



Interledger

Chicago Payments Symposium

Stefan Thomas





135

Team members
 $\frac{2}{3}$ engineering talent

Our Experience

Financial Services

JP. Morgan
Citi
Merrill Lynch
BlackRock
Visa
Fiserv
Paypal
Prosper

Technology

Google
Apple
Yahoo
Bloomberg
NASA

Regulation

Federal Reserve
SEC
DTCC
NSA



San Francisco | NYC | London | Sydney | Luxembourg

Board & Advisors — Deep Industry Expertise



Gene Sperling
White House



Susan Athey
Microsoft, Stanford



Karen Gifford
NY Federal Reserve



Donald Donahue
DTCC



Michael Barr
Dept. of Treasury



Interledger

The protocol for connecting ledgers.



Interledger

- White paper released in October 2015
- Open standard for connecting any type of ledger
- W3C Community Group with 220+ members



What are we trying to solve?



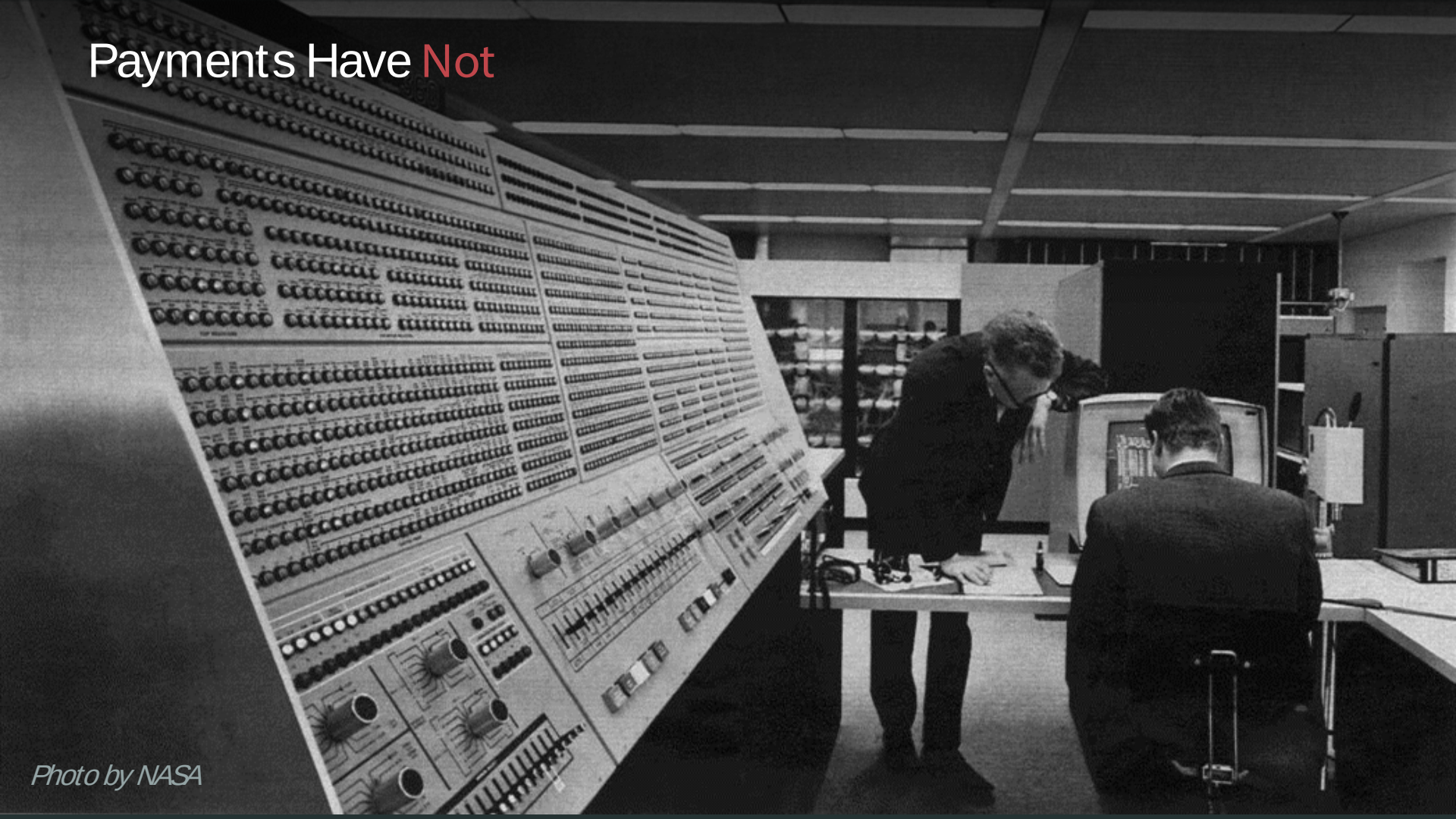
The World Has Changed



Photo: UNAMID

Payments Have Not

Photo by NASA



The New Corporate



Global from day one

On-demand fulfillment

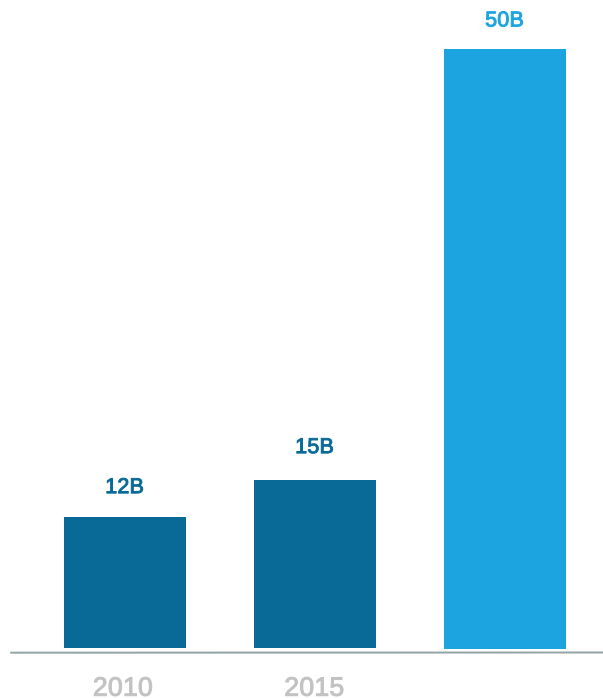
Distributed suppliers and customers



Digitally native



The Consumer Space Is Changing Too



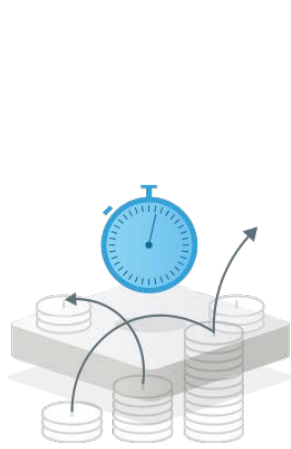
Internet of Things

50 Billion Connected Devices by 2020

Consumers Will Make International Micropayments Without Even Thinking

Source: DHL and Cisco Internet of Things Trend Report, 2015;
Cisco Internet of Things White Paper 2011

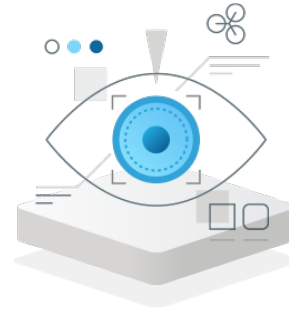
The New Corporate's Transaction Needs



High volume, low value,
high velocity



On demand and
real time

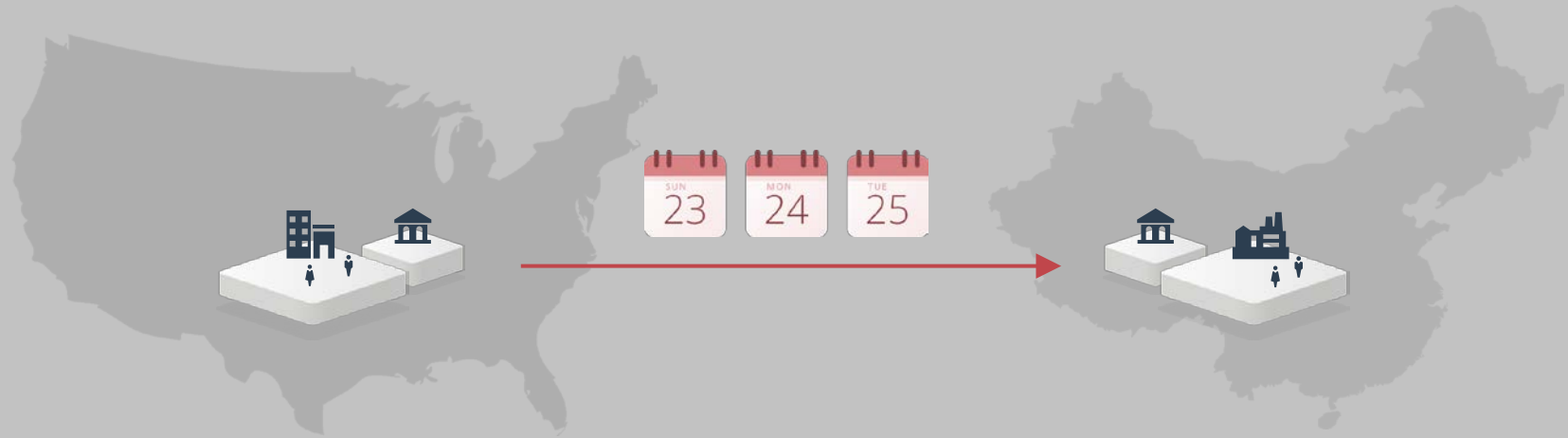


Complete visibility



Value-added controls

Today's Infrastructure Designed for **High Value** Payments



Low-Volume High-Value Slow Batch Payments



A photograph of a server room with multiple rows of server racks. The racks are filled with various electronic components, including circuit boards, connectors, and cooling fans. The perspective is looking down the length of the racks, creating a sense of depth. The lighting is somewhat dim, with some highlights on the components.

MONEY

IS JUST

DATA

SO WHY
DOES IT NOT
MOVE LIKE
DATA?



internetworking



in·ter·net·work·ing

noun

The interconnection of two or more networks so as to form a larger network.





Everywhere you want to be.



There are some things money can't buy.
For everything else, there's MasterCard.



In global payments today,

REACH

is what matters.



XFINITY® Internet

XFINITY is the fastest Internet provider in the nation according to PC Mag.

PC The Fastest ISPs 2011

\$29⁹⁹/mo for 6 Months

special offer for new customers

BEST PRICE

LEARN MORE →

the office

The advertisement features a silver laptop on the right side, displaying a scene from the TV show 'The Office' where the cast is having a picnic in a park. The background is a dark grey gradient.

"... the fastest Internet provider in the nation .."



An advertisement for AT&T U-verse with GigaPower. The background is a city skyline with several tall skyscrapers under a blue sky with white clouds. In the foreground, there are blurred, colorful light trails in yellow, orange, and blue, suggesting motion or data flow. A white circular graphic on the left contains the text.

Introducing
AT&T U-verse® with
...GigaPowerSM

Just like you, we love Austin so we're building a 100% fiber network to deliver U-verse straight to your home or small business with super-fast Internet and an enhanced TV experience.

"... with **super-fast** Internet ..."



Get FiOS.
America's fastest,* most consistent
and most reliable Internet.

Get FiOS.

America's fastest,* most consistent
and most reliable Internet.

STARTING AT
\$89.99
/mo. + taxes, fees,
equip. charges
& RSN Fee

**NO ANNUAL
CONTRACT
REQUIRED.**

OF



05



WITH A 2-YEAR AGREEMENT

FiOS® Internet 15Mbps + FiOS® TV Prime HD + FiOS® Digital Voice

VISIT WelcomeToFiOS.com
or **CALL** 1.888.279.8085



FiOS

"America's fastest, most consistent and most reliable Internet."



***The future of
broadband exists
in Karlskoga.
Buckle up.***

www.karlskogaenergi.se/broadband

Energi  & Miljö

In information networks, it's all about

SPEED

COST RELIABILITY SIMPLICITY



We're already the biggest.

We're already the best.

We've already got more
members.

We already offer more
services.

So we decided to make some improvements.

"...biggest ..."

"...more members ..."

"...more services ..."

Isn't that just like us? Never satisfied. Even though CompuServe is already the best computer information service in the world, we're still full of surprises.

Like the CompuServe Information Manager software. It revolutionizes the CompuServe experience for MS-DOS users. Now, you can do things like utilize a windowed PC interface with pull-down menus and dialog boxes. Or compose letters and read PC support material offline.

All this for only \$39.95*, including software and a \$25.00 usage credit. Usage charges are as low as 10¢ a minute.

And it's not only exciting, and breakthrough, and revolutionary, it's easy to order, too. If you're already a CompuServe member, just type GO ORDER. If not, see your computer dealer, or call us today.

The new CompuServe. Now customized for MS-DOS computers.

CompuServe®
800 848-8199

CIRCLE 226 ON READER SERVICE CARD
Requirements for MS-DOS version of CompuServe: Hayes compatible modem and 640K RAM. Hard drive recommended.
*Sign-on fee not included.

REACH



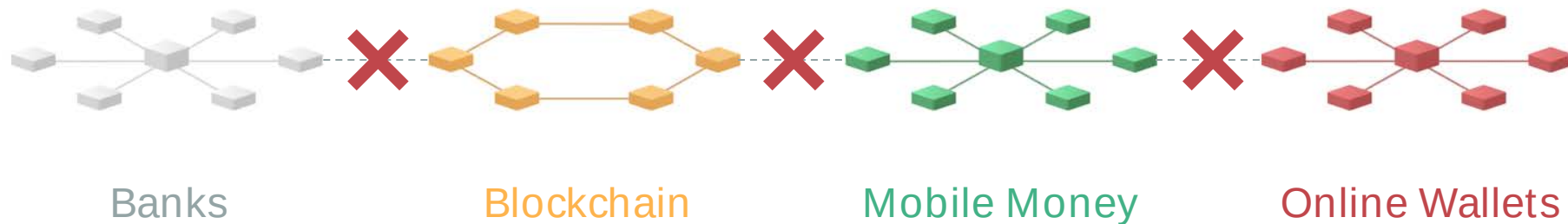
SPEED

COST QUALITY

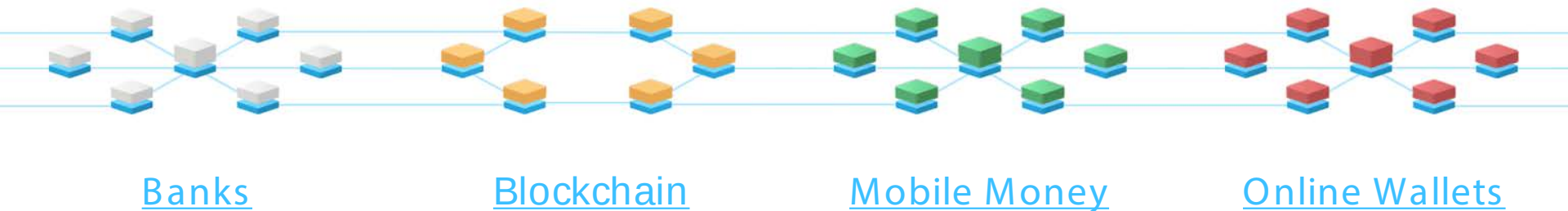
Internetworking changes the game.



