Peer-to-Peer Economics for Post Catastrophic Recovery

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Abstract

Post-catastrophic recovery is gaining more importance to human societies.

This paper proposes use of a distributed autonomous economic medium to support recovery of communities after catastrophic events. It proposes a model in which everyone in the world can help each other as peers, instead of creating one's dependencies on others. The model applies peer-to-peer technologies on the Internet to achieve an environment for mutual help in the planetary scale.

1 Introduction

1.1 Post-catastrophic recovery and complementary currencies

On December 26, 2004, a tsunami swept the coastlines of Southeast Asian countries, killing an unprecedented number of people, taking means of life away from millions.

Recovery from such a catastrophe requires a lot of money. That is the reason why many appeals were made for fund-raising after the disaster. But the problem may lie in scarcity of the medium itself.

Complementary currencies, or alternative forms of monetary medium, have been proposed and tested in real life to achieve an autonomous, sustainable local economy even in short of money. Many of these currencies fall into the category of MCS[7] (Mutual Credit System), in which participants freely credit one another, and the tradings are recorded in a single accounting system. These currencies can potentially help the disaster-affected economy to recover, because they impose smaller budgetary constraints.

There have already been efforts to pursue such possibilities, including those from *ccTsunami*[1], an open forum on the Internet for discussion and implementation of programs to support the tsunami-affected places.

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Such programs need to be carefully designed not to impose excessive overhead or the communities' dependencies on others. We believe that requirements are as follows: 1) We need to build a mechanism so that anyone in the world can transfer funds to someone in an affected place safely and with certainty, 2) Such a mechanism, in a long term, should help the local economy to stand independently, and 3) It should require the smallest overhead as possible.

1.2 Contributions of this paper

This paper proposes an alternative to today's ways for raising funds or facilitation by MCS currencies – we will propose an alternative economics using *i*-WAT[4], an electronic descendant of the WAT System[8].

Sustainability of MCS has been in question because of their high operational cost. A simulation[5] has shown that growing the number of free-riders in MCS has a paradoxical effect of increasing "welfare" of the community. Since there is no pressure to stop the growth of the bad users, it is difficult to sustain the soundness of the system without strong interventions from the operators of the system. The same simulation indicated that *i*-WAT users can spontaneously sustain barter relationships even in the presence of free-riders by natural evasive actions to avoid risks, which makes it ideal for economics in post-catastrophic recovery, where autonomy is particularly important.

This paper starts by briefly explaining WAT/*i*-WAT currency system. It will then describe the model and what consequences are expected. Some proof-of-concept experiments have been conducted on the model.

2 WAT/i-WAT currency system

2.1 The WAT System

The WAT System uses a *WAT ticket*, a physical sheet of paper resembling a bill of exchange, as the medium of exchange. A lifecycle of a WAT ticket involves three stages of trading (*the WAT Core*) as illustrated in Figure 1:
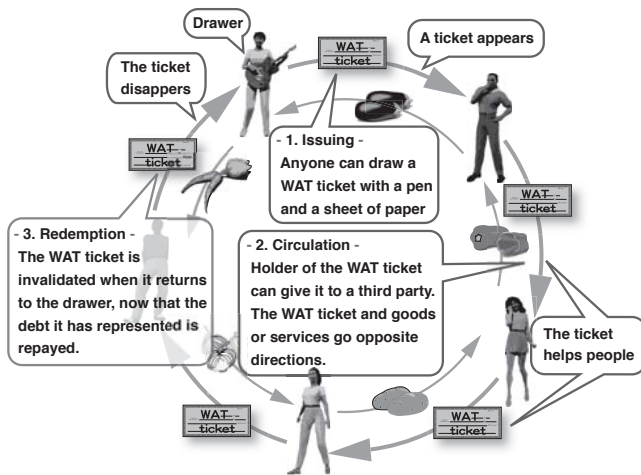
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Figure 1. The WAT Core

Figure 2. Reduction over time

Issuing A *drawer* issues a WAT ticket by writing on an empty form the name of the provider (*lender*) of the goods or service, the amount of debt[1], the present date, and the drawer's signature. The drawer gives the ticket to the lender, and in return obtains some goods or service.

Circulation The person to whom the WAT ticket was given can become a *user*, and use it for another trading. To do so, the user writes the name of the recipient, as well as their own, on the reverse side of the ticket. The recipient will become a new user, repeating which the WAT ticket circulates among people.

Redemption The WAT ticket is invalidated when it returns to the drawer.

In case the drawer fails to meet their promise on the ticket, the lender assumes the responsibility for the debt. If the lender fails, the next user takes over. The responsibility follows the chain of endorsements (*security rule*). The longer the chain is, the more firmly backed up the ticket is.

