# Resilience: multi-hop tax reallocation in Ripple for guaranteed basic income

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ABSTRACT: Ripple, the multi-hop mutual credit system invented by Ryan Fugger in 2003, is an ideal topology for a person-to-person safety net. The web of credit lines that Ripple models can be used as a conduit for reallocation of transaction taxes, used to pay for debt reduction to provide a social safety net for access to basic needs. The result is similar to Silvio Gesell's notion of "decaying currency".

Introduction

Ryan Fugger improved on mutual credit by adding payment routing via multiple hops, similar to how traffic routing works on the internet. Ripple takes money to down the smallest possible scale. You are the bank. You issue money, and can only do so to people who trust you. In Ripple when you make a payment, you have to find a path of people that trust one another, going from you to the person you send the payment to.
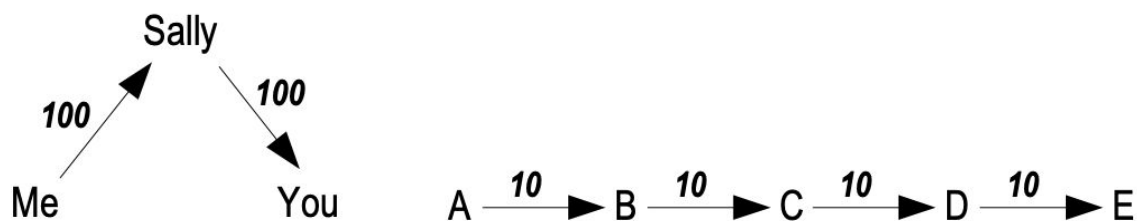
In Ripple, your balance is between you and another person only. If you receive an IOU from someone else, it will not affect your balance with the other person. The way your balance is cleared is instead via credit clearing, when a circle of IOUs has formed.
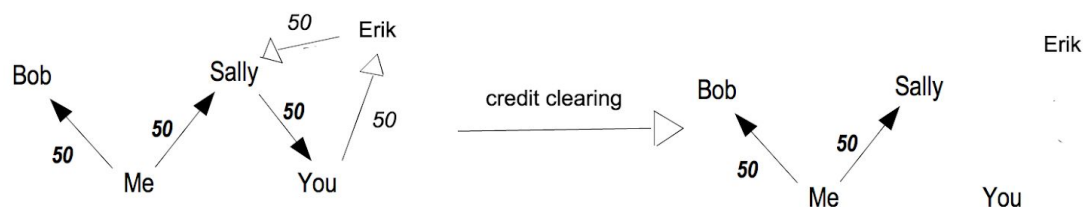
The credit lines that record IOUs (I-Owe-You) in Ripple are what create the "web" that Resilience is built on top of, similar to how email built on top of the internet.

Resilience

Resilience provides a social safety net in a way similar to traditional wealth redistribution, that is, from the rich to the poor, with the difference that the reallocation is in debt being forgiven, debt reduction. The safety net is paid for with transaction taxes, applied to every IOU, at each intermediary in payment routing.

The taxes are allocated to the "credit line web" by multi-hop debt reduction, propagating along credit lines, person-to-person. Each person reduces the debt others have to them with an amount equal to the amount their debt was reduced. When a person lacks an "income", has no incoming credit lines, they only receive, the system provides them with guaranteed basic income.

In other words, the tax "hops" from person to person until it finds a person without an income. That way of scaling mass-reallocation of wealth, is similar to how the internet scales data transmission, or how Ripple scales payments by hopping between people who trust one another.