Payment Networks Are Disconnected



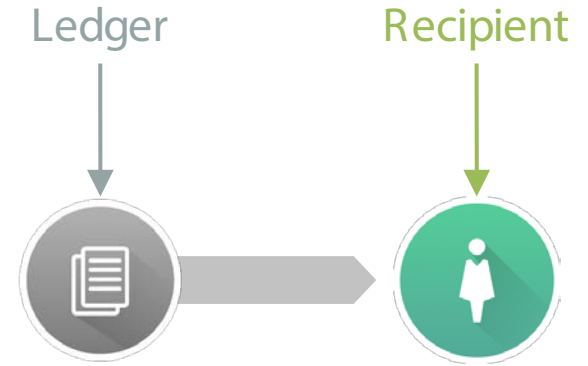
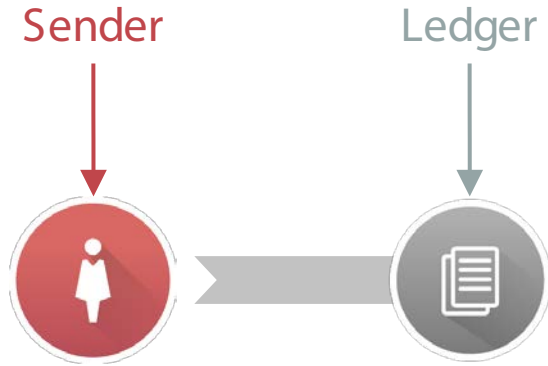
Internetworking For Payment Networks



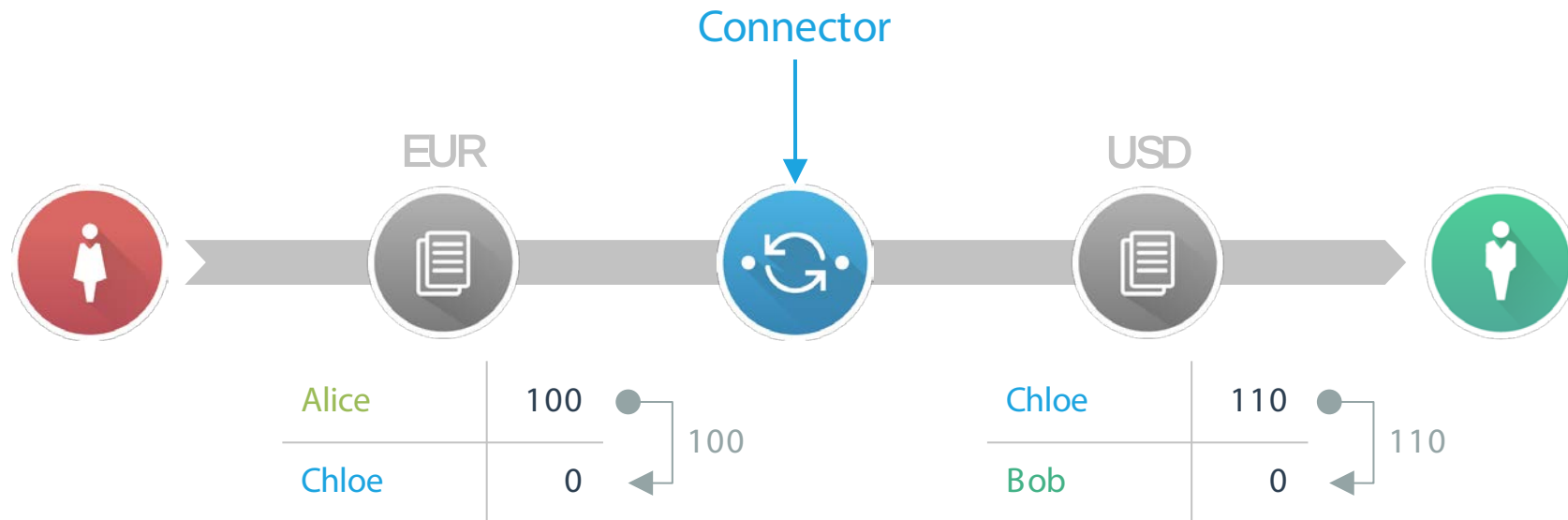
How Does It Work?



Transferring Funds Across Networks



Connectors Link Two Ledgers

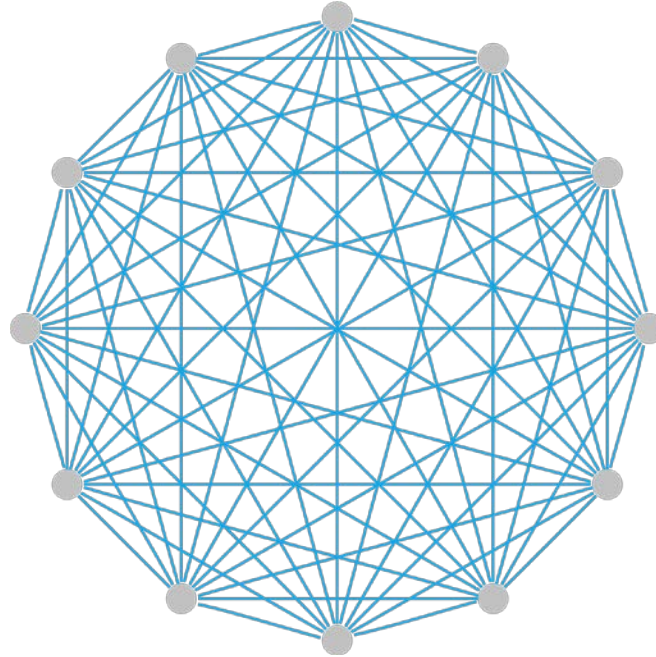


Bilateral Connections Don't Scale



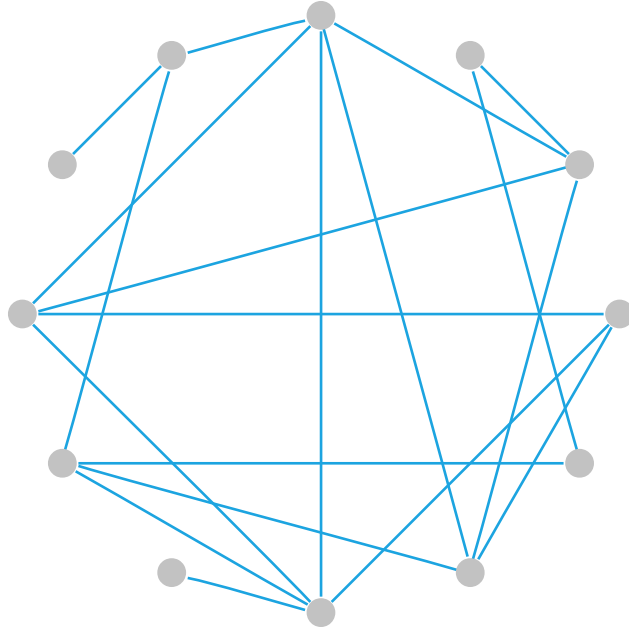
Bilateral Connections Don't Scale

$$O(n^2)$$



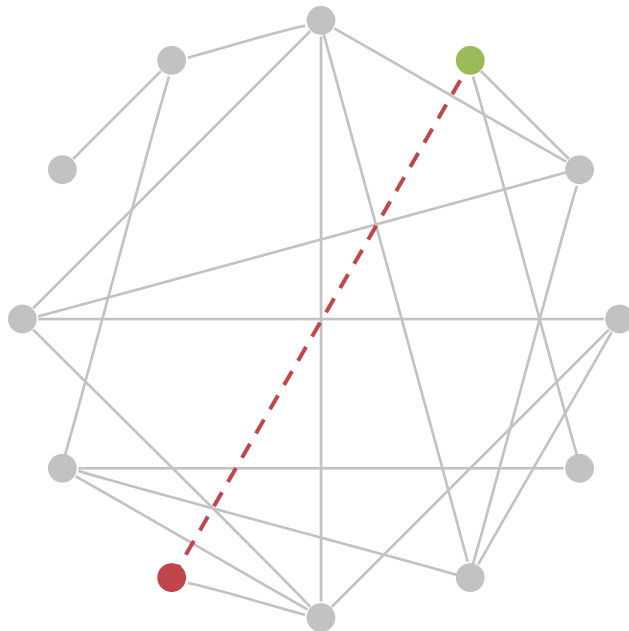
Networks Do Scale

$O(n)$



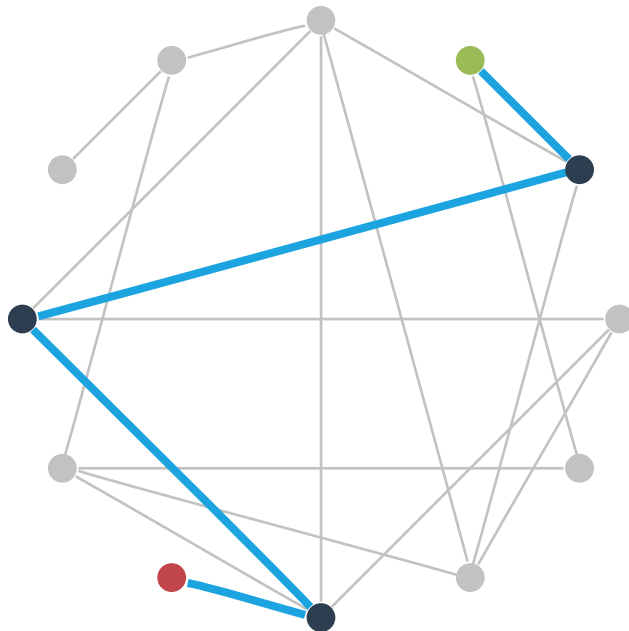
But There Isn't Always A Direct Connection

