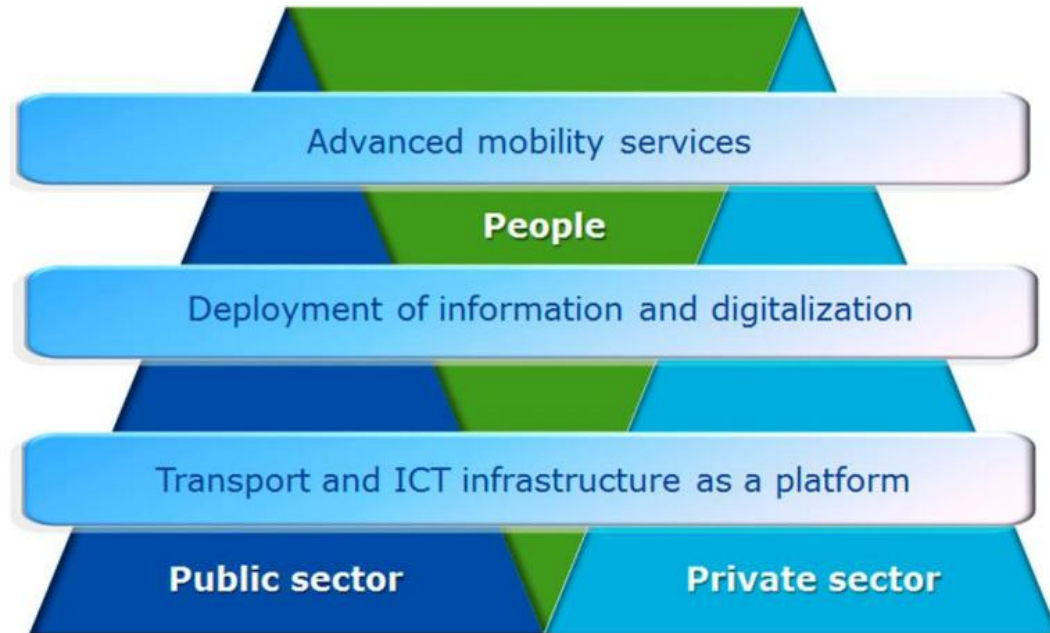
**September 27, 2020 to October 01, 2020 - Lisbon, Portugal**

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# About this paper

- This paper introduces blockchain services for Mobility As A Service (MAAS) infrastructures, allowing to use public or private modes of transport during a trip.
- The blockchain system interacts with three classes of blockchain accounts: User, MAAS, and transport operators.
- It details some possible scenari and associated transactions.
- It demonstrates that this concept is realistic with emerging and existing technologies.

# About MAAS



- The Mobility As A Service (MAAS, is an emerging concept, born in 2014 in Finland, allowing to use public or private modes of transport during a trip. It involves the unification of mobility services, and a fusion of ticketing and multimodal information tools.
- *"The ecosystem consists of the transport infrastructure, transportation services, transport information and payment services"*.

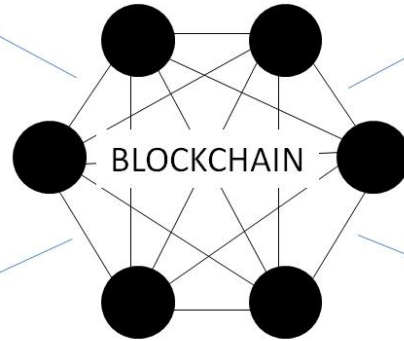
# About MAAS

- Many modes of transport are implemented such as bicycles, electric scooters, scooters, electric cars, buses, metro, and taxis.
- Some of them (generally private) rely on mobile applications associated with bank cards; others require tickets delivered by dedicated machines or subscription cards.
- In Helsinki, the WHIM app offers several subscriptions; for example a monthly package of 499 Euros, including unlimited public transport, taxis (up to 5 km), car-sharing and cycling.