2.2 i-WAT: the Internet WAT System

i-WAT is a translation of the WAT Core onto the Internet. In *i*-WAT, messages signed in OpenPGP (*i-WAT messages*) are used to implement transfers of an electronic WAT ticket (*i-WAT ticket*). An *i*-WAT ticket contains a unique number, amount of debt and public key user IDs of the drawer, users and recipients. Endorsements are realized by nesting PGP signatures over canonical XML expressions.

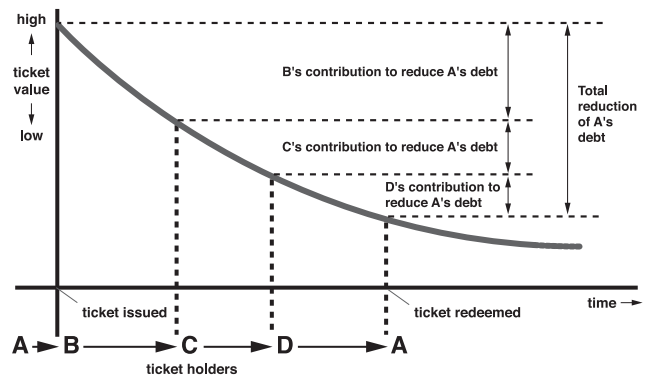[1]Typically in the unit kWh, which represents cost of producing electricity from natural energy sources.

Upon translating the WAT Core onto the digital networks, we have made the following changes from the state machine of a WAT ticket: 1) Trades need to be asynchronously performed. Intermediate states, such as waiting for acceptance or approval, are introduced, and 2) Double-spending needs to be prohibited. The drawer is made responsible for guaranteeing that the circulating ticket is not a fraud. This means that every trade has to be approved by the drawer of the involved ticket.

The semantics of this design and the trust model of *i*-WAT are discussed in detail in [3].

2.3 ROT: Reduction Over Time

It is known among the practitioners of complementary currencies that reducing the value of the exchange medium over time accelerates spending, because users want to use the medium before its value decreases.

In [6], we have explained that this has potential effects of not only promoting exchanges, but also providing participants with means to mutually support peers, by sharing debts among one another in a form of currency. We clarified the semantics of a *reduction* ticket, which is a realization of the concept in the WAT/*i*-WAT currency system. Reduction of the value means that the drawer's debt is reduced. The cost of reduction is first admitted by the lender who credits the drawer, and then shared among the endorsers as illustrated in Figure 2.

3 Post-catastrophic recovery

3.1 The model

The model is illustrated in Figure 3. It assumes the presence of an NGO installed at the disaster-affected place which facilitates reconstruction of the community. Its main
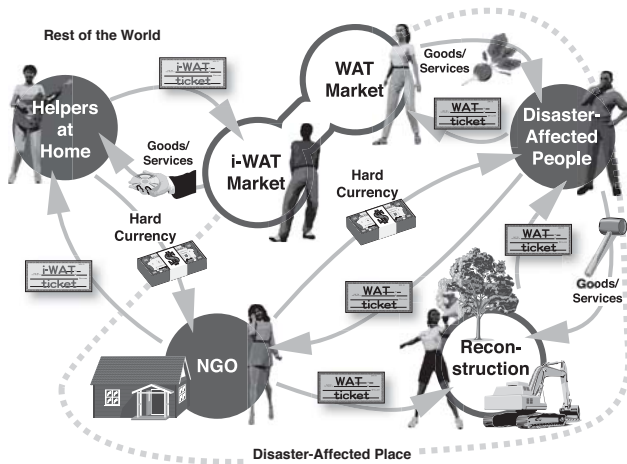
* WAT and *i*-WAT markets are connected by entities which issue one type of tickets by promising another (*exchange points*). The NGO in this figure is an example of such entities.

Figure 3. Post-catastrophic recovery model

function is three-hold: 1) Safely transfer funds to people in need in return with WAT tickets they issue, 2) Employ people for reconstruction work with the WAT tickets, and 3) Collect funds in hard currencies such as US dollar, euro or yen from the rest of the world in return with *i*-WAT tickets corresponding to the WAT tickets in their possession.

The WAT tickets represent the debt of the disaster-affected people, which is reduced over time using the mechanism of ROT. Helpers in the rest of the world can assist this reduction by deferring the transfer of *i*-WAT tickets they have obtained.

Economics for the disaster-affected place   The principle is that the local people work for the local people, creating few dependencies on the outer economics.

The people acquire means for life such as fishing instruments by issuing WAT tickets. By issuing the tickets, they promise that they will provide some goods or services when the tickets return to them in future.

In case the merchants do not accept WAT tickets, they can give the tickets to the NGO to receive funds in hard currency in return. The money is only transferred in exchange with some WAT tickets issued and presented by the people in the community. By knowing that there is a way to exchange WAT tickets with money, it will become easier for people to accept WAT tickets.