$O(n)$

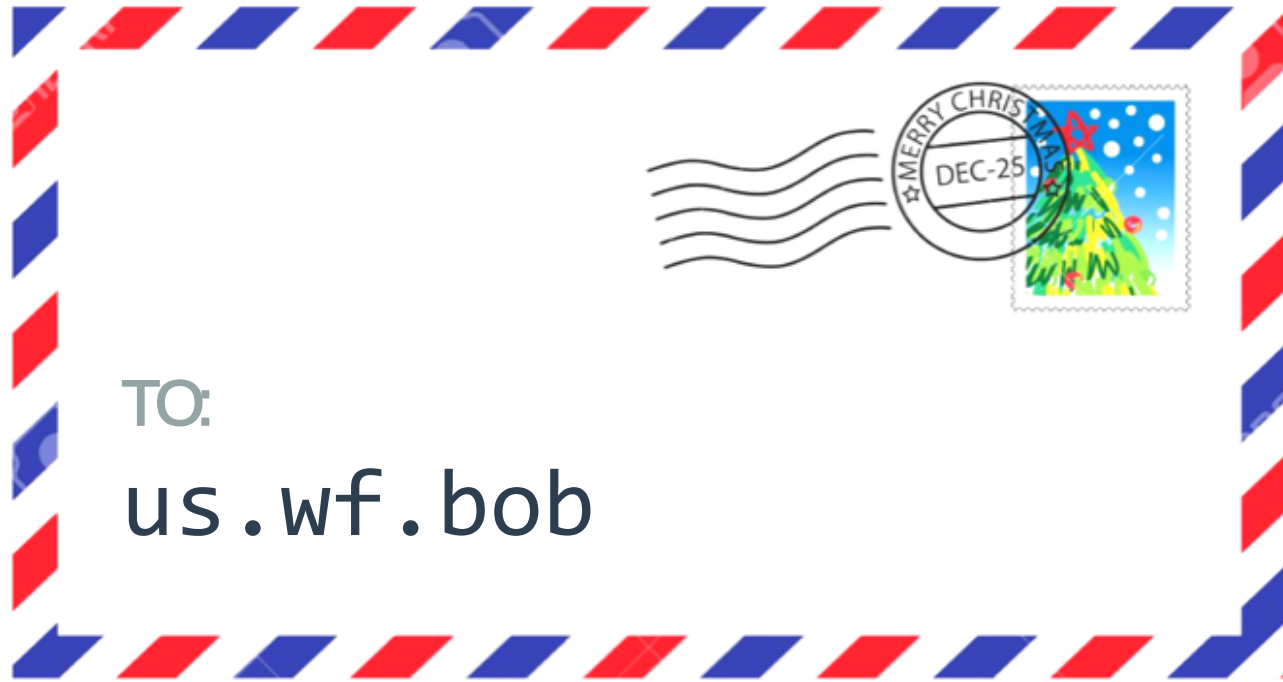


We Need Multiple Hops

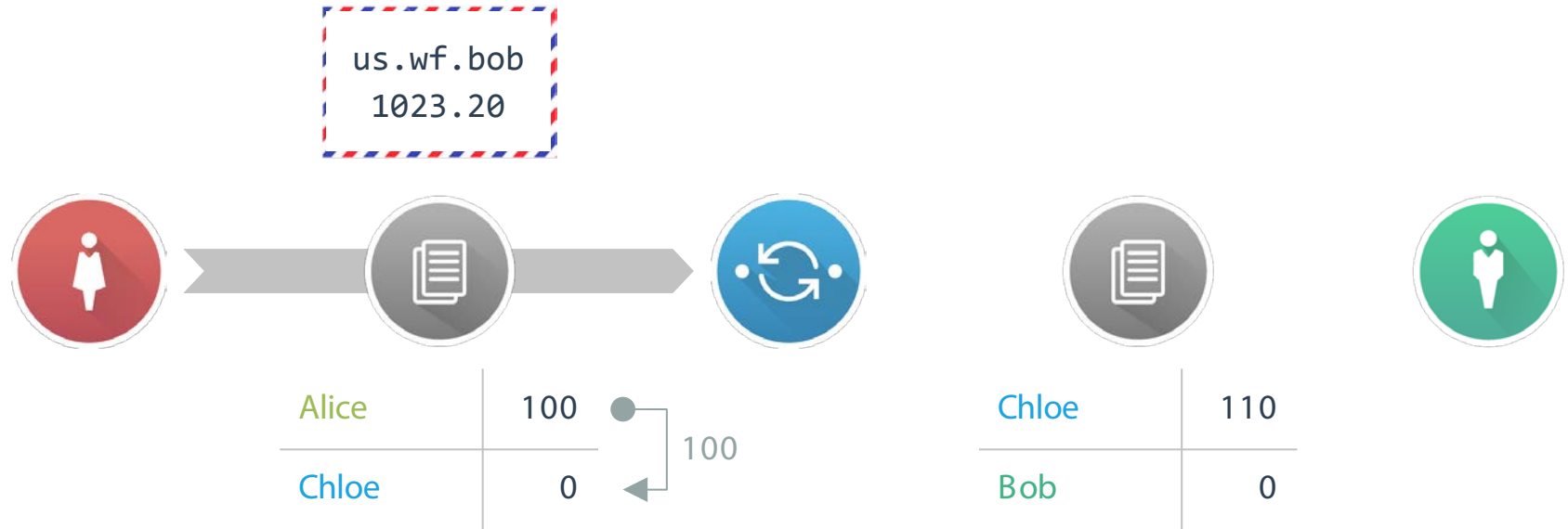
$O(n)$



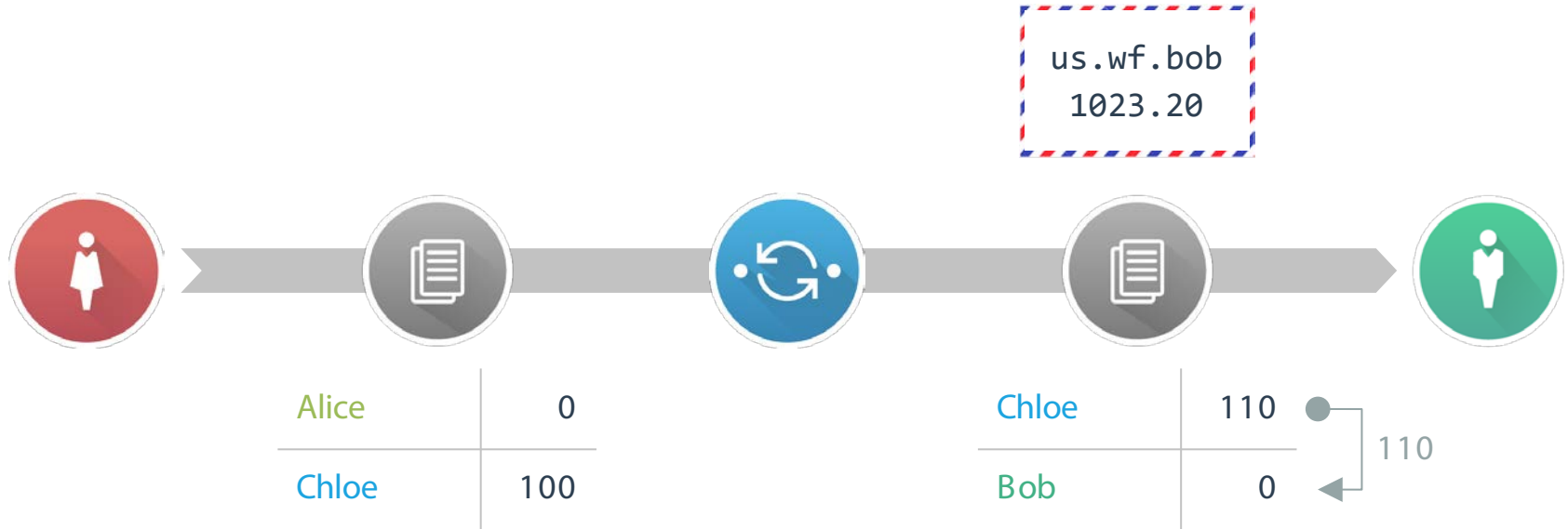
First Step: Interledger Address



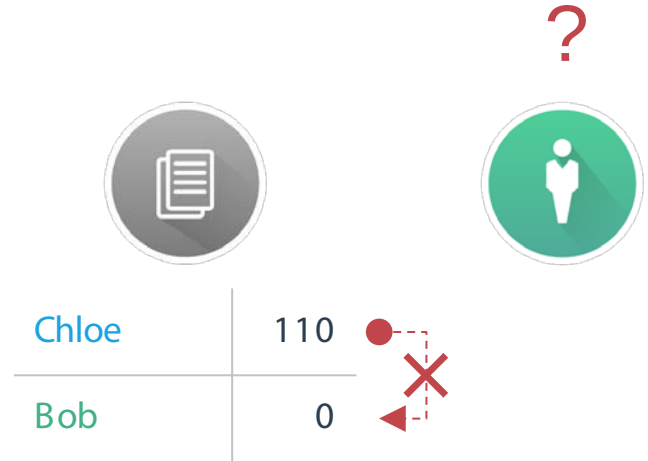
Sender Attaches Packet to Local Transfer



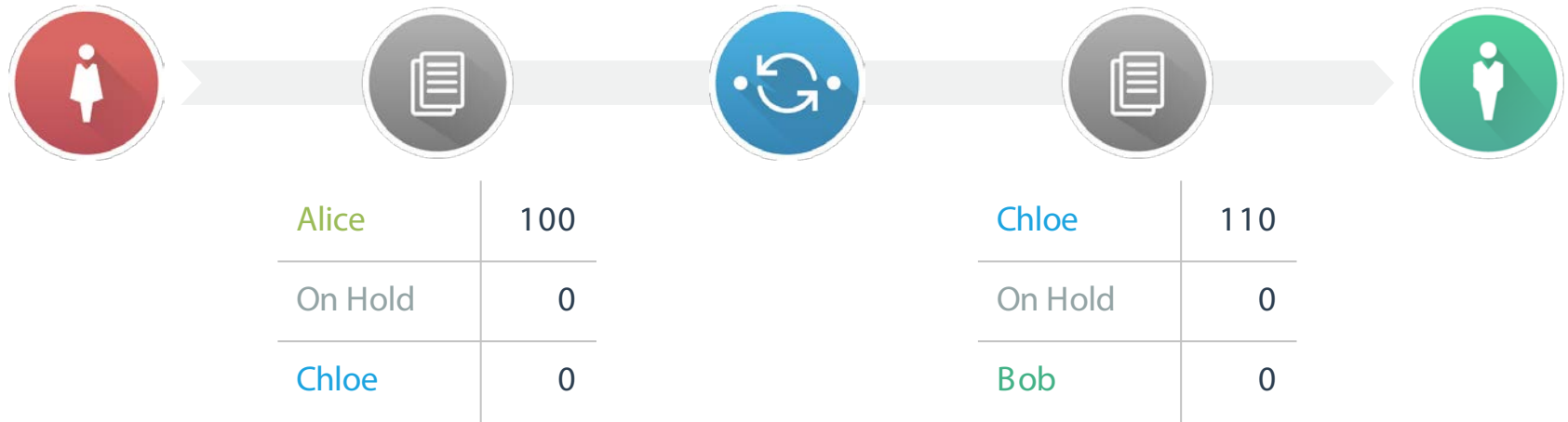
Connector Forwards the Packet via Another Transfer



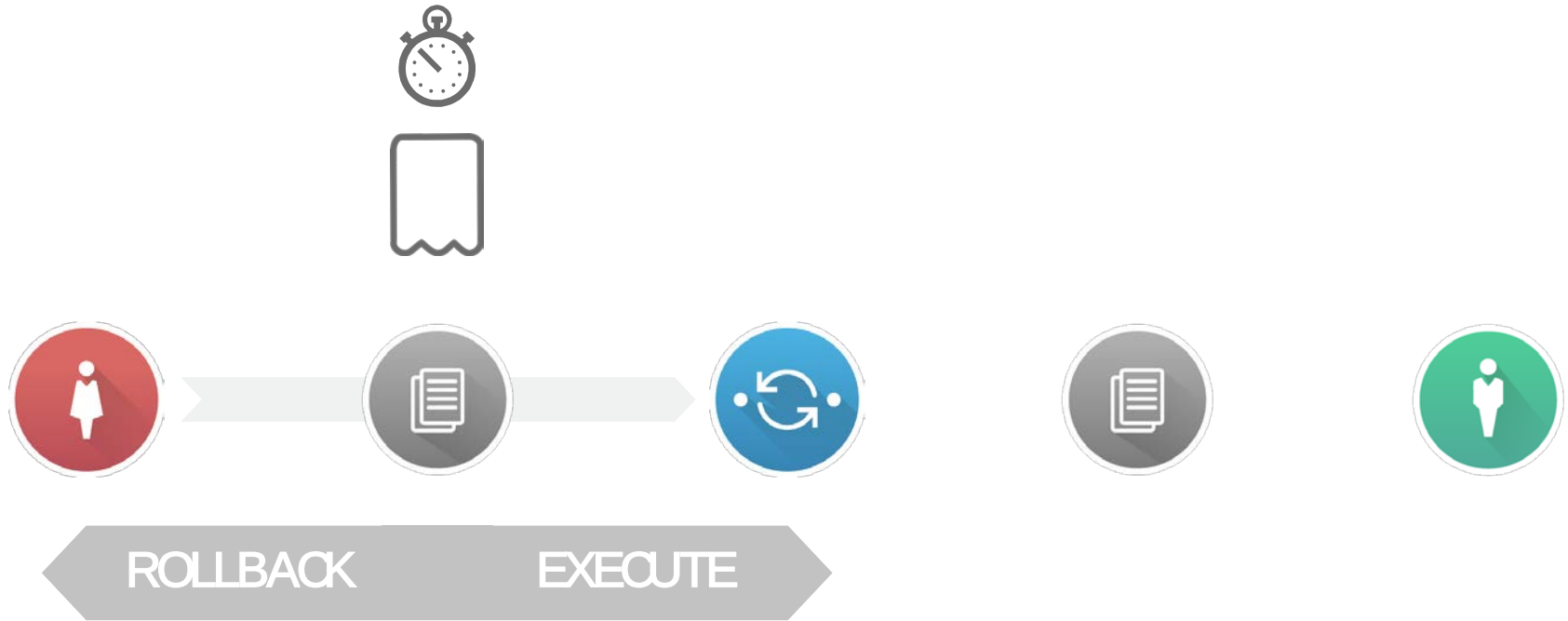
If Connectors Fail, Would We Lose Money?