@Transport  
Operator



@User



@MAAS



Transport  
Operator

# This Paper

MAAS: Mobility as a service

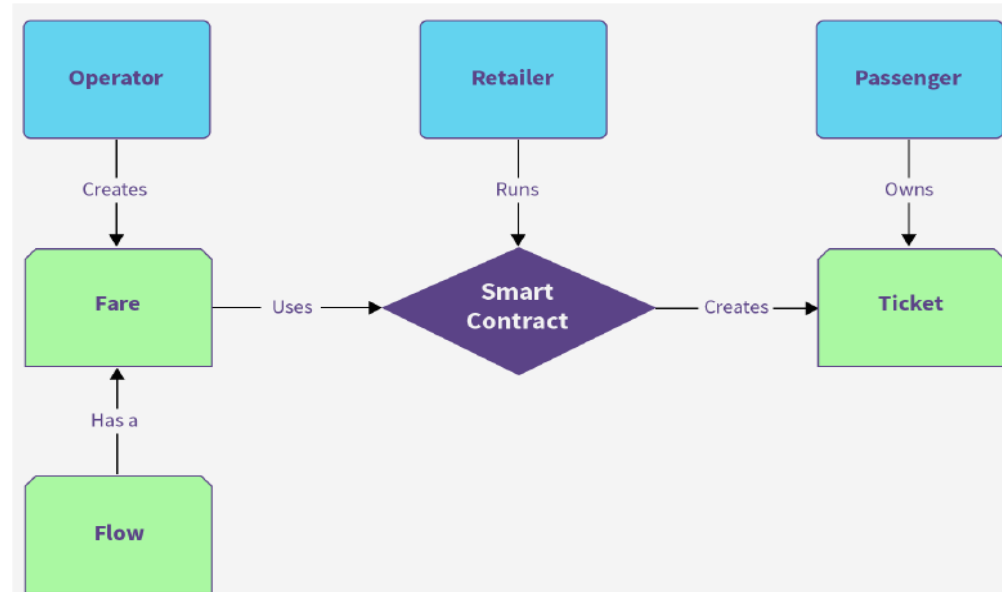
- In this paper we introduce the concept of blockchain services for MAAS.
- The MAAS is a federation of transport operators, managing ticketing services and validators.
- The main idea is to store these tickets in blockchain interacting with several entities (transport operator, user, MASS operators)

# About Blockchain

- The first blockchain was deployed in 2009 by Satoshi Nakamoto , an anonymous creator (or group of creators).
- Bitcoin has had remarkable success, with a price reaching \$20,000 at the end of 2017, for a valuation of \$ 340 billion.
- Originally the blockchain carried out the transfer of crypto currency, but since 2015, several platforms appeared, such as Ethereum or Hyperledger, which also allow the exchange of data or the execution of programs (smart contracts) charged in crypto currency.
- The services delivered by a blockchain are as follows:
  - Generation of signed transactions:
  - Gathering of transactions by a P2P (*Peer To Peer*) network;
  - Creation of transaction blocks by nodes of the P2P network.
  - Chaining a new block to the existing block list (the blockchain), according to a consensus mechanism such as PoW (*Proof of Work*) or PoS (*Proof of Stake*).

# Planar Networks

- Blockchain is by nature based on a consensus of players, and therefore could be the technological cornerstone of the new MAAS mobility, bringing together multiple players.
- An example of this concept is the "planar networks" project which uses Ethereum smart contracts, for implementation of universal ticketing system.



# The DOVU Project

- The creation of crypto currencies dedicated to MAAS is also an opportunity. The DOVU project deploys a crypto currency dedicated to multimodal mobility services.

