The Future of Marketing is Ad-free

WOM Economy Paper

womprotocol.io

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Request for feedback

Overview

The WOM whitepaper outlines the goals of the WOM Protocol and native WOM Token: namely to enable brands to access genuine word-of-mouth (WOM) recommendations and provide a way to reward creators for their product-referring content without compromising consumer trust in the content and its creators.

In order to accomplish these goals, WOM is bringing together several parties: to create a decentralized ecosystem WOM must also use incentive mechanisms that align each party and ensure all act in the best interest of the WOM Ecosystem. With no central authority, these incentive mechanisms are a core foundation of the WOM Ecosystem to ensure that value is perpetually created and the economy is continually strengthened.

This document outlines the economic incentives for the various parties and how the WOM Protocol will implement these mechanisms. The WOM Economy Mechanisms paper is an **initial public request for comment and feedback**, following our extensive research and feedback from advisors and industry leaders.

For any feedback and comments, please email daniel.wingen@womprotocol.io.

As we receive feedback and additional insights and learnings, we will continue to update and evolve the economic incentives and mechanisms of the WOM Protocol.

Join the discussion in our Telegram channel.

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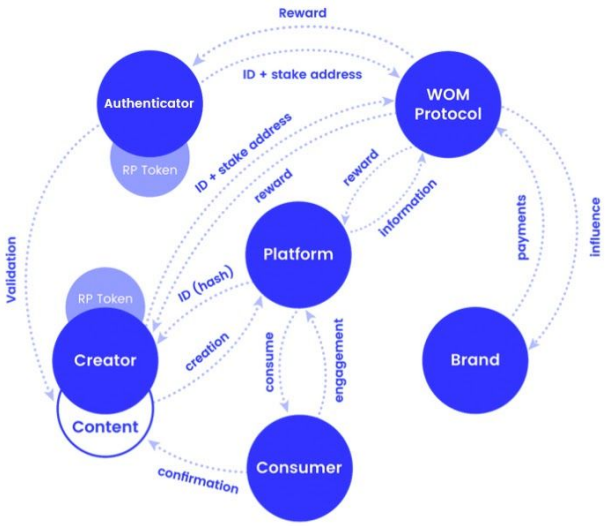
1 OBJECTIVE

The WOM Protocol is designed to maximize accessible valuable WOM content. This incentive design is ensured through several mechanisms inherent in the blockchain protocol which are outlined in this paper. The incentive design follows the stakeholder map as shown below:



First, users are incentivized to create WOM content. Second, high-quality content is differentiated from low-quality content through an authentication process. Finally, the content is distributed through platforms and eventually engaged with by consumers. The WOM Protocol acts as an incentive machine that holds all actors together and fosters collaboration.

2 WOM CONTENT STAKEHOLDERS

The value of WOM content is important for two stakeholders: the consumers and the network which includes the brands acting on the network. As a result, the value of WOM content for these stakeholders defines the quality of the respective content piece.

Consumers attribute some value to the content directly related to its quality. This means that generally, the higher the quality of the content, the more interesting and valuable the content is for consumers.

In traditional advertising, the quality of content is defined and agreed on by marketing managers and creative agencies, but as WOM content is user-generated, marketing managers and brands do not have an input. Rather, the WOM Protocol incentivizes WOM content in general and is not solely about WOM content for a specific brand. This means content about all brands will emerge without each brand necessarily being involved in the WOM Protocol.

The other dimension is the value of the content for the network, expressed through content engagement. Engagement is a purely quantitative measurement widely used and accepted by the advertising industry. The value is derived through the understanding that the higher the engagement with the content, the more reach it creates and the more influence on purchase decisions it generates. Purchase decisions result in more revenue for brands; therefore brands see more value in the WOM Ecosystem and increase their financial stake in the WOM Economy.

2.1 Quality KPIs associated with WOM content

By definition, WOM content is valuable when it brings value to the person who is consuming the content. The following categories serve as a proxy for evaluating content through its value for consumers:

- Authenticity
- Creativity
- Positivity

The dimension "Authenticity" means honest, reliable, and trustworthy content that is not sponsored or faked, i.e. the content is not compromised by a monetary incentive from a brand. For example, situations in which the influencer gets paid upfront by a brand to target the brand's audience are punished through a low authenticity score.

The dimension "Creativity" expresses the creativity and effort put into the content creation such as a holistic description of the product with its pros and cons, a comparison with other products as well as pictures, videos and other creative elements. Important aspects are the creation of desirability and that the creator of content is not copying any existing content but instead created new content, i.e. put work into it.