The NGO, by using the WAT tickets they have obtained, can employ people in the affected place and its vicinities to work for restoring the infrastructure.

It is also possible to use *i*-WAT instead of WAT in the

disaster-affected place where communication infrastructure has presumably been destroyed. Our reference implementation of *i*-WAT currently uses XMPP (Extensible Messaging and Presence Protocol), requiring rather consistent connectivity, but we have been investigating the possibility of applying CCS (Content Cruising System)[2] as a transport layer for conveying *i*-WAT messages, which will enable people to use portable wireless devices with ad-hoc channels where no Internet-connectivity is available.

Economics for the rest of the world   The NGO issues *i*-WAT tickets which can be purchased on the Internet by the rest of the world. To do so, the NGO will need consistent connectivity with moderate bandwidth.

Those *i*-WAT tickets promise to give WAT tickets issued by the disaster-affected people. If someone in the rest of the world purchases one of those tickets, it means that they help some particular person, household or enterprise.

It can be seen that the NGO purchases the WAT tickets issued by people using the money the organization obtained in exchange with their *i*-WAT tickets.

3.2   Expected consequences

The disaster-affected community in some day will be reconstructed. As the situation improves, people there will be able to pay back to the rest of the world with their working and their products. Their debt will have been considerably decreased with the help of the holders of corresponding *i*-WAT tickets by then.

The helpers in the rest of the world can use the *i*-WAT tickets they have purchased for trades on the Internet. Since each ticket represents debt owed by a disaster-affected person, household or enterprise, WAT/*i*-WAT unites the disaster-affected community with the rest of the world.

If people regard the NGO as an overhead, they can invent ways to get around it. Gradually, the NGO will complete its role as a medium for spreading the idea of economics based on WAT/*i*-WAT. Possibly they will realize that the economics can sustain without hard currency – perhaps it will be the birth of a new autonomous economy where everyone can participate spontaneously.

4   Experiments

4.1   Proof of concept of the scheme

Reduction tickets have already been in use in reality to help people in need for funds. The travel expenses to and from EXPO 2005 AICHI JAPAN for the experiment described later was in part paid by supporters of *i*-WAT research across the country, in exchange for the equivalent amount of *reduction* tickets issued by a researcher.

This was an actualization of a theoretical model of mutual aids: the ones in need issue *reduction* tickets, so that their debts are reduced by the contributions of the supporters who accept the tickets, and supporters are helped by the utilities of the media of exchange.

The researcher received 26,000 Japanese yen, and issued 26 *reduction* tickets each worth 10kWh initially (Figure 4) in return, each of which promises 6-minute worth of programming labor per 1kWh.

Sum	8.72kWh (as of October 2006)
Initial value	10kWh
Over-time rate	-0.2%/week
Stop value	0kWh
Reaches at	Wed Feb 04 23:41:10 JST 2015
Creation date	Wed Jul 06 23:41:10 JST 2005

Figure 4. Example: an issued reduction ticket

This real-life experiment also involved an actualization of another aspect of the described model. Since many of the supporters of the research were not *i*-WAT users yet, they needed an exchange point who translated the researcher's *i*-WAT tickets into paper-based WAT tickets, whose values are reduced at the same rate as their electronic counterparts. This was a proof of concept that the exchange mechanism such as the NGO in Figure 3 is operable in reality.

4.2 Proof of concept of the technology

We have experimented on *i*-WAT trades and PGP public key exchange by a group of wireless handheld devices communicating in an ad-hoc manner, together with a team of CCS-experimenters. The experiment was conducted at EXPO 2005 AICHI JAPAN.

The main purpose of the experiment was a proof of concept that *i*-WAT can be used over wireless ad-hoc channels of communication. This was a step forward for *i*-WAT to become a tool for mutual help under such situations of post-catastrophic events, where energy and connectivity are both insufficient.

The experiment took the form of a trading game of vegetables (just as in Figure 1), in which 24 people partici-

pated, 34 *i*-WAT tickets were issued, and 47 trades were performed during the 30-minute game. Although the experiment was successful in proving that *i*-WAT is operable over ad-hoc communication channels, we discovered that usability needs much improvement.

Detail of the experiment is described in [4].

5 Conclusions and future work

This paper proposed use of WAT/*i*-WAT to support recovery of communities after catastrophic events. It proposed a model in which everyone in the world can help each other as peers. We are in the hope that those people unfortunately affected by disasters will consider WAT/*i*-WAT as an option for helping themselves.

For this to happen, we need to make an environment where the concept of WAT*i*-WAT is readily accepted by the general public. We will start by spreading the idea that those barter currencies can help, through more experiments and applications on daily interactions among people.

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