The screenshot shows the DOVU website interface. At the top, the logo 'DOVU' is on the left, and a navigation menu with links 'HOME', 'TEAM', 'COMMUNITY', 'NEWS', 'CAREERS', 'RESOURCES', 'CONTACT', 'CN', and 'KR' is on the right. Below the navigation, there are four white panels, each with a title, an icon, and a description:

- EARN**: Icon of a hand holding coins. Description: "Earn DOV tokens for sharing your mobility data or making small but important changes to your travel behaviour."
- SPEND**: Icon of two overlapping circles. Description: "Spend your earned tokens on mobility related products or services within our ecosystem of selected partners."
- CREATE**: Icon of two hands shaking. Description: "Create your own tokenised mobility service with seamless peer to peer transfers between DOVU wallets."
- CONTROL**: Icon of two overlapping circles. Description: "Maintain control over the data you choose to share (and get rewarded for) with realtime access controls. Disable or remove access at any time."



# USE CASE

# VOTRE E-BILLET



PARIS MONT 1 ET 2 / RENNES

80.00 EUR  
CA

Nom : **URIEN**  
Prénom : **PASCAL**  
Voyageur : **ADULTE**

**DOSSIER VOYAGE : UGDQMN**  
Référence client : 0029090162200235586  
N° e-billet : 345654746



**Vous voyagez avec un tarif TGV Pro ou Fréquence :** retrouvez vos avantages Pro Flexi, Pro Express et Pro Mobile sur [sncf.com](https://www.sncf.com)

N° FCE IMT ATLANTIQUE BRETAGNE : C000K74

Départ / Arrivée	Date / Heure	TGV	TGV PRO-ECH/REMB INCLUS. CONDITIONS APRES DEPART
PARIS MONT 1 ET 2	11/02 à 09h57	<b>TRAIN N°8009</b> <b>VOITURE 09 - PLACE 27</b>	E-Billet valable uniquement sur ce train
RENNES	11/02 à 11h25	2e CLASSE / PLACE ASSISE FENETRE DUO	

Présence à quai obligatoire 2 mn avant départ.

i0CV UGDQMN 345654746 1211 13/07/1957 FRPMOFRRNS0 8009 11/02  
0029090162200235586 URIEN PASCAL 2FA000 00000

FA00

# Blockchain Ticket: user's identity is bound to a blockchain address

Legacy Ticket: QR CODE

i0CV UGDQMN 345654746  
1211 **13/07/1957**  
FRPMOFRRNS0 8009 11/02  
0029090162200235586  
**URIEN PASCAL**  
2FA000 00000

Blockchain Ticket

i0CV UGDQMN 345654746  
1211 FRPMOFRRNS0 8009  
11/02  
0029090162200235586  
**1f889b79e2e1d4c412b2eea5e**  
**5286e44884414b5** 2FA000  
00000