The dimension "Positivity" refers to content presented in such a way that sparks desire for the specific product, brand, or service. Content without a positive recommendation of a product, service, or brand does not match the definition of word-of-mouth content.

Each of the above mentioned categories has a range from 0 to 10.

The formula for calculating the quality of WOM content is as follows:

$$quality\,(WOM) \;:=$$

$$\tfrac{1}{2}\,rating_{authenticity} + \tfrac{1}{4}\,rating_{creativity} + \tfrac{1}{4}\,rating_{positivity}$$

Authenticity is considered twice as important as the other dimensions "creativity" and "positivity." Therefore, authenticity influences the overall quality of WOM content by 50%. This weighting might be changed over time if the community comes to the conclusion that creativity and positivity need a larger influence on the quality rating of the WOM content.

WOM content is rated by authenticators. Authenticating or validating WOM content is a potentially-subjective activity so authenticators are incentivized not to state their own opinion of the content, but to guess the possible overall

opinion of the market. Authenticators only receive a reward if they meet the market's consensus. Not matching the market's opinion results in a penalty for the individual authenticator. These mechanisms are explained in great detail further on in this paper.

2.2 Value KPIs associated with WOM content

High-quality content is worth nothing without an audience consuming it, according to the principle "value derives from engagement." Thus, the WOM Protocol utilizes engagement KPIs to measure the ultimate value of the content.

As soon as WOM content is publicly available, it receives ratings in different dimensions based on the interaction with the consumer. These value KPIs are defined as follows:

- Number of views
- Number of likes
- Number of comments
- Number of clicks on the brand link, if included (may only be included if a brand supports the content through a campaign)

Views are considered as least important whereas clicks are the most important. A view is worth 1/500 of a click. Comments are slightly more important than likes, which are worth 1/3 and 1/4 of a click, respectively. In the formula below, the differentiation of these dimensions is relative to the number of clicks.

The formula for calculating the rating of all value KPIs is as follows:

$$rating(value\ KPIs) :=$$

$$n\left(\frac{1}{500}\#(views) + \frac{1}{4}(likes) + \frac{1}{3}\#(comments) + \#(clicks)\right)$$

with

$$likes :=$$

$$\frac{1}{2}\#(authenticity) + \frac{1}{4}\#(creativity) + \frac{1}{4}\#(positivity)$$

:= number of, n(x) as normalization function to a range from 0 to 10.

The differentiation of likes in the dimensions authenticity, creativity, and positivity is optional. Individual platforms decide whether to adopt this differentiation in their platform or not. The WOM Protocol supports such a differentiation either way.

For the calculation of the overall reward function, the KPIs for each content piece must be normalized to set all factors properly in relation to each other. The normalized range of all factors is determined to range between 0 to 10. The normalization factor is derived by the highest value of all instances as determined by the formula:

$$\frac{1}{500}\#(views) + \frac{1}{4}(likes) + \frac{1}{3}\#(comments) + \#(clicks)$$

The resulting number is the "upper bound." Eventually, the equation for normalization is derived as follows: $\frac{upper\ bound}{m} = 10$ since the highest normalized number is 10. This results in the normalization factor $m = \frac{upper\ bound}{10}$. Each instance is then divided by the normalization factor. As a result, the upper bound equals 10 and the remaining values range between 0 and 10.

This upper bound, which is the highest non-normalized value of the value KPI rating, is constantly pulled. Thus, the calculation is current and in alignment with growing user rates. In the beginning, the time frame for calculating the normalized rating is 7 days. In more detail, the highest rating over the last 7 days receives the normalized rating of 10. Subsequent ratings are normalized according to this upper bound. Every 7 days, the new upper bound for normalization is calculated.

Platforms measure value KPIs. These KPIs influence the reward content creators receive. Since platforms receive a share of the content creators' rewards, the KPIs indirectly influence the platform's reward which then influences the platform's home feed, as explained in section "Platforms."

3 INCENTIVIZING ACTORS

3.1 Staking

Incentives must be set in a way that actors in the WOM Economy have an equity-like return function which comprises reward and punishment: On the one hand, they have a great upside potential. On the other hand, they may lose tokens.