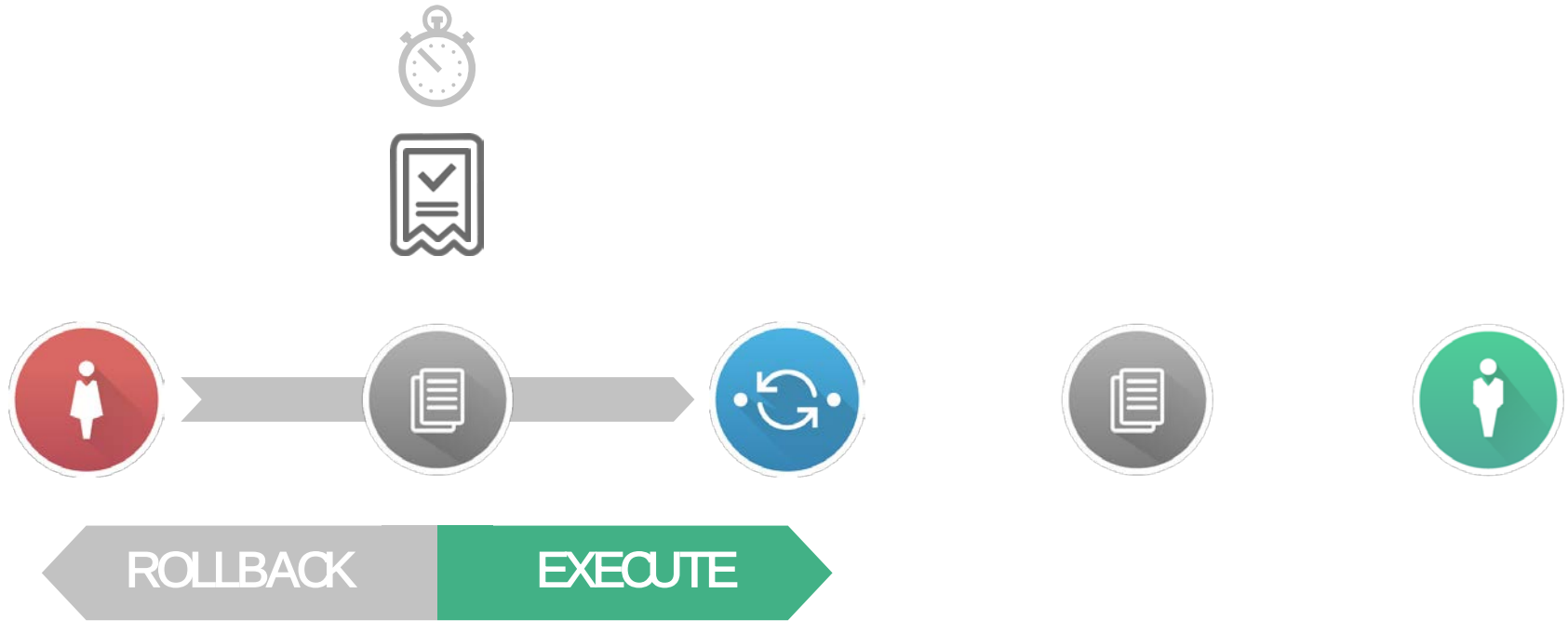
Ledgers Provide Hold Functionality



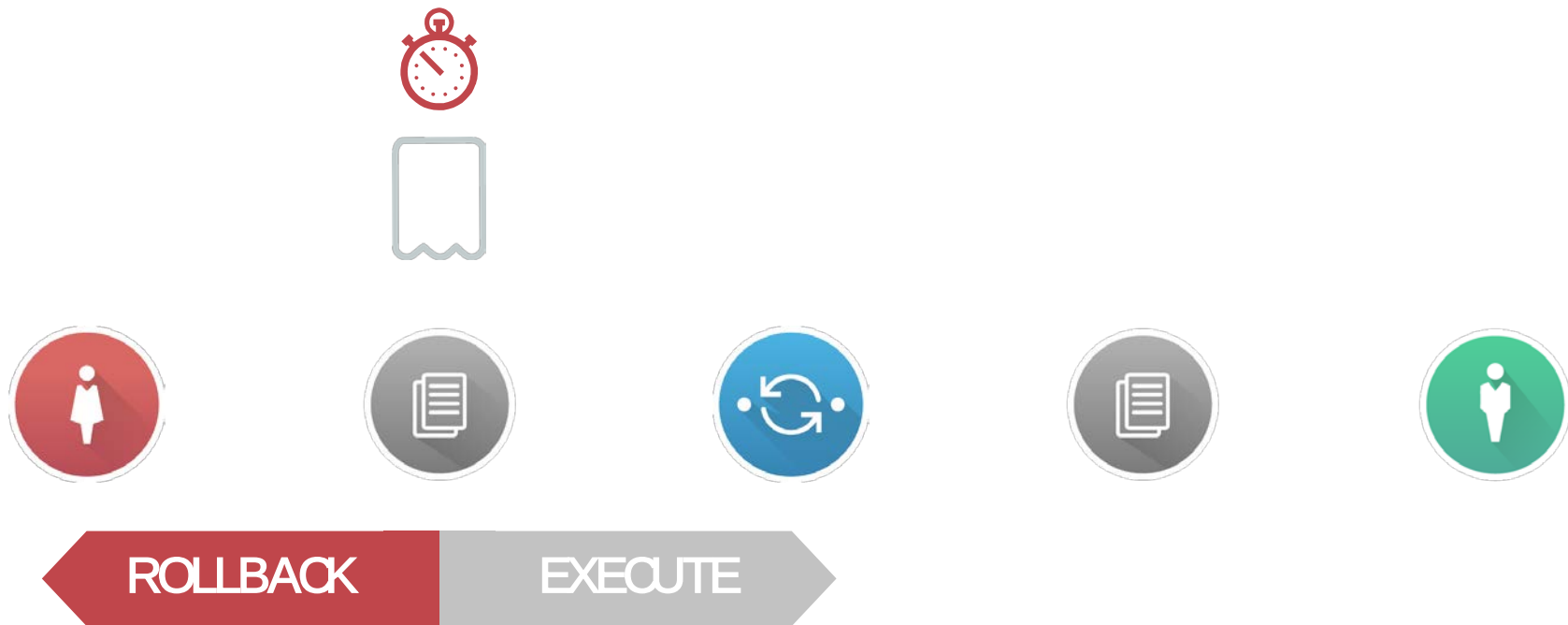
Holds Are Dependent on Conditions + Expiries