@User = **1f889b79e2e1d4c412b2eea5e5286e44884414b5**

# BlockChain Addresses

User Address : **1f889b79e2e1d4c412b2eea5e5286e44884414b5**

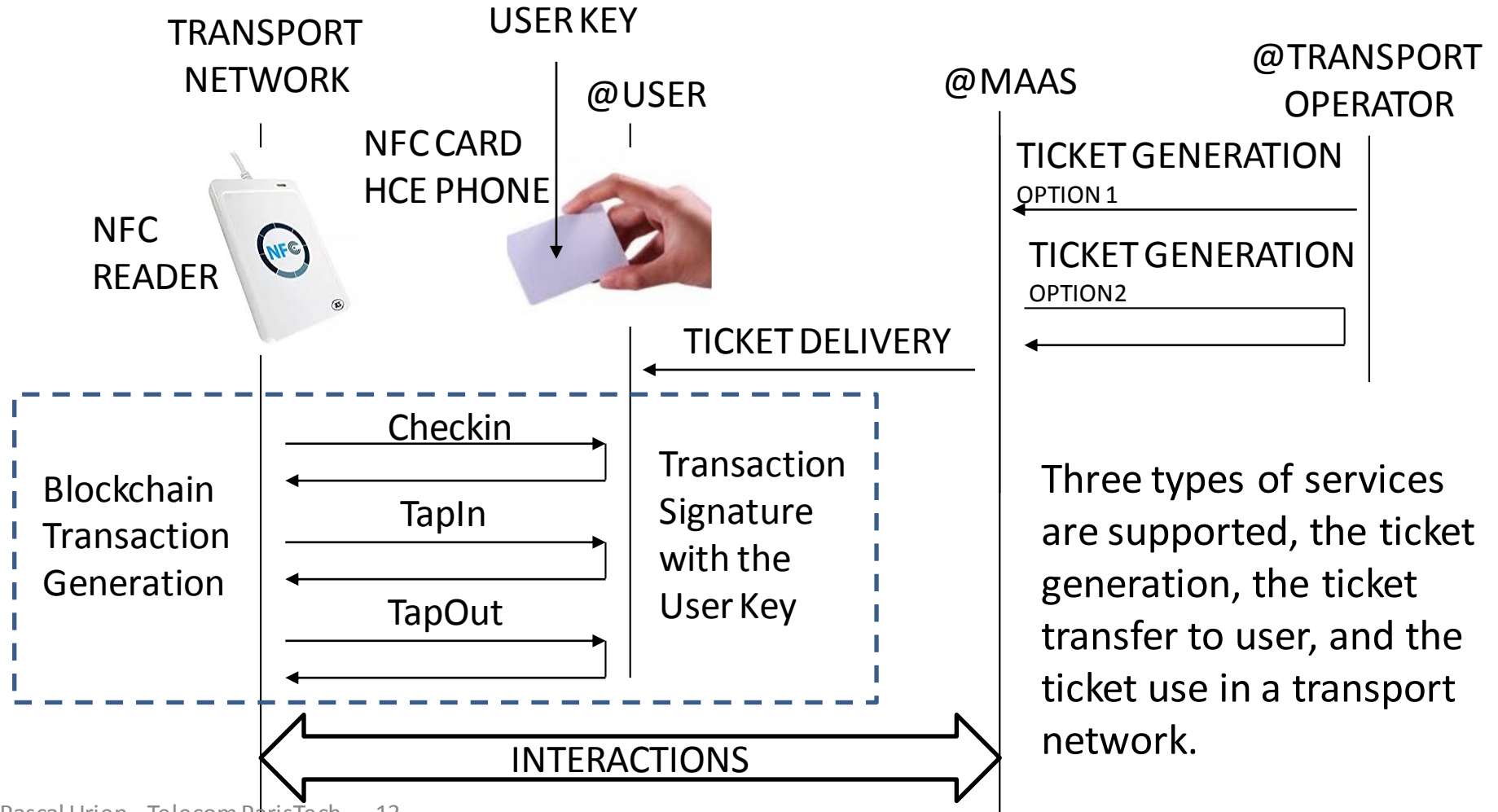
<https://ropsten.etherscan.io/address/0x1f889b79e2e1d4c412b2eea5e5286e44884414b5>

MAAS Address : **266ABe4B01CE1899100C36c3D33E872b52cb12D8**

<https://ropsten.etherscan.io/address/0x266ABe4B01CE1899100C36c3D33E872b52cb12D8>

TRANSPORT OPERATOR Address : **11baa7742ff512acc35b86d2c1b02391d533a4b2**

<https://ropsten.etherscan.io/address/0x11baa7742ff512acc35b86d2c1b02391d533a4b29>



# Ticket Generation & Transfer

# Option 1: Transport Operator Ticket Generation

## Transport Operator to MAAS

Transaction Hash:	0x8069bda915d10b60da37983c234497438166b005356633192fc24b24f741a567
Status:	Success
Block:	5042109 <span>3013600 Block Confirmations</span>
Timestamp:	477 days 31 mins ago (Feb-18-2019 08:56:05 AM +UTC)
From:	0x11baa7742ff512acc35b86d2c1b02391d533a4b2 @TransportOperator
To:	0x266abe4b01ce1899100c36c3d33e872b52cb12d8 @MAAS
Value:	0 Ether (\$0.00)
Transaction Fee:	0.00088092 Ether (\$0.000000)
Gas Limit:	60,000
Gas Used by Transaction:	29,364 (48.94%)
Gas Price:	0.00000003 Ether (30 Gwei)
Nonce	0 <span>Position</span> 1
Input Data:	0xi0CV UGDQMN 345654746 1211 FRPMOFRRNS0 8009 11/02 0029090162200235586 1f889b79e2e1d4c412b2eea5e5286e44884414b5 2FA000 00000