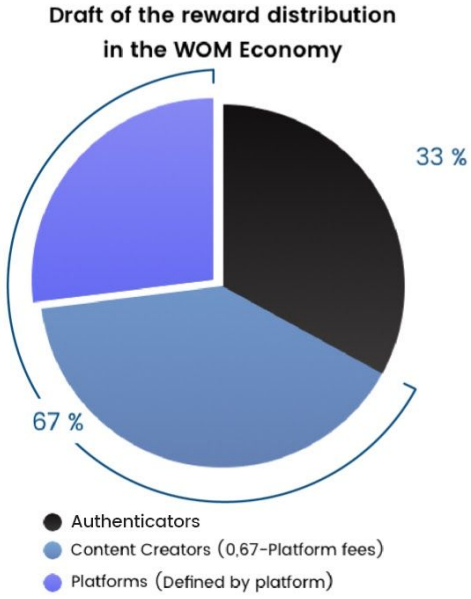
Losses are perceived as bad for the respective individuals. However, behavioral economics shows that individuals do not perceive a double loss as twice as bad as a single loss. Rather, the function of suffering related to loss is logarithmic (strong suffering in the beginning and then flattening). According to Prospect Theory by Kahnemann and Tversky (1979), individuals are risk-taking with increased losses. For this reason, the WOM Protocol uses a steep linear loss function to create a strong deterrence of incorrect behavior. For gains, individuals act risk averse. Therefore, the WOM Protocol uses flat linear gain curves to incentivize maximum individual performance.

As there should be no central authority to punish the participants for being non-compliant with the terms and conditions (excluding extreme cases such as criminal actions), it is necessary for participants to stake something against every action they take on the network.

3.2 Creating incentives through the Value Creation Fund

The Value Creation Fund is the crucial module of the WOM Protocol to incentivize actors to participate in and create value for the WOM Ecosystem. It is meant to kickstart the WOM Ecosystem and support the objective to maximize accessible and valuable WOM content. In the course of the Token Generation Event (TGE), WOM Tokens are paid into the Value Creation Fund. When the WOM Protocol is deployed, staked tokens which are lost and payments by brands are paid into the Value Creation Fund.

Rewards from the Value Creation Fund are emitted in regular time intervals. These rewards are divided between the content creators and platforms (2/3), and authenticators (1/3). The heavier weight for the content creators and platforms creates strong incentives for content creation. However, authentication is important for a well-functioning WOM Economy so the rewards for authentication are 1:2 compared to content creation and the infrastructure for content.



Individual platforms each define the share of the content creator rewards they receive. This creates competition and the platforms with the best fee-service structure will be the most successful.

3.3 RP Tokens and WOM Tokens

Reputation (RP) Tokens are introduced to incentivize authenticators to come to a decentralized consensus about the quality of WOM content. RP Tokens reflect the authentication power of each authenticator and therefore the influence on the network. RP Tokens are backed 1:1 with WOM Tokens and WOM Tokens are worth the same.

Reputation can be increased by sending WOM Tokens to the RP Token smart contract which holds them in custody. RP Tokens are backed 1:1 in full reserve. In this process, a fee of 20% is charged that goes to the Value Creation Fund. The other way around is possible as well: RP Tokens can be exchanged into WOM Tokens.

The exchange may take place with the platform that holds WOM Tokens in reserve for each distributed RP Token. This is achieved completely decentrally and independent of any intermediary through a smart contract that manages RP and WOM Tokens. However, exchanging between RP and WOM Tokens is limited through a certain holding period: trading RP Tokens to WOM Tokens requires a minimum time frame of 7 days.

3.4 Reward time

In the beginning centralized phase, the reward time is 24 hours. Payouts to the actors of the Ecosystem are bundled and triggered through a smart contract initiated by the content platform. With increasing decentralization, the reward time is reduced to one minute and is handled with state channels. In any case, the given time spans for determining the rewards for content creators and authenticators must be accomplished first.

4 INCENTIVIZING VALUABLE WOM CONTENT

4.1 Content creators

The content creator (CC) has the role of creating content within the WOM Economy. The following functions hold:

For any content piece $p \in P$, there is a mapping

$$Creator : p \rightarrow C \text{y}$$

to all content creators C, which means that for any $p \in P$ there is a function

$$Creator\,(p) \in C$$

Content creators have to be correctly incentivized. Thus, content creators need to have skin in the game, which is why they must stake tokens. Staking tokens ensures enough incentivization for good content so the market is not spammed.