Condition Fulfillment Executes Transfer



Timeouts Cause Funds to Be Returned

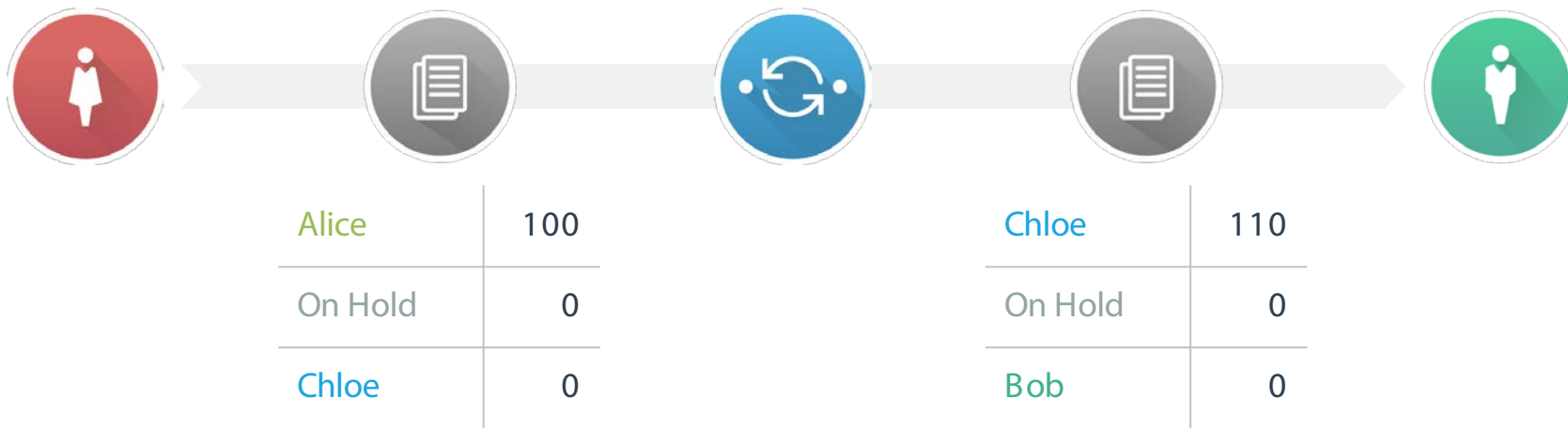


Sender **Commits Funds**
To Initiate Payment

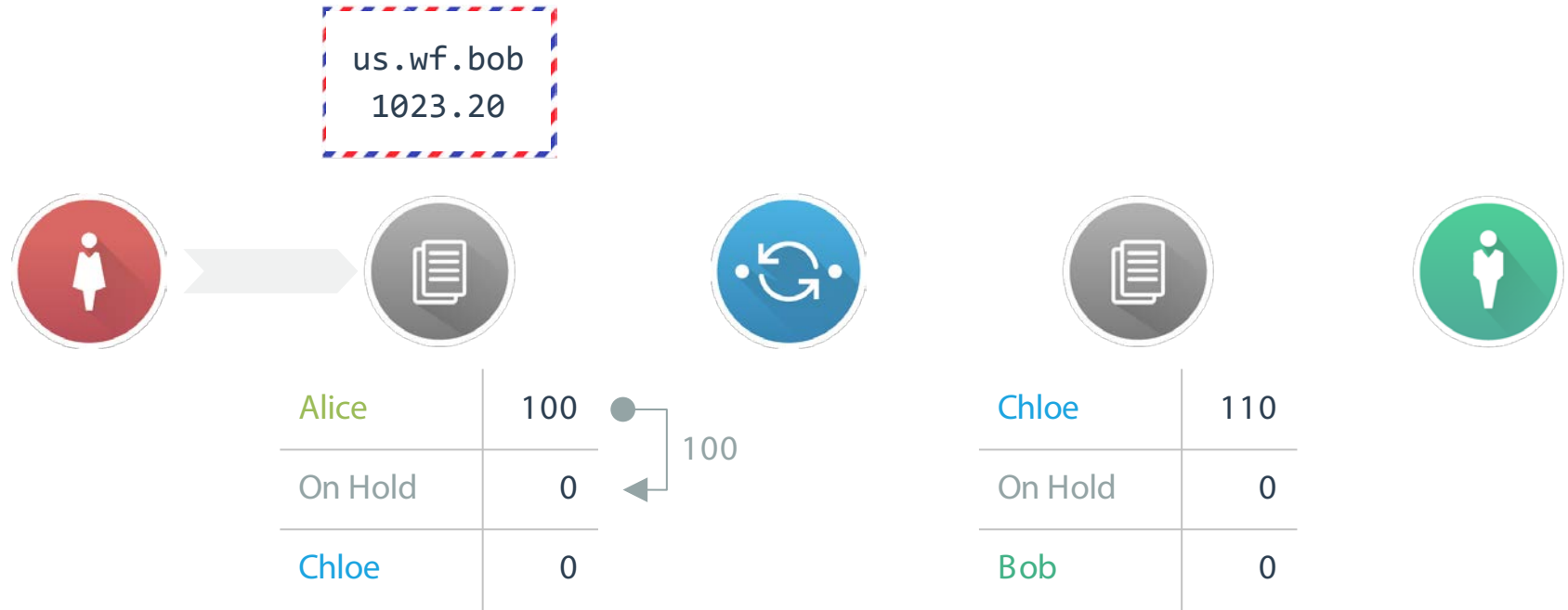


Funds Are Committed From Left to Right

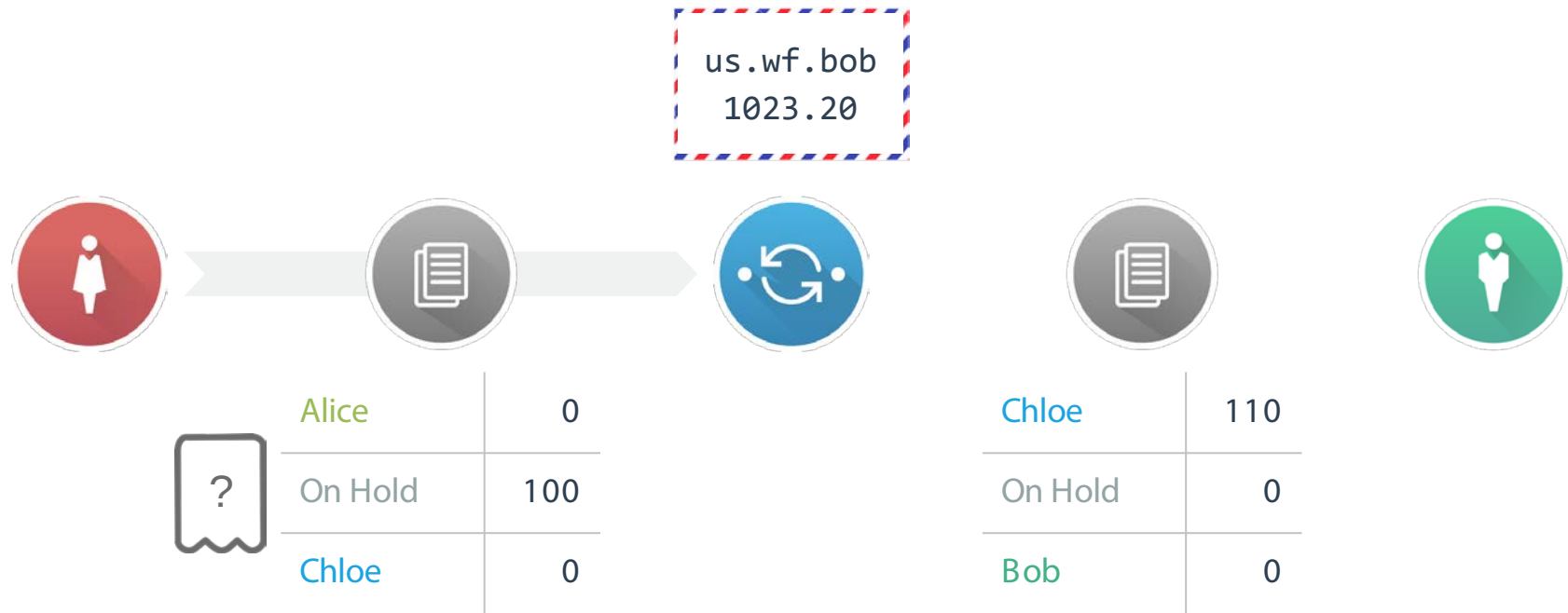
COMMITMENT



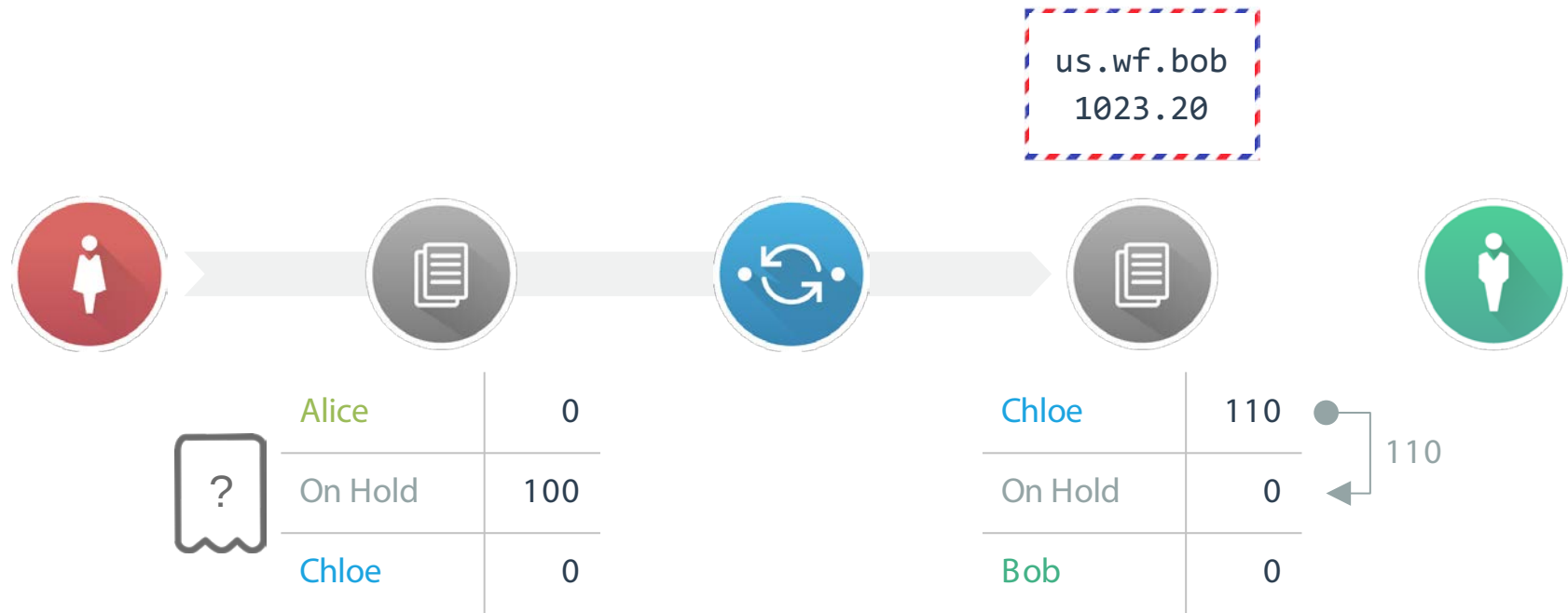
Sender Puts Funds On Hold



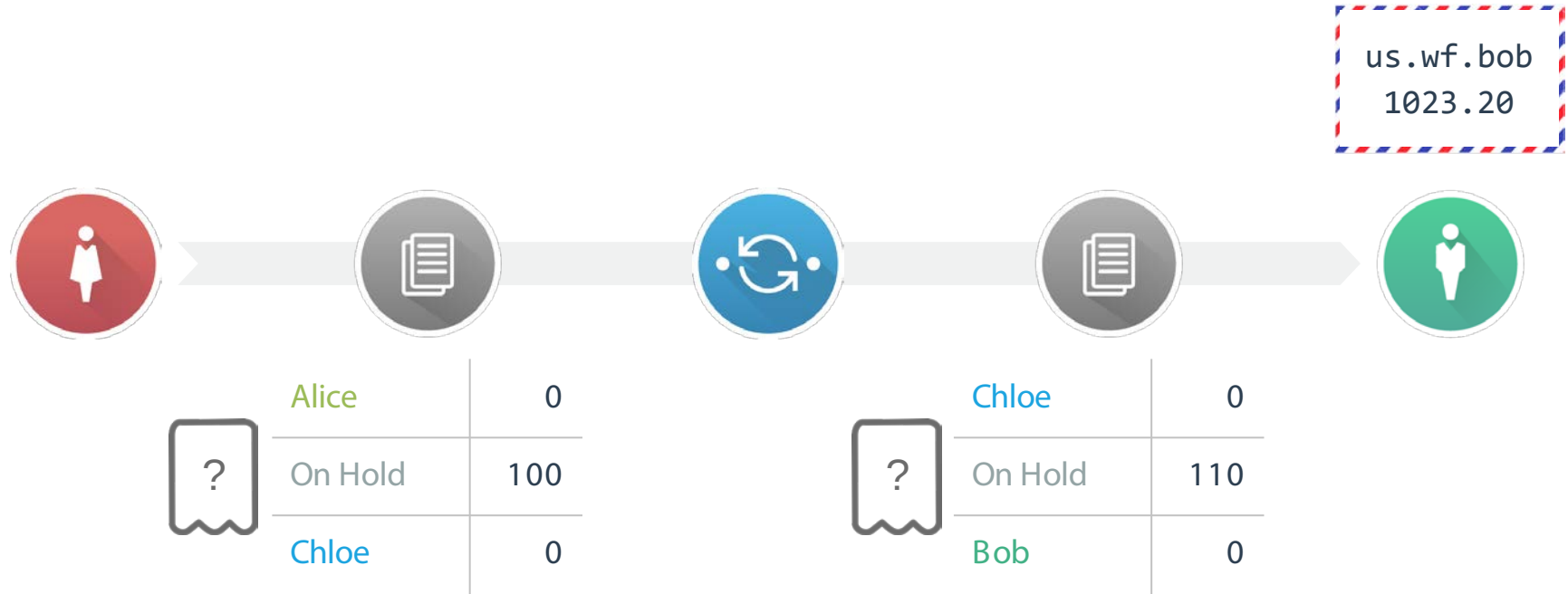
Connector Gets Notification of Funds on Hold



