4 June 2019

ECB/BOJ joint research project on distributed ledger technologies
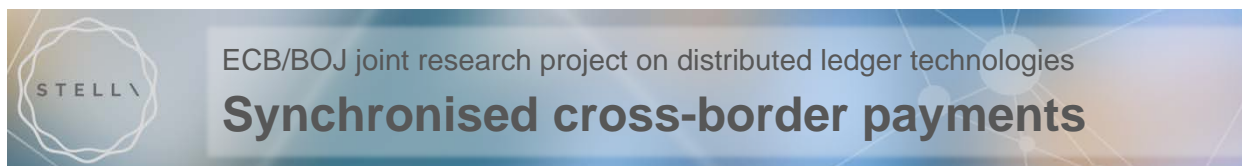**Synchronised cross-border payments**
STELLA

Background to Project Stella

The emergence of distributed ledger technologies (DLT) in recent years has spurred discussions around the future of financial market infrastructures (FMI) supporting payments and securities settlement. Since its inception in December 2016, Project Stella, a joint research project of the European Central Bank (ECB) and the Bank of Japan (BOJ), has contributed to the ongoing debate with experimental work and conceptual studies exploring DLT's opportunities and challenges for FMI.[1] This work has already resulted in two reports. Phase 1, published in September 2017[2], analysed the processing of large-value payments using DLT, and phase 2, published in March 2018[3], investigated securities delivery versus payment in a DLT environment. The latest phase of Project Stella, "Synchronised cross-border payments," builds on the insights gained from the previous two phases to bring our research into the broader sphere of cross-border payments.

Scope of Stella phase 3

Cross-border payments are payments between currency areas that involve various entities across multiple jurisdictions. Compared with domestic payments, they are often characterised as slow and costly. While initiatives exist to address these current inefficiencies of cross-border payments, the safety aspects of transactions across payment ledgers remain a challenge (see Box A). In view of this, Stella phase 3 explores whether cross-border payments could potentially be improved, especially in terms of safety by using new technologies.
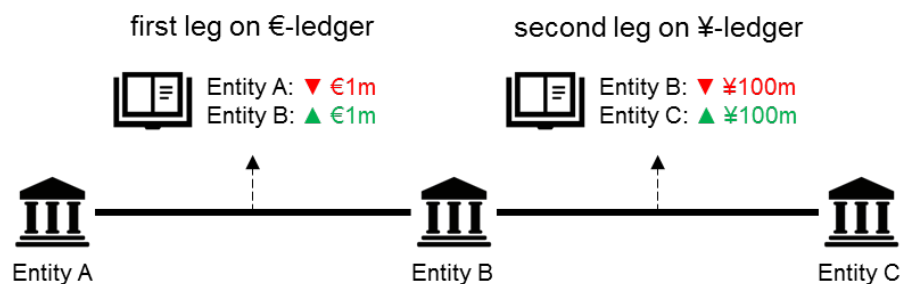
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[1] The analysis and experimental results presented in Project Stella are not geared towards replacing or complementing existing arrangements, which include central bank-operated payment systems. Moreover, legal and regulatory aspects are outside the scope of the project.

[2] *Payment systems: liquidity saving mechanisms in a distributed ledger environment*, ECB and BOJ, September 2017.

[3] *Securities settlement systems: delivery-versus-payment in a distributed ledger environment*, ECB and BOJ, March 2018.

Box A – Simplified example of credit risk arising from cross-border funds transfer

Credit risk might arise if a party fails prior to completion of a cross-border transfer. In this simplified example, Entity A intends to send ¥100 million to Entity C by sending €1 million to Entity B (e.g. an intermediary bank), which has access to both euro and yen ledgers, and in turn sends ¥100 million on behalf of Entity A. If Entity B fails after the first leg of the transfer is complete (i.e. the €1m-transfer from A to B) but before the second leg of the transfer is complete, Entity A faces the risk of loss of its funds. This risk can be mitigated if the payments are synchronised and funds are locked, but in today's world such synchronisation rarely happens.

first leg on €-ledger

Entity A: ▼ €1m
Entity B: ▲ €1m

second leg on ¥-ledger

Entity B: ▼ ¥100m
Entity C: ▲ ¥100m

Entity A   Entity B   Entity C

Approach taken in Stella phase 3

Stella phase 3 builds on the previous two stages of Project Stella. This is particularly so of Stella phase 2, which identified a new approach for settlement across ledgers through Hashed Timelock Contracts (HTLC) that could potentially allow the mitigation of credit risks through the synchronisation of settlement. Stella phase 3 expands the scope of this analysis and investigates the safety and efficiency of a variety of payment methods that could be used in cross-ledger payments[4]. Payment methods are thereby understood as specific bilateral agreements between counterparties to settle obligations (see Box B). Experiments conducted in phase 3 involved synchronised payments between DLT ledgers, between centralised ledgers and between DLT and centralised ledgers.
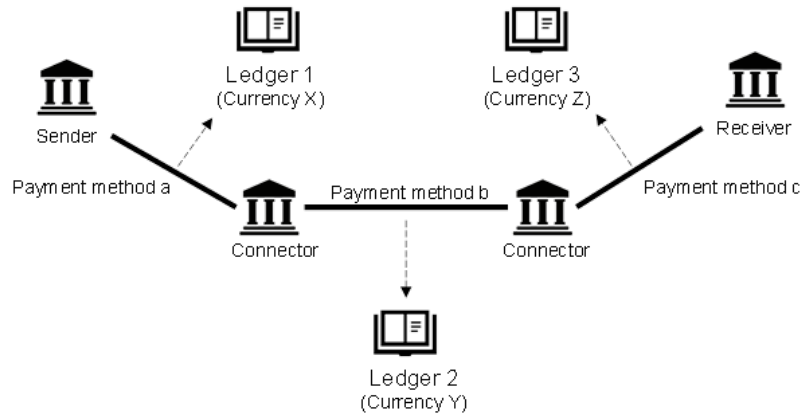
Main results of Stella phase 3

The report concludes that only payment methods with an enforcement mechanism, either through the ledger itself or through a third party, can ensure that the transacting parties who completely satisfy their responsibilities in the transaction process are not exposed to the risk of incurring a loss on the principal amount being transferred.

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[4]   Five methods are assessed in Stella phase 3: trustlines, on-ledger escrow using HTLC, third-party escrow, simple payment channels, and conditional payment channels with HTLC.

Box B – Stylised payment chain constituting a cross-border payment

A cross-border payment chain is composed of a series of bilateral payments (between the Sender and the Connector, between Connectors, and between the Connector and the Receiver) that are synchronised via a cryptographic condition. Some of the payment methods explored in Stella phase 3, for example, use a smart contract to enforce a conditional payment, whereby funds are temporarily locked until a cryptographic condition for the payment is fulfilled. When the condition is fulfilled, payment of the locked fund is executed.

Ledger 1
(Currency X)

Ledger 3
(Currency Z)

Sender

Receiver

Payment method a

Payment method b

Payment method c

Connector

Connector

Ledger 2
(Currency Y)

In addition, experiments applying a payment method with HTLC[5] proved the technical feasibility of synchronised settlement between different types of ledgers, including settlement between DLT and centralised ledgers. In conclusion, from a technical perspective, the safety of today's cross-border payments could potentially be improved by using payment methods that synchronise payments and lock funds along the payment chain. It should, however, be noted that further reflections on legal and compliance issues, the maturity of the technology and a cost-benefit analysis would be required before the possible implementation of such new methods could be considered.

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[5] The experiment was conducted for on-ledger escrow using HTLC.