4.2 Staking WOM Tokens

Content creators must stake a certain number of WOM Tokens to get their content listed on the authentication market. If the quality of the content is evaluated above a certain threshold, the content creator may receive a reward. This mechanism is described in great detail later in this paper. If the content is rated below a certain threshold, the content creator loses all staked WOM Tokens. These WOM Tokens are then distributed to the authenticators that correctly evaluated the content.

The amount of WOM Tokens creators must stake to get their content listed on the authentication market depends on the WOM Token price. As the price of the WOM Token increases, a lower stake is needed to ensure the same incentivization. Conversely, if the price of the WOM Token decreases, a higher stake is necessary to ensure that the platform is not flooded with spam content. The actors must put skin in the game to the degree that a loss becomes painful.

Only staked content may receive rewards. As soon as content creators withdraw their stake, rewards are no longer possible.

In general, the content creator can earn more WOM Tokens than are staked and is incentivized to keep the content in the authentication market for the assumed lifespan of the content piece. The lifespan of social media content is just a few days or even hours.[1] The lifespan of a blog is far higher--an average of 30 days. Some studies claim an even higher lifespan of two years.[2] Therefore, the recommended

staking time depends on the assumed lifespan which in turn depends on the platform's way of presenting content.

In the case that content is not authenticated (which means that less than three authenticators evaluated the content piece), content creators receive their stake back and do not earn any rewards. A non-authenticated content piece indicates bad quality content due to mechanism design: Authenticators generally prefer to authenticate high quality content since they may receive a portion of the rewards. For poor-quality content, authenticators merely receive the content creators' lost stake. This mechanism ensures efficiency of the WOM Economy.

There is the question of how content creators may receive their first WOM Tokens for staking. There are two options: First, the content creator acts as authenticator where a small amount of authentication power is given for free. By performing authentication actions within the network the participant has the opportunity to receive WOM Tokens. Second, WOM Tokens are bought on an exchange.

There is a permanent link between content and the content creator. This link ensures that only the content creator may stake content and have the opportunity to receive rewards. There is one exception: the content creator may grant copyrights to the platform so the platform may stake the content piece in return for a share of the rewards. The specific criteria are set by the platform and will eventually be determined by the natural economic forces of supply and demand. In this case, the content creator does not need a wallet.

4.3 Objective function of the content creator

The objective function of the content creator that determines the content creator reward is defined as follows:

$$R(CC) :=$$

$$max\, F((\tfrac{1}{3} \times u(quality\ (WOM)) + \tfrac{2}{3} \times rating\ (value\ KPIs))$$

with

- Quality (WOM) and rating (value KPIs) as defined above and
- The function u(x) either transforms the quality of the WOM content into a negative value which results in losing staked tokens or into a positive value through which rewards may be obtained (details defined in a subsequent section); if u(x) is negative, then R(CC) becomes the value of u(x) and all other factors are neglected.
- F(x) depends on the Value Creation Fund allocation which includes brand payments

The dimension "quality (WOM)" and "rating (value KPIs)" defines the rating of each content piece among all content pieces. The value KPIs are considered more important than the quality of the WOM content and therefore have double the reward. The function F(x) sets the individual content creator reward in relation to the overall content creator reward. At the same time, the share of the Value Creation Fund that flows to the authenticators and the platform is deducted. Thus, the first aspect concerns the portion of rewards within the group of content creators and the second aspect concerns the portion of rewards among all actors of the WOM Economy.

In general, stakes that have been lost by content creators and authenticators are always distributed among actors that were involved with the specific content piece. So let's say content piece X created by content creator A and authenticated by B, C, D, E, F was not considered as WOM content. Authenticators B and E lose their stakes due to wrong assessment. Then the stakes of A, B and E are distributed to C, D and F.

4.3.1 The quality of WOM content influences content creator rewards

Staked WOM Tokens are lost when the following threshold in user and authenticator rating is reached:

Authenticity at a low score (0-8)
Creativity or Positivity at a very low score (0-7)