Connector Puts Funds on Hold



Recipient Gets Notification of Funds on Hold

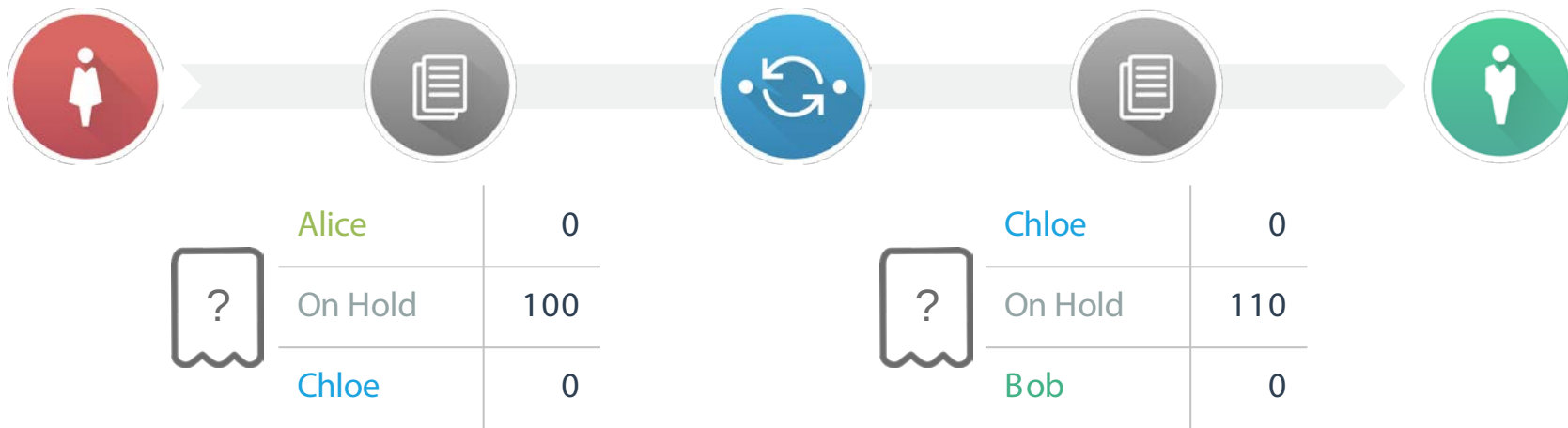


Recipient Triggers Execution
By Fulfilling the Condition

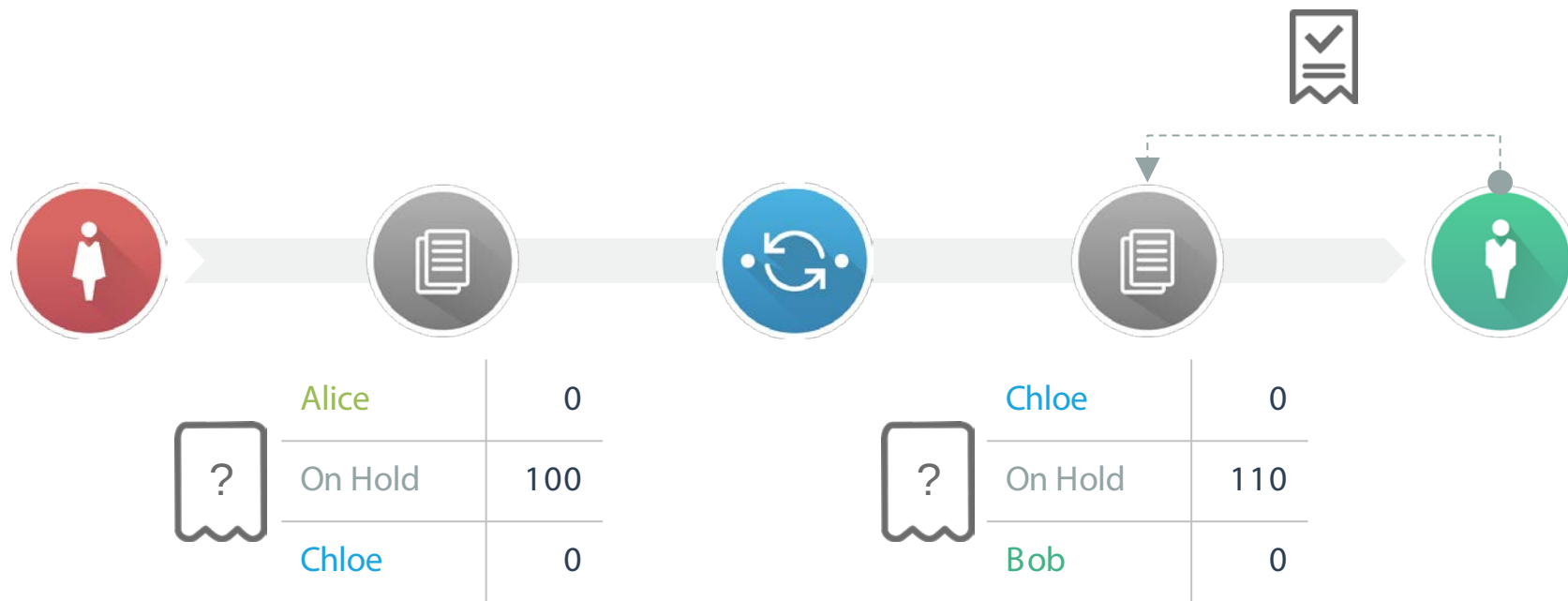


Transfers Are Executed Right to Left

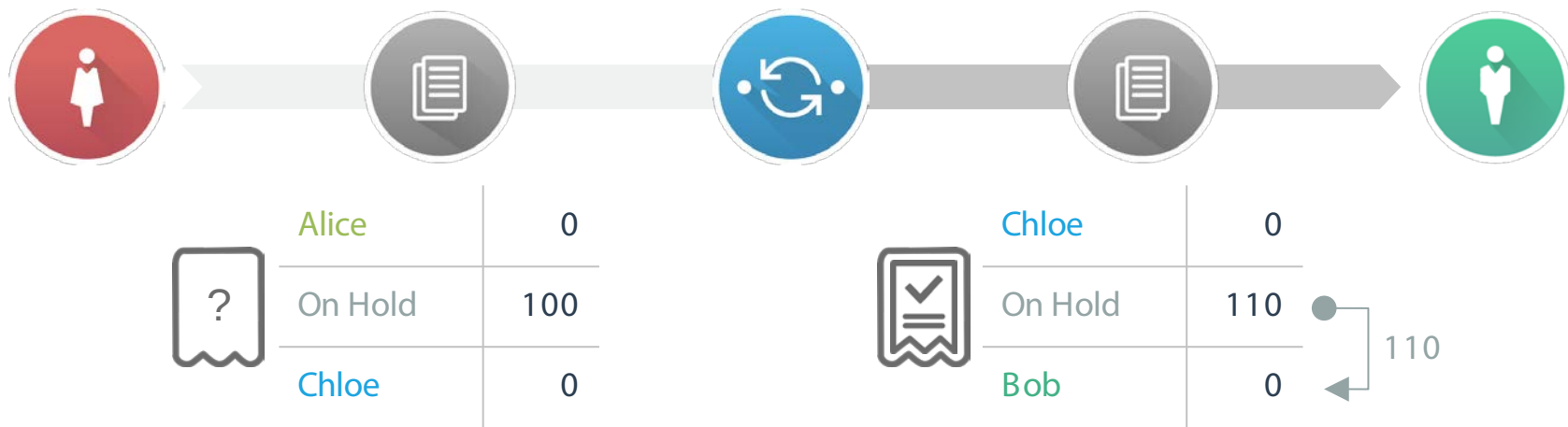
EXECUTION



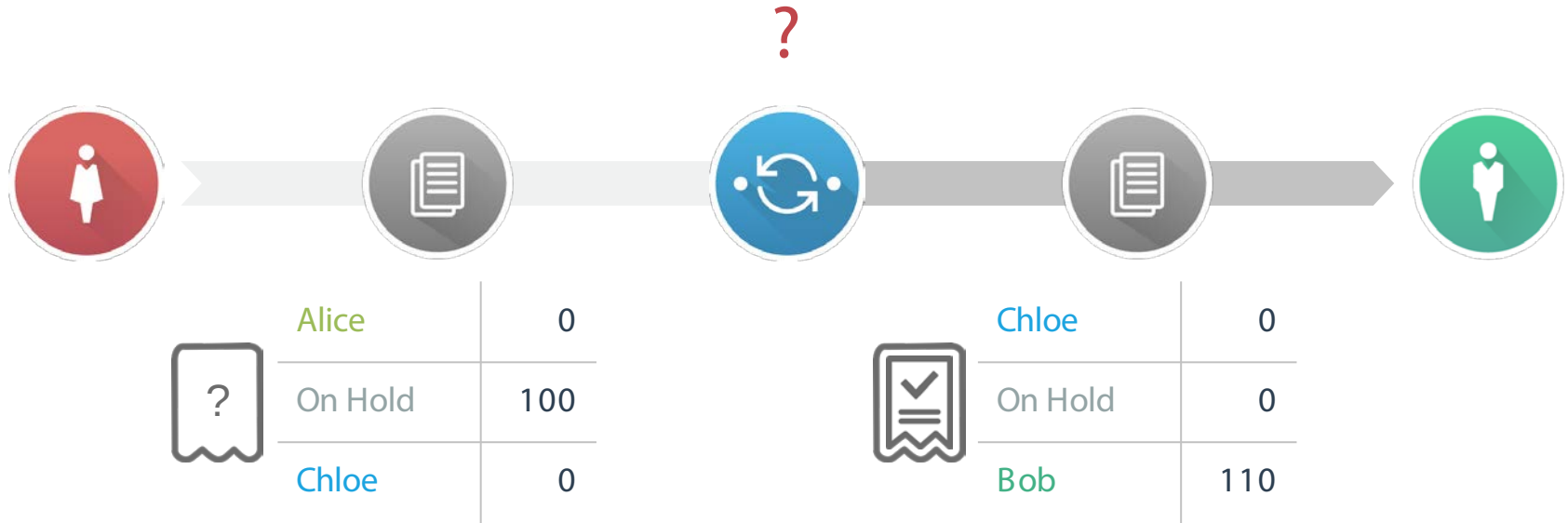
Recipient Signs Receipt



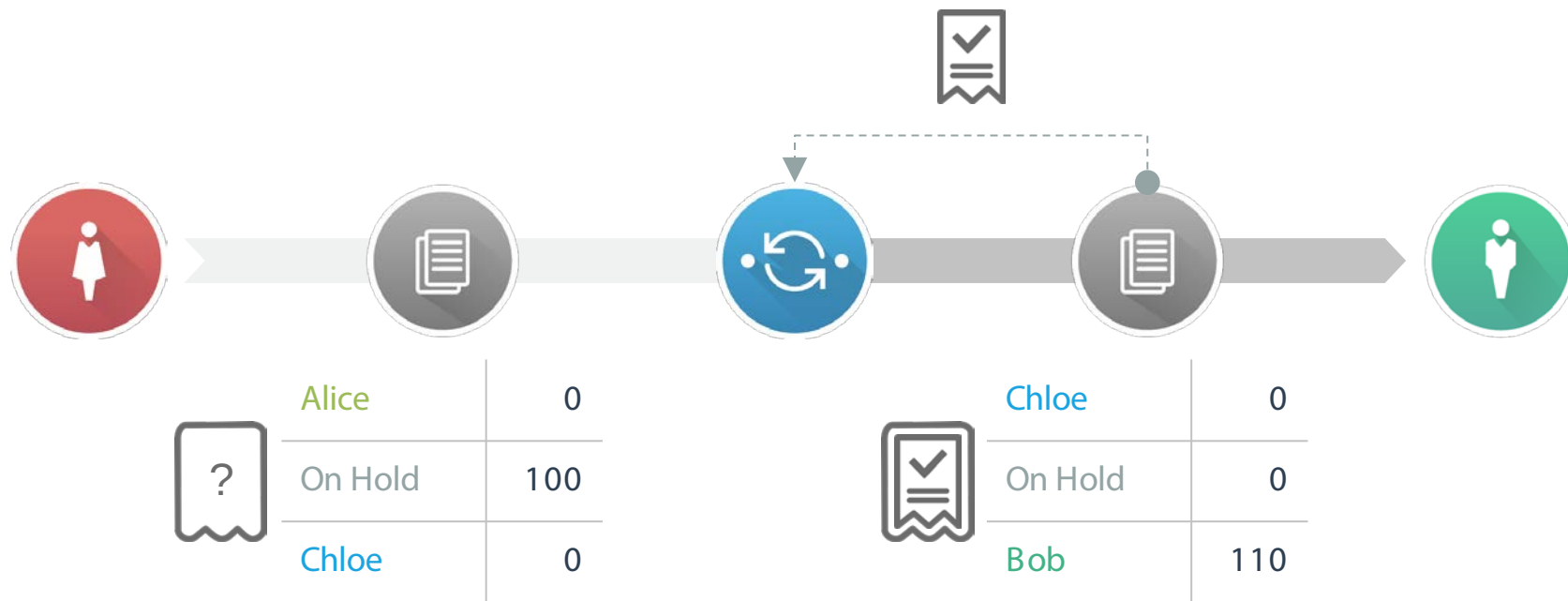
Signature Fulfills Condition, Ledger Releases Held Funds



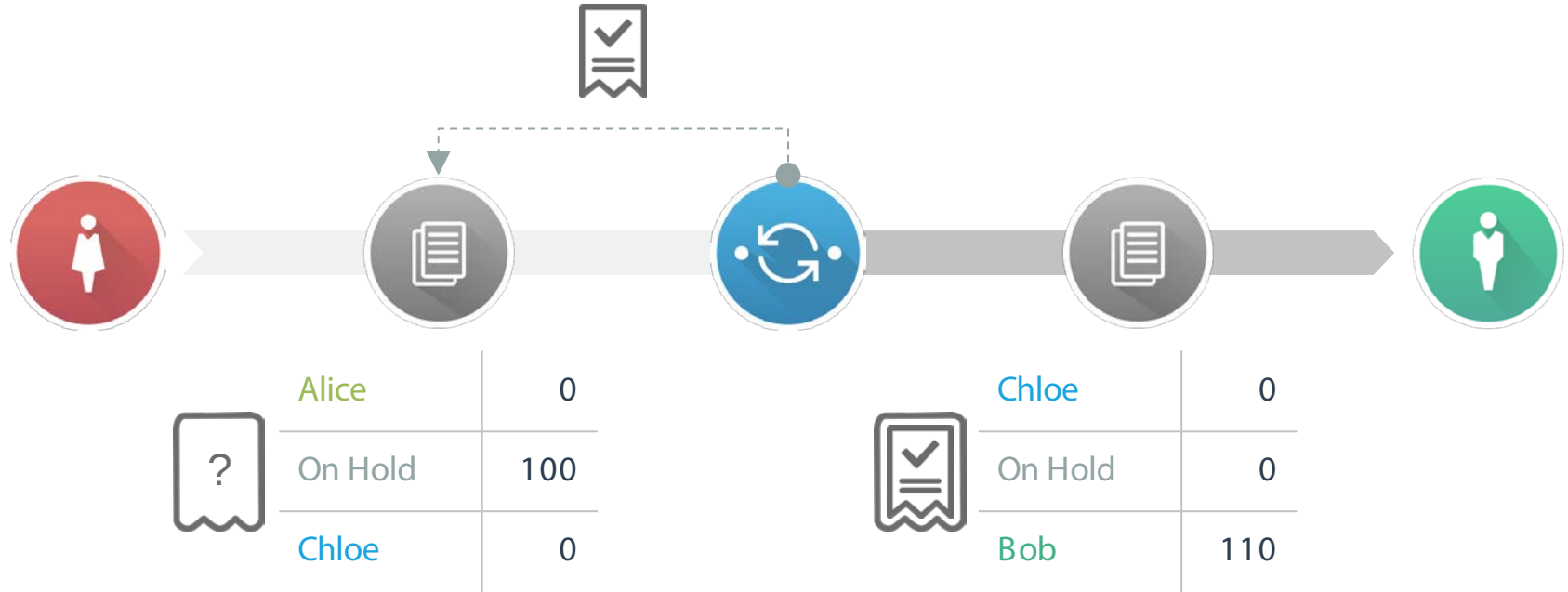
How Does the Connector Get Reimbursed?



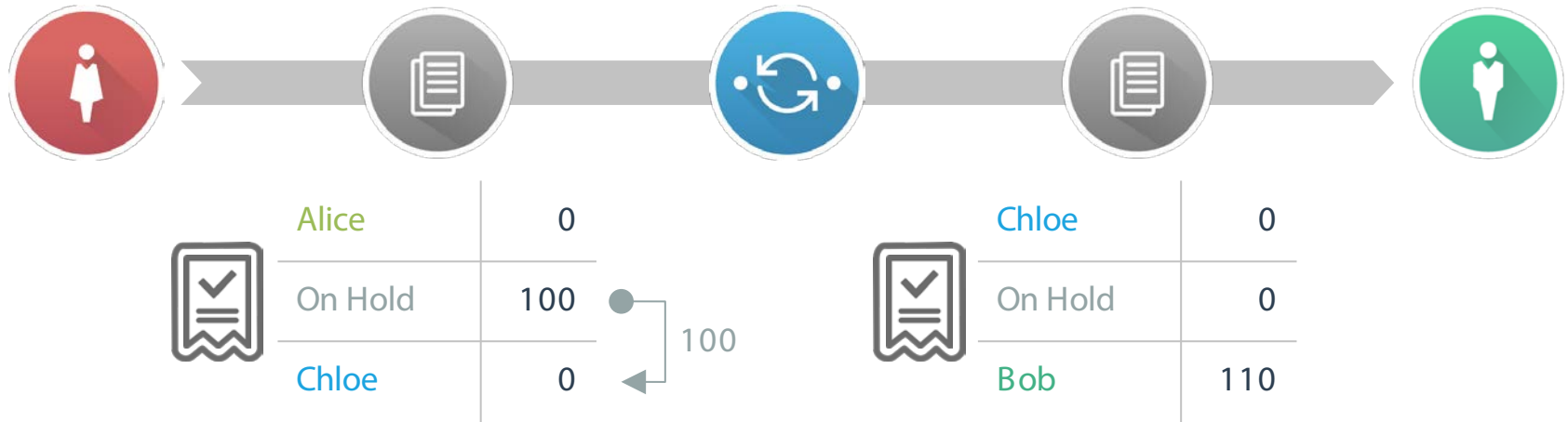
Connector is Notified That Funds Have Been Released



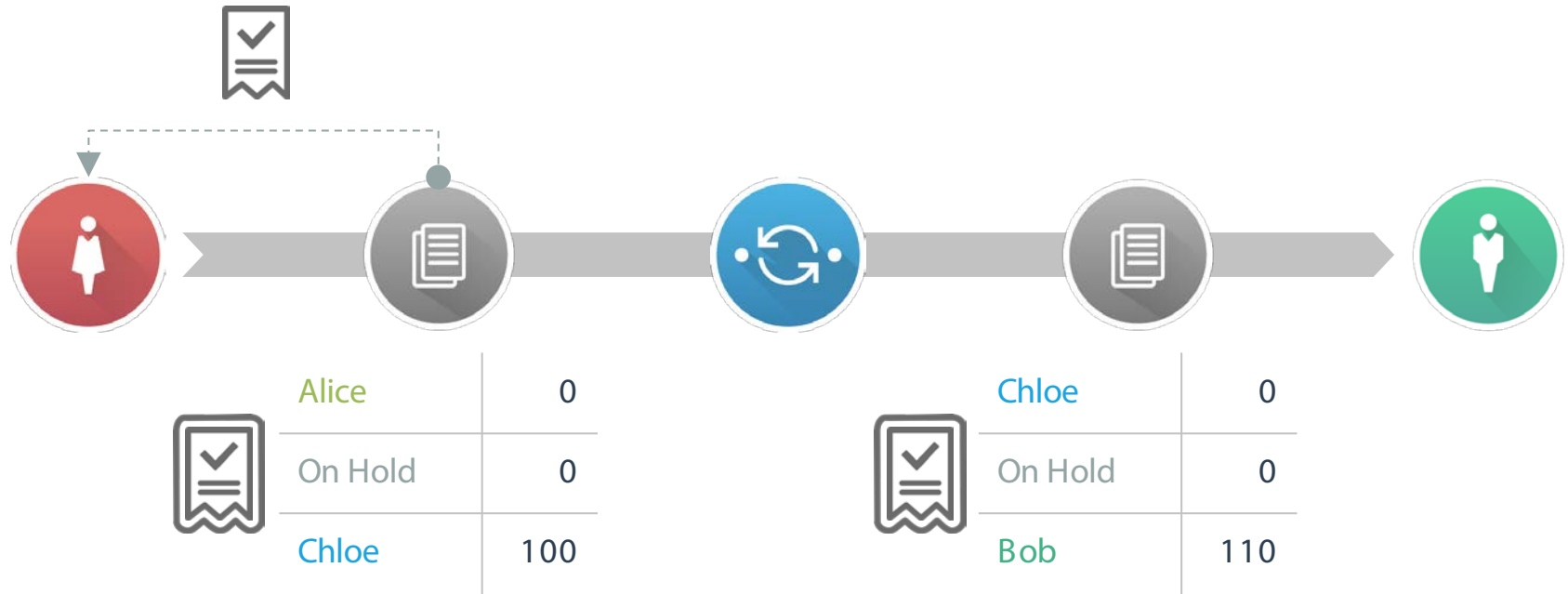
Connector Passes on the Recipient's Signature