The example below shows payment routing of 1000 XYZ with one hop, from Me via Sally to You, with a 4% transaction tax, and multi-hop debt reduction. The credit line for the payment also propagates tax. (animation)
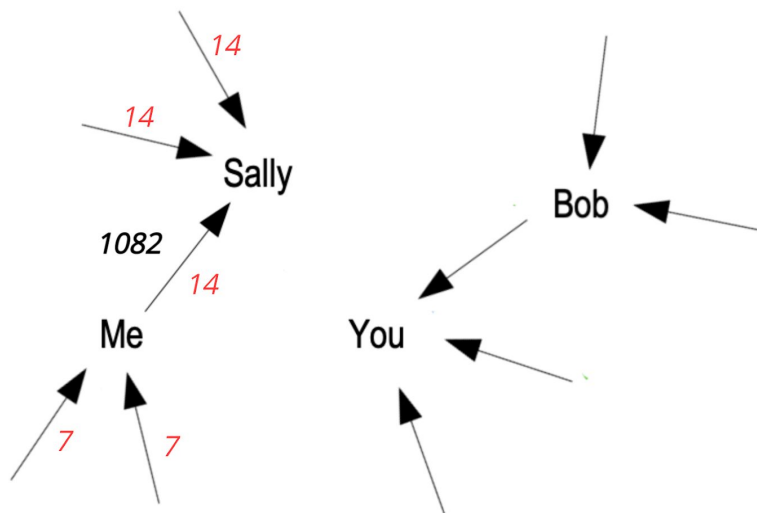
These "pulses" decrease with the number of credit lines they split into, assuming an average number of credit lines per person the pulses decrease with $\frac{1}{creditLines^{hops}}$. The number of people reached increases with the same factor, $creditLines^{hops}$. This means that that how often pulses reach *you* increases with same factor as the amount you receive decreases. The resulting field is homogeneous, and can be mathematically defined with the equation:

$$\frac{1}{creditLines^{hops}} \times creditLines^{hops} = 1$$

The credit lines in Ripple have some properties that make them ideal for reallocation of taxes, they are one-directional, never loop because they are cleared when they do, and since credit lines clear continuously, the amount of credit lines per person should, roughly, approximate an equal distribution.

There is one more detail, to prevent an attack vector, the propagation of taxes is in proportion to the size of a credit line, larger credit lines divert more than smaller. That removes any advantage from maximally distributing credit lines. (animation)

Trust index

The tax-rate in Resilience is regulated by mechanisms that have no central point of control, using peer selection. When issuing an IOU, you inherit the tax-rate the other person is using. This creates a "pay it forward" effect, allowing tax-rates to be selected for as trends that spread via relationships of trust, in the context of rules defined in the code of the protocol.

To be able to have tax-rates as trends, each person has their own "trust index", a value for their preferred tax-rate. The regulation of tax-rates in the network is done with the "trust index", and peer selection, a form of sexual selection by mate choice. The "trust index" can be adjusted at any time.

Taxemes

Taxemes are created from the trust indices, and are how tax-rates spread as trends via transactions. They serve as a social coordination protocol for regulating tax-rates.

The tax propagation is based on that credit lines have different "conductance", a 2% credit line has twice the conductance of a 1% credit line. People compete at any "hop" to propagate tax based on the taxemes they select for, encoded in the "width" of their credit lines. This is analogous to propagation of electricity or water in a pipe system, where rate of flow is proportional to area.

The taxemes are regulated in equilibrium with each person's credit balance. There is inheritance whenever input < output, and new taxemes created when input > output based on the value set by the trust index. The total amount of taxemes perfectly reflect the total amount of credit lines in the network, they are encoded within credit lines, and cleared as credit lines clear.

Taxemes are also cumulative, merging on inheritance, forming a single measure always. In the example, Carol having a 100 XYZ credit line at 4% and a 150 XYZ credit line at 3% would be a 250 XYZ taxeme at 3.4%, 100/250*4% + 150/250*3% = 3.4%. (animation)
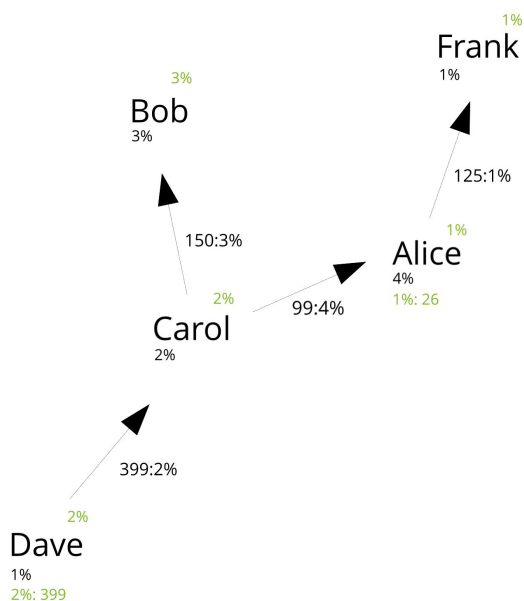
To prevent an attack vector, credit lines conductance is in proportion to all credit lines from a person.

References

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