This results in an overall threshold for losing tokens:

$$threshold :=$$

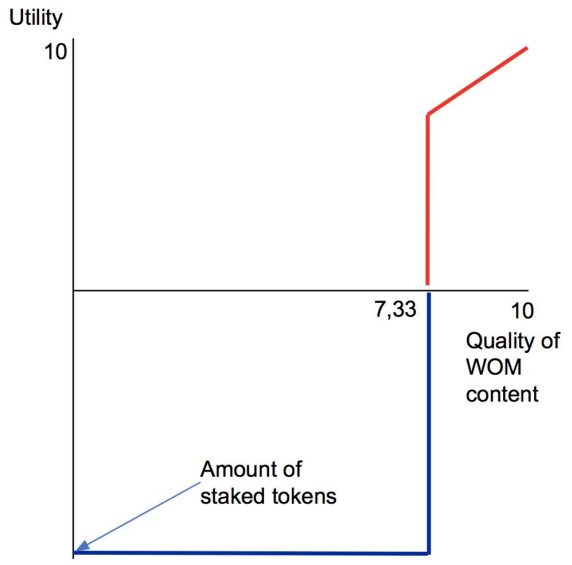
$$\frac{ut\ (authenticity) + ut(creativity) + ut(positivity)}{3} = \frac{8+7+7}{3} = 7.33$$

with

- ut := upper threshold

In this design, bad ratings in the dimension "authenticity" are rated higher than in the other dimensions to ensure trustworthy content. For an overall rating of 0, all staked tokens are lost. If one dimension is rated below the aforementioned threshold, then WOM Tokens are lost independent of the rating of the other dimensions. This ensures high-quality content in all dimensions. For an overall rating of 10, the utility of the quality of the WOM Token receives maximum value. The final reward is determined by the value KPIs which are based on consumer interaction.

The following graph shows the content creator's utility function regarding the quality of WOM content.



The utility depends on the quality of WOM content. The downside utility is defined by the staked tokens. If the dimension quality (WOM) is below a certain threshold, all staked tokens are lost and no reward is possible. This threshold is defined at a quality of WOM content of 7.33. The protocol sets a minimum of tokens that must be staked as explained in the section "Staking WOM Tokens." Since there is no upside potential when staking more tokens than this minimum, a rational actor would merely stake the exact minimum. As soon as the function u(x) returns a negative value, no returns are possible. R(CC) directly turns into the negative value as given by u(x). The upside potential mirrors the rating of the quality of the WOM content as defined by the authentication process.

In the figure above, the red gain curve is linear. As soon as a certain threshold is reached, all staked tokens are lost. This means that content must be good to receive a high reward and as soon as content is valued negatively, the associated loss is severe. This model provides:

1. Strong incentives for high quality content
2. Strong disincentives for bad content

4.3.2 The value KPIs are the main drivers for content creator rewards

Value KPIs which reflect the consumer interaction with WOM content are the main drivers for content creator rewards. The more the content is interacted with (reach), the more valuable it becomes. This parameter is evaluated independent of the stake.

After the content creator has created and then staked WOM Tokens to the content piece, the content is placed on the authentication market. During the authentication period, users may engage with the content. This engagement enables rewards only if the authentication is positive, i.e. the content is defined as WOM content. If the content is not authenticated as WOM content, then the content creator loses their stake. The general calculation of the normalized rating of the value KPIs including the standardization has already been discussed in section "Value KPIs associated with WOM content."

4.3.3 The Value Creation Fund allocation influences content creator rewards

The reward dimension related to fund allocation is dynamic according to the number of tokens the Value Creation Fund emits in each period and the amount of tokens a brand pays into the fund. The first number is pre-determined by the protocol. Initially, the Value Creation Fund is filled with 35% of the tokens generated during the TGE. A portion of the brand payments (50%) is directly transferred to the Value Creation Fund and the other portion (50%) is reserved to support brand-related content.

For the following calculations, the term $\frac{1}{3} \times u(quality\ (WOM)) + \frac{2}{3} \times rating\ (value\ KPIs)$ is defined as $R(CC)_{int}$ for an intermediate result without the function F(x) applied.

The content creator reward depends on the tokens emitted by the Value Creation Fund (value creation reward) and the lost stakes of authenticators that are not in alignment with the overall authenticator vote. The portion each content creator receives is:

$$F(x) :=$$

$$\frac{R(CC)_{int}}{\Sigma R(CC)_{int}} \times value\ creation\ reward \times \frac{2}{3} \times (1-p)$$

with

- $\frac{R(CC)_{int}}{\Sigma R(CC)_{int}}$ as the individual intermediate content creator reward
- *Value creation reward* as defined by the distribution pattern of WOM Tokens as explained in the whitepaper
- 2/3 as the portion which flows to the content creators and platforms (1/3 flows to authenticators)
- p as the percentage reward flowing to the platform hosting the content as defined by the platform

4.3.4 Brand support influences content creator rewards