<https://ropsten.etherscan.io/tx/0x8069bda915d10b60da37983c234497438166b005356633192fc24b24f741a567>

# Option 2: MAAS Ticket Generation

## MAAS to MAAS

Transaction Hash:	0x64b915bab898c38953e488a10e9867ffaba35b933e7f64cb508a200146b41ed5	
Status:	<span>Success</span>	
Block:	5039041	3016706 Block Confirmations
Timestamp:	477 days 11 hrs ago (Feb-17-2019 09:39:48 PM +UTC)	
From:	0x266abe4b01ce1899100c36c3d33e872b52cb12d8	@MAAS
To:	0x266abe4b01ce1899100c36c3d33e872b52cb12d8	@MAAS
Value:	0 Ether	(\$0.00)
Transaction Fee:	0.00088092 Ether	(\$0.000000)
Gas Limit:	60,000	
Gas Used by Transaction	29,364 (48.94%)	<a href="https://ropsten.etherscan.io/tx/0x64b915bab898c38953e488a10e9867ffaba35b933e7f64cb508a200146b41ed5">https://ropsten.etherscan.io/tx/0x64b915bab898c38953e488a10e9867ffaba35b933e7f64cb508a200146b41ed5</a>
Gas Price:	0.00000003 Ether (30 Gwei)	
Nonce	2	0
Input Data:	<pre>0xi0CV UGDQMN 345654746 1211 FRPMOFRRNS0 8009 11/02 0029090162200235586 1f889b79e2e1d4c412b2eea5e5286e44884414b5 2FA000 00000</pre>	



# Ticket Transfer To User

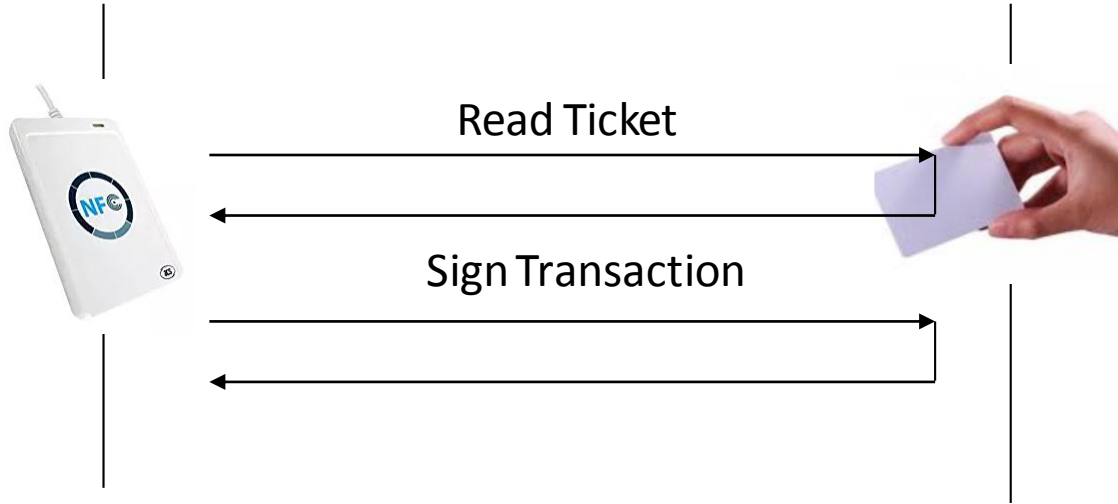
Transaction Hash:	0xaabaed08f4f87896f6d1aed70b01da025f06d0feba62eb60f58068bed2fc1dbc
Status:	Success
Block:	5038990 <span>3016894 Block Confirmations</span>
Timestamp:	477 days 12 hrs ago (Feb-17-2019 09:28:20 PM +UTC)
From:	0x266abe4b01ce1899100c36c3d33e872b52cb12d8 @MAAS
To:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5 @User
Value:	0.01 Ether (\$0.00)
Transaction Fee:	0.00087888 Ether (\$0.000000)
Gas Limit:	60,000
Gas Used by Transaction:	29,296 (48.83%) <a href="https://ropsten.etherscan.io/tx/0x611fb4a116c715cb6b16add7c0b61d0bf414070de5872a512364fc88bb310118">https://ropsten.etherscan.io/tx/0x611fb4a116c715cb6b16add7c0b61d0bf414070de5872a512364fc88bb310118</a>
Gas Price:	0.00000003 Ether (30 Gwei)
Nonce	1 <span>Position</span> <span>2</span>
Input Data:	<pre>0xi0CV UGDQMN 345654746 1211 FRPMOFRRNS0 8009 11/02 0029090162200235586 f889b79e2e1d4c412b2eea5e5286e44884414b5 2FA000 00000</pre>