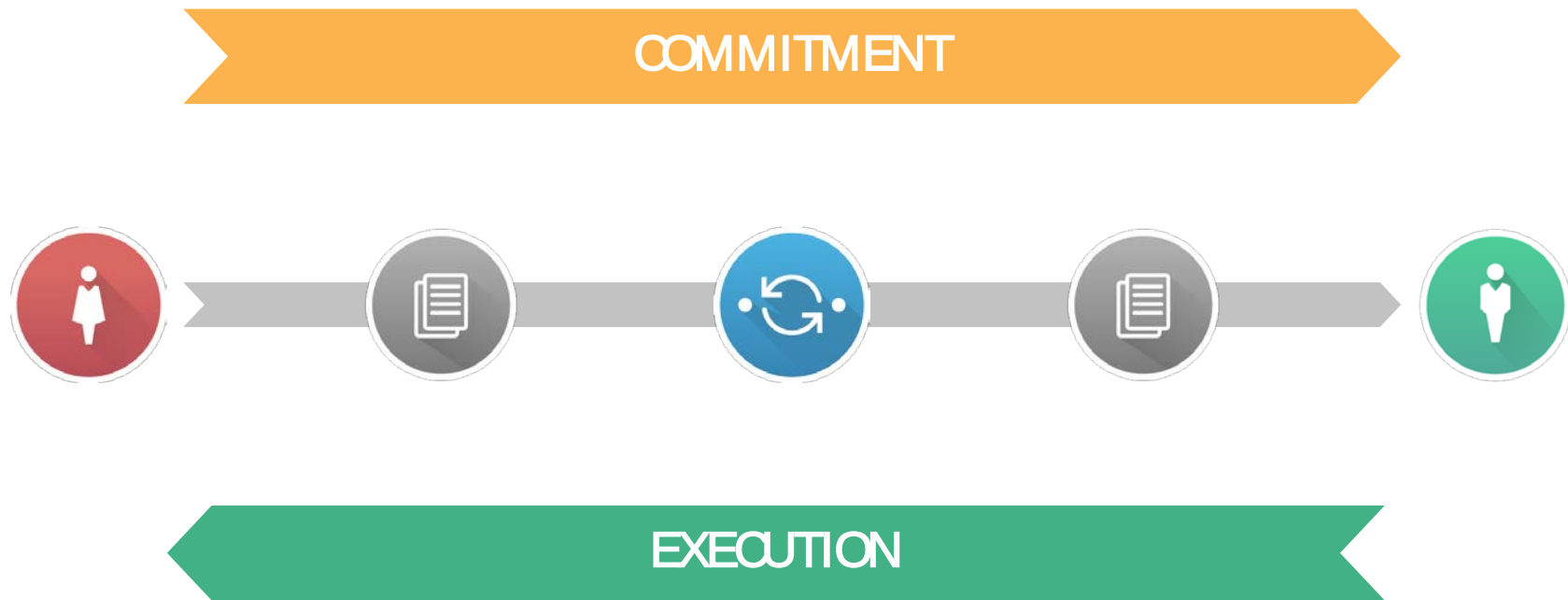
Receipt Releases Funds from Hold



Sender Gets Non-Repudiable Proof of Payment



Transfers Are Committed L2R, Executed R2L



The Impact



Before Internet: Dedicated Infrastructure

Phone



Telegraph



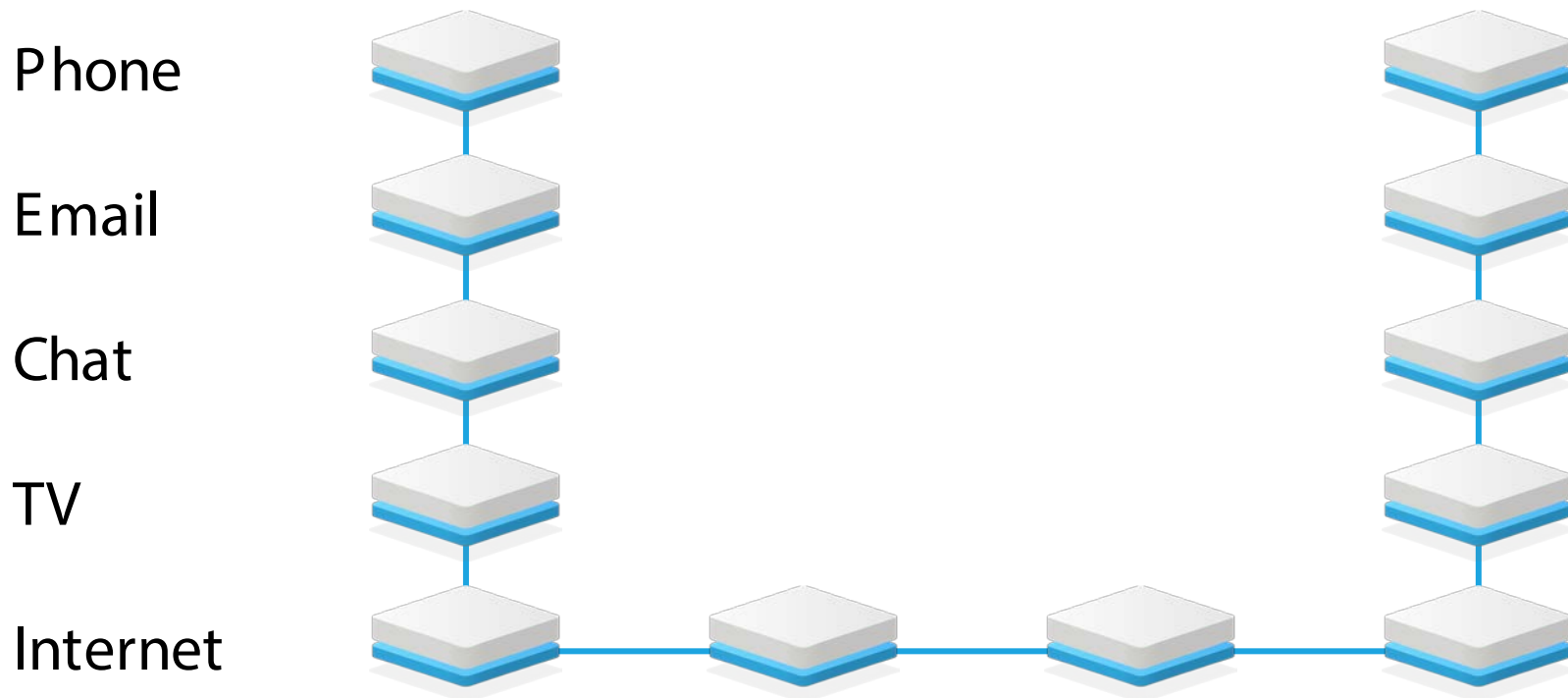
Pagers



TV



Infrastructure Consolidation



Internet Architecture

Application

HTTP SMTP NNTP NTP RTP

Transport

TCP UDP

Internetwork

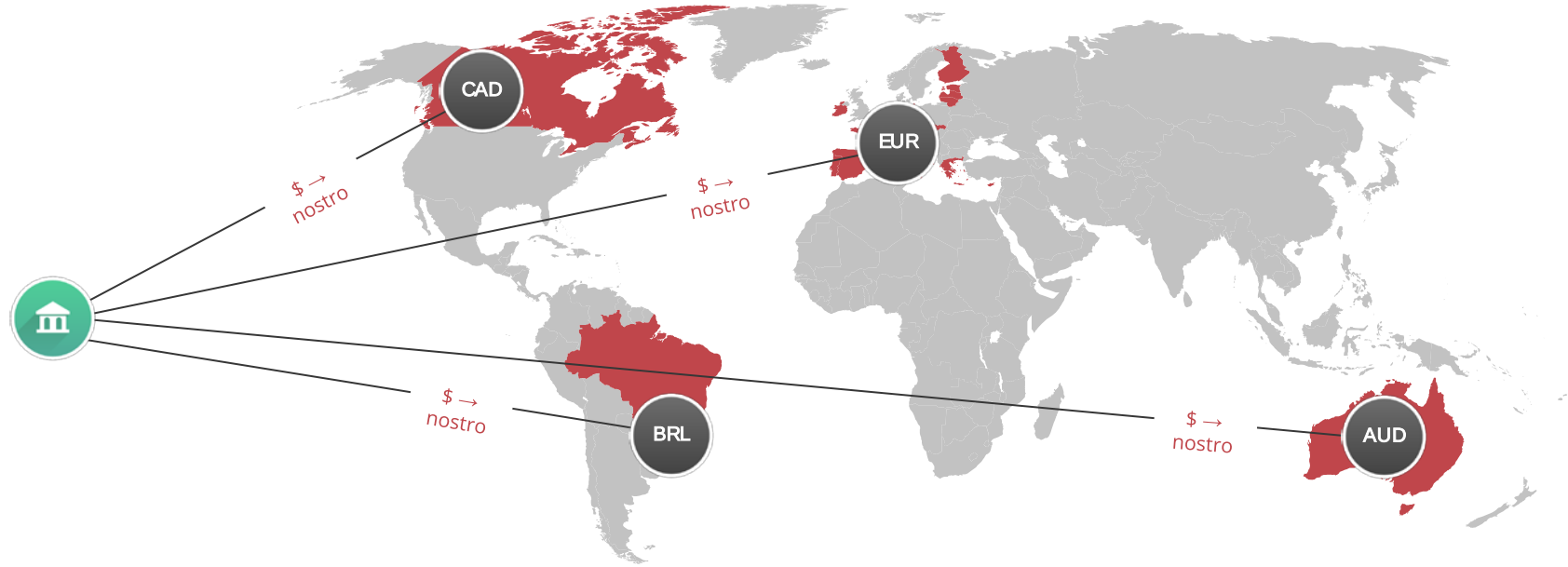
IP

Network

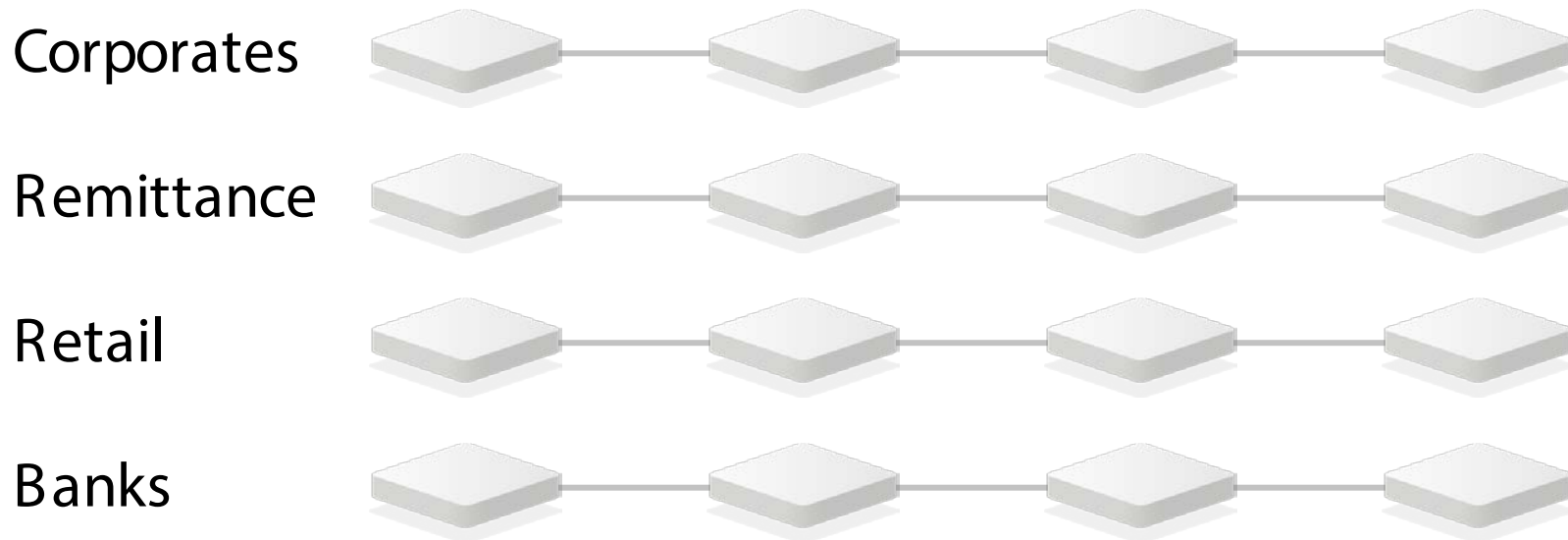
WIFI BLUETOOTH ETHERNET



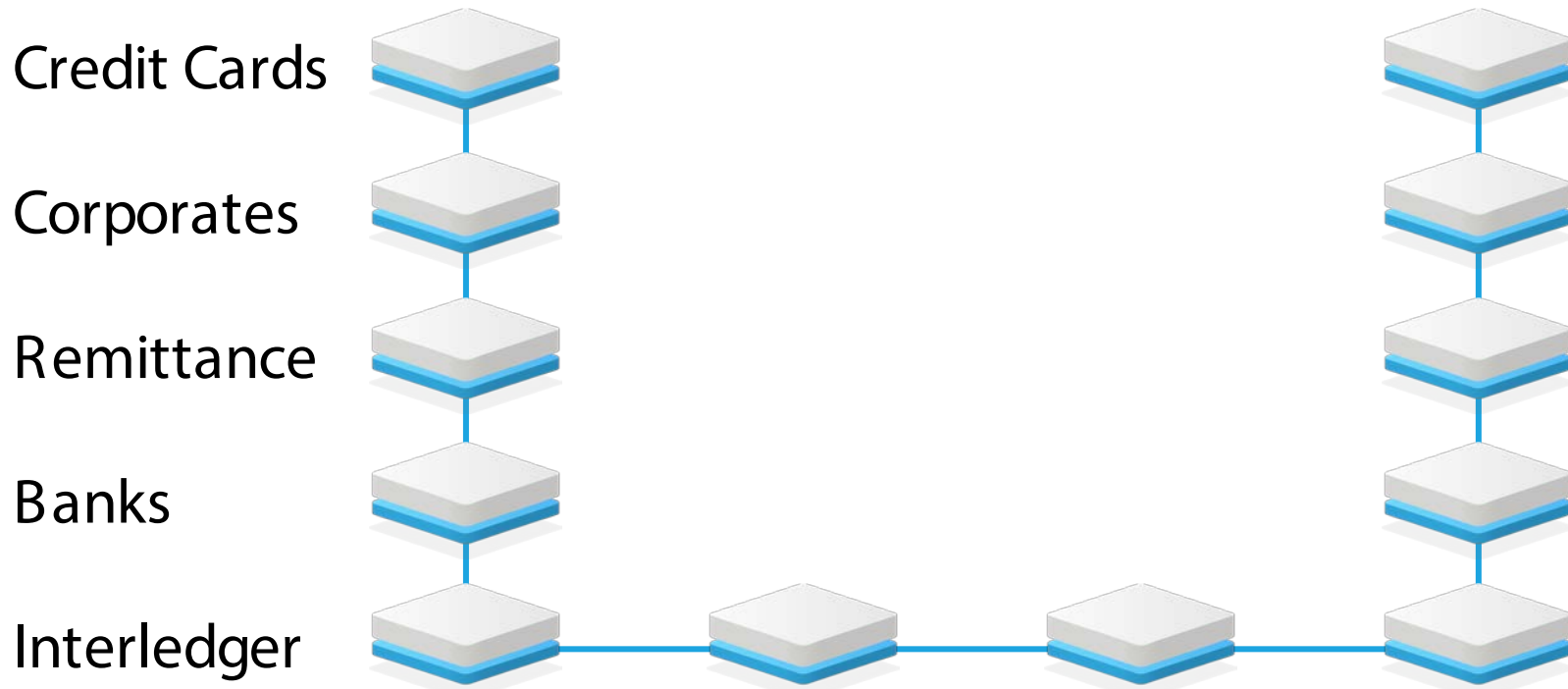
Realtime Payments Require Capital



Before Interledger: Dedicated Float



Capital Consolidation



Interledger Architecture

Application

SPSP PPSP ...

Interledger

ILP

Ledger

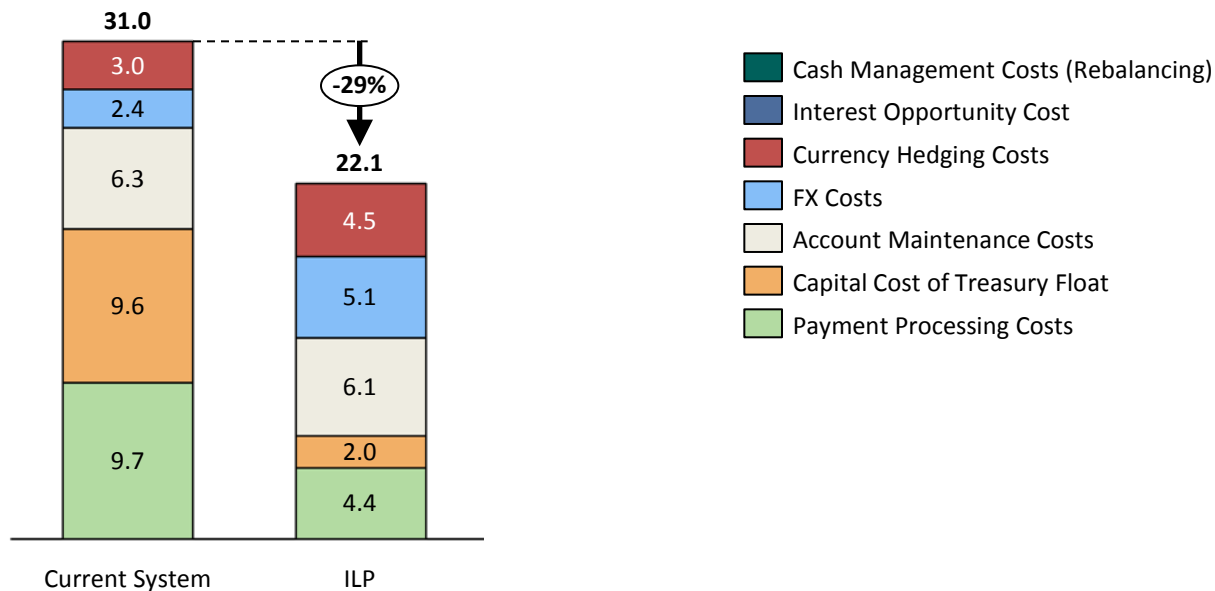
ISO 20022
BITCOIN ETHEREUM



ILP Cost Model (Example)

International Payment Infrastructure Costs

(Representative Bank, Costs in \$M USD)



The Internet: Cheaper Letters?