# Ticket Use

# Ticket Use

- The user is equipped with a Near Field Communication (NFC) card or a Host Card Emulation (HCE) smartphone. The NFC card (possibly virtual) hosts the private key associated to the blockchain account, and is able of carrying out the transaction signature
- In an off-line approach (*Checkin* scenario, the NFC card stores a ticket linked to an address, whose authenticity is proven by a signature, calculated using the private key. The user's blockchain address can be associated with a certificate issued by the MAAS, if a static authentication mechanism (off-line) is required.
- In an on-line approach (*TapIn, TapOut* scenario), similar to payment by contactless bank card in the London Underground, proof of customer identity is required at the start and end of the mobility service. The ticket (or contract) can be stored in the MAAS account, or paid by using a dedicated crypto currency.

# CheckIn Scenario

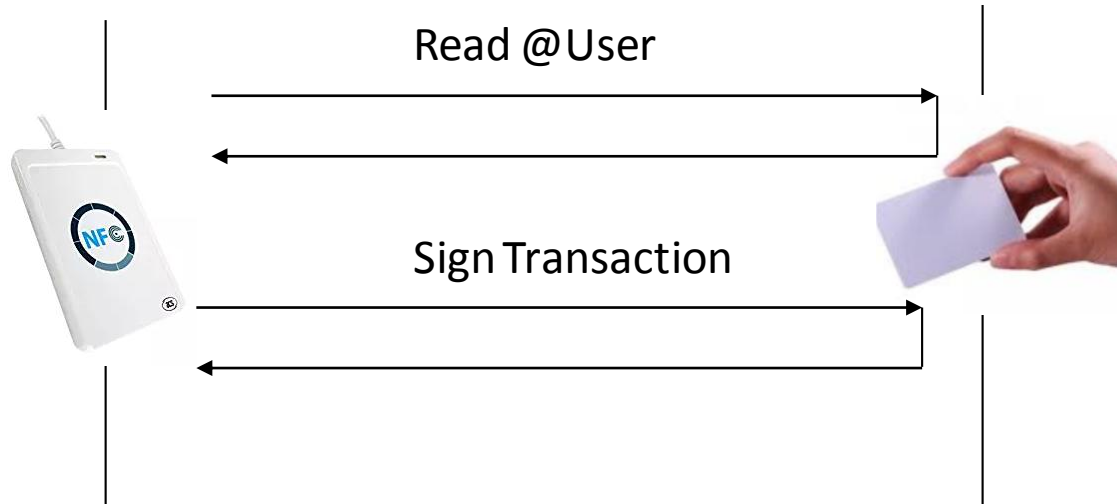


# CheckIn: User to MAAS

Transaction Hash:	0x43f620407a4fcd205aed8400c9f651fbc3493127109e5e7c1173f23b1a551684	
Status:	Success	
Block:	5039184	3017021 Block Confirmations
Timestamp:	477 days 13 hrs ago (Feb-17-2019 10:11:28 PM +UTC)	
From:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5	@User
To:	0x266abe4b01ce1899100c36c3d33e872b52cb12d8	@MASS
Value:	0 Ether (\$0.00)	
Transaction Fee:	0.00088092 Ether	(\$0.000000)
Gas Limit:	40,000	
Gas Used by Transaction:	29,364 (73.41%)	
Gas Price:	0.00000003 Ether (30 Gwei)	
Nonce	Position	21
Input Data:	<pre>0xi0CV UGDQMN 345654746 1211 FRPMOFRRNS0 8009 11/02 0029090162200235586 1f889b79e2e1d4c412b2eea5e5286e44884414b5 2FA000 00000</pre>	

<https://ropsten.etherscan.io/tx/0x43f620407a4fcd205aed8400c9f651fbc3493127109e5e7c1173f23b1a551684>

# TapIn-TapOut Scenario



# User TapIn: User to User

Transaction Hash:	0x91c75910254456b906d3aa26d7610f354efe96bd0a626fb2cbdbb21acd7c5874	