The Internet: New Business Models



Google

facebook

UBER

ebay



airbnb



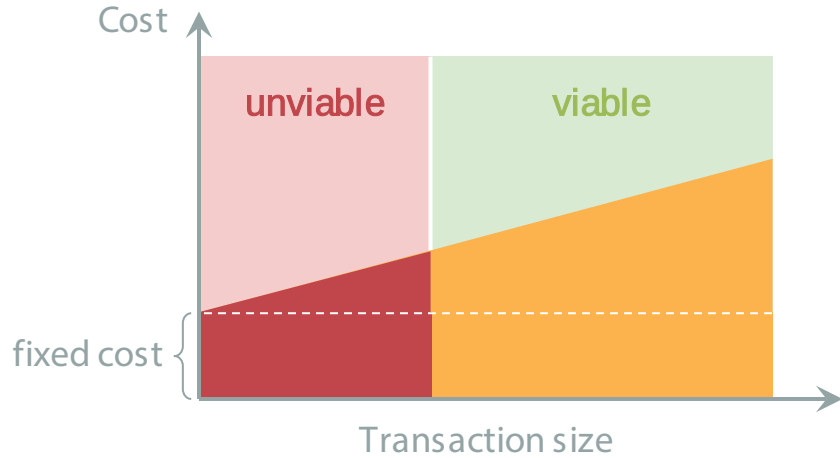
Spotify

NETFLIX

amazon.com[®]

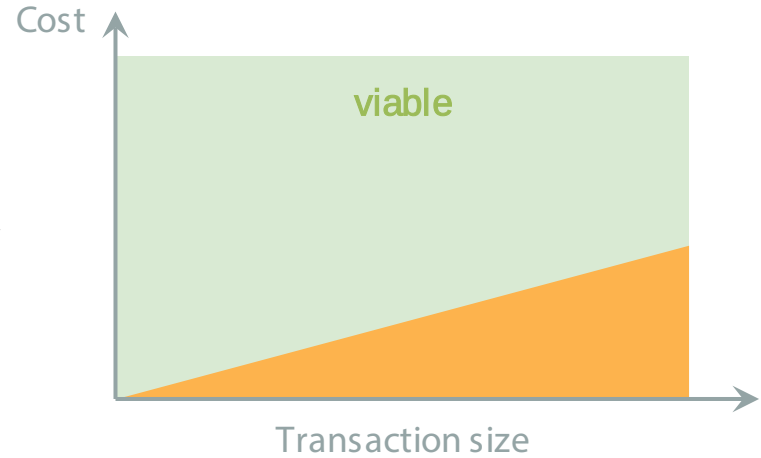


Removing Fixed Costs



pre-internetworking

fixed costs price out
long-tail use cases

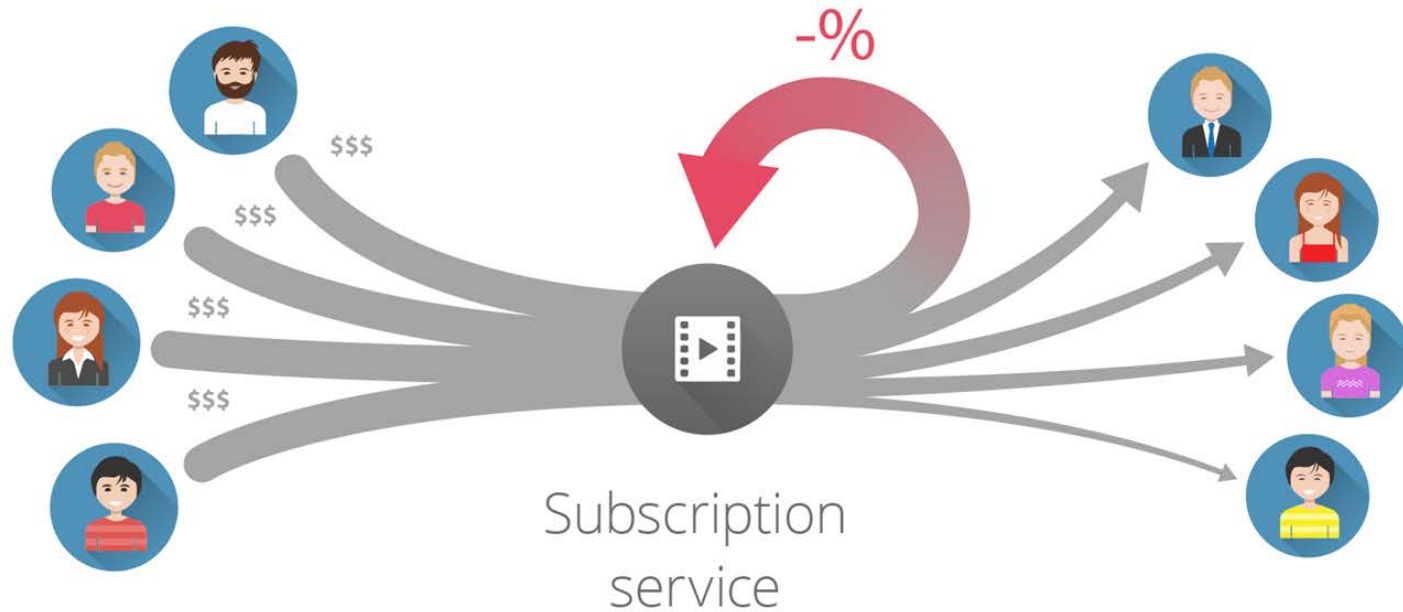


post-internetworking

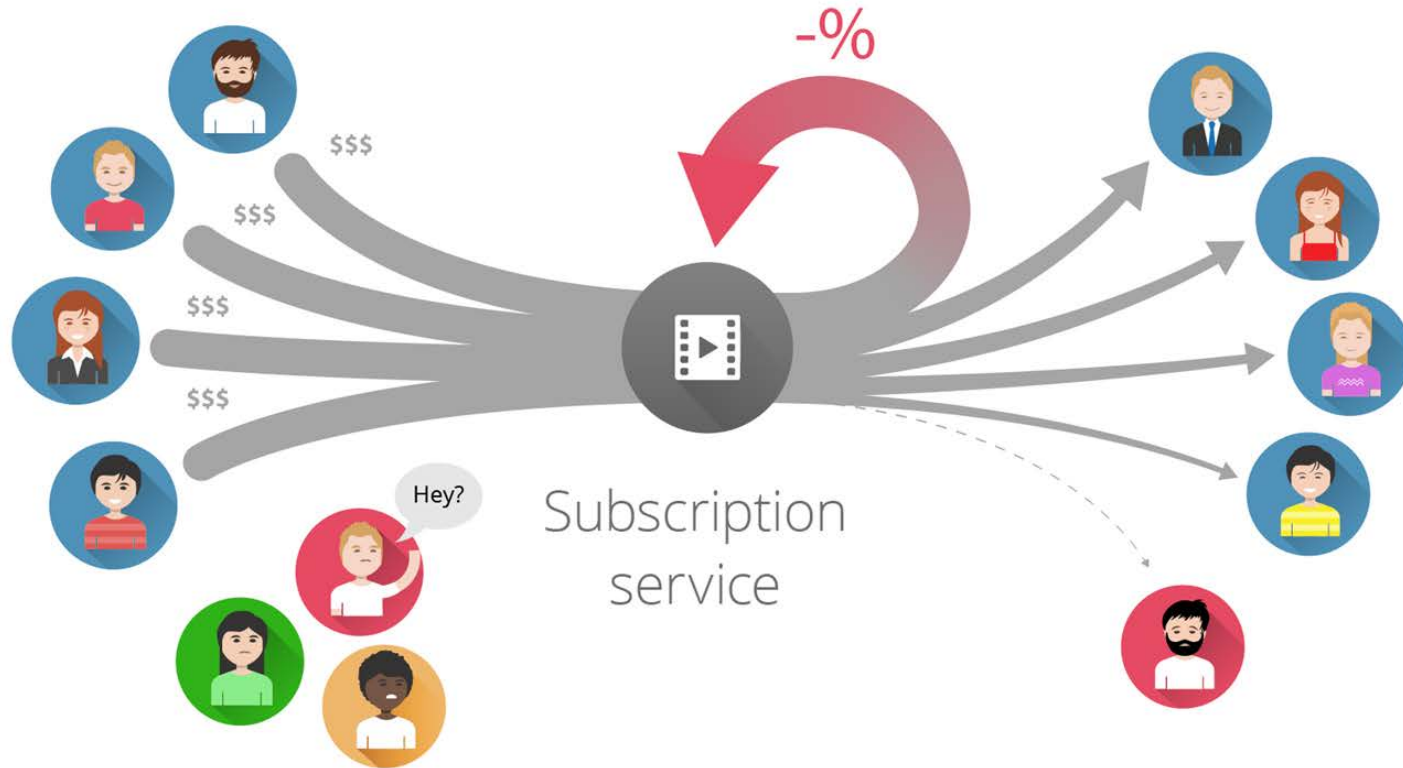
new business models
become possible



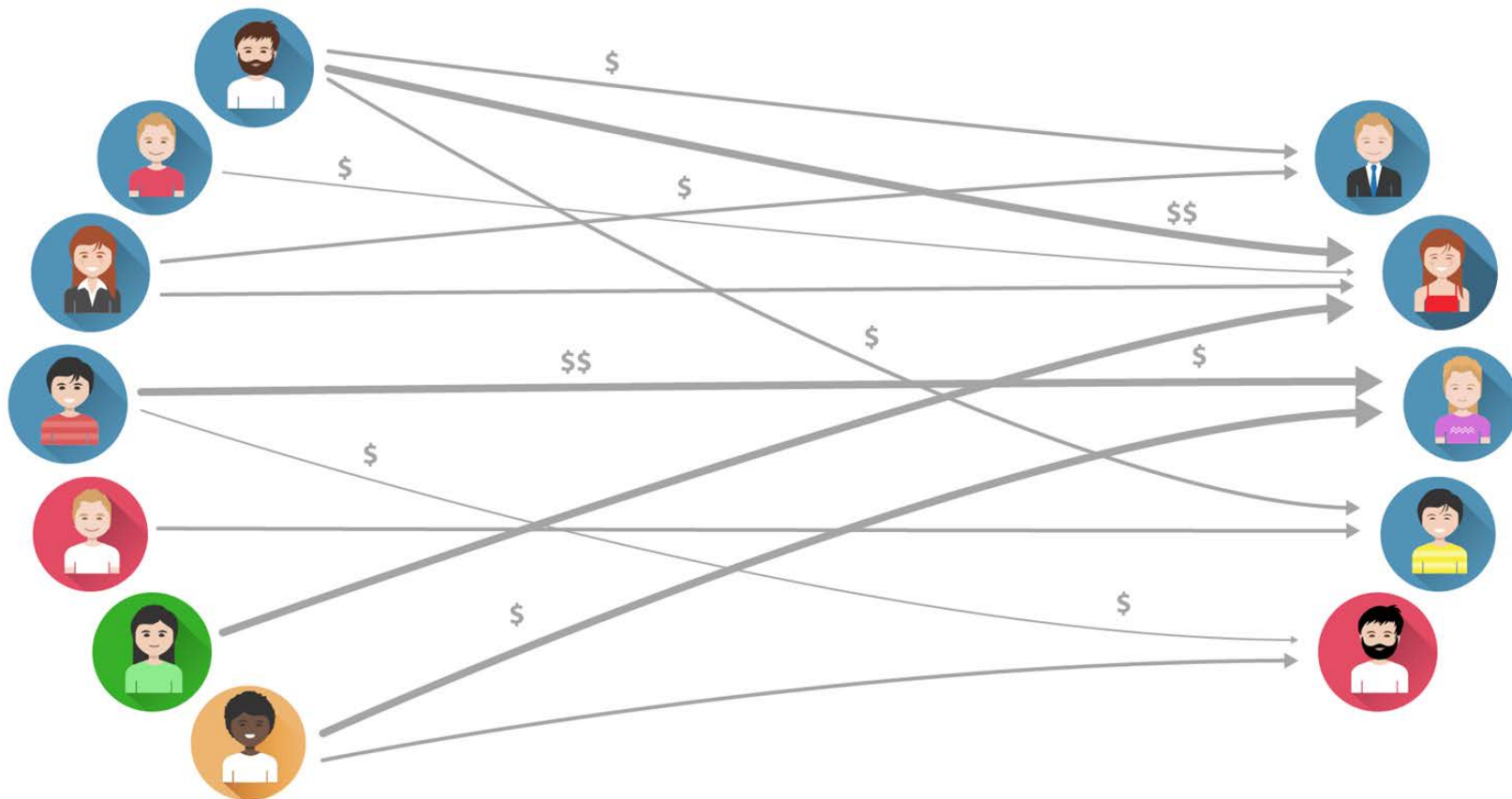
Example: P2P Content



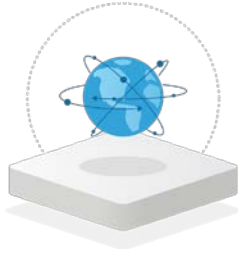
Example: P2P Content



Example: P2P Content



Future Examples



Distributed
Systems



Nano-
Economies



Incremental
Payments



Smart
Contracts



The Internet of Value is a game changer.