Status:	Success	
Block:	5039126	3017119 Block Confirmations
Timestamp:	477 days 13 hrs ago (Feb-17-2019 09:58:46 PM +UTC)	
From:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5	@User
To:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5	@User
Value:	0 Ether (\$0.00)	
Transaction Fee:	0.00069732 Ether (\$0.000000)	
Gas Limit:	40,000	
Gas Used by Transaction:	23,244 (58.11%)	<a href="https://ropsten.etherscan.io/tx/0x91c75910254456b906d3aa26d7610f354efe96bd0a626fb2cbdbb21acd7c5874">https://ropsten.etherscan.io/tx/0x91c75910254456b906d3aa26d7610f354efe96bd0a626fb2cbdbb21acd7c5874</a>
Gas Price:	0.00000003 Ether (30 Gwei)	
Nonce	19	1
Input Data:	0xHello Projet Transport Blockchain	

# User TapOut: User To User

Transaction Hash:	0xc67248fb8244d8f388a28ff2e7fe6af00b9bca48fa6f10abcc8f8eb5a01ff670	
Status:	Success	
Block:	5039145	3017137 Block Confirmations
Timestamp:	477 days 13 hrs ago (Feb-17-2019 10:03:39 PM +UTC)	
From:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5	@User
To:	0x1f889b79e2e1d4c412b2eea5e5286e44884414b5	@User
Value:	0 Ether (\$0.00)	
Transaction Fee:	0.00069732 Ether	(\$0.000000)
Gas Limit:	40,000	
Gas Used by Transaction:	23,244 (58.11%)	<a href="https://ropsten.etherscan.io/tx/0xc67248fb8244d8f388a28ff2e7fe6af00b9bca48fa6f10abcc8f8eb5a01ff670">https://ropsten.etherscan.io/tx/0xc67248fb8244d8f388a28ff2e7fe6af00b9bca48fa6f10abcc8f8eb5a01ff670</a>
Gas Price:	0.00000003 Ether (30 Gwei)	<a href="https://ropsten.etherscan.io/tx/0xc67248fb8244d8f388a28ff2e7fe6af00b9bca48fa6f10abcc8f8eb5a01ff670">https://ropsten.etherscan.io/tx/0xc67248fb8244d8f388a28ff2e7fe6af00b9bca48fa6f10abcc8f8eb5a01ff670</a>
Nonce	Position	20
Input Data:	0xHello Projet Transport Blockchain	



# Questions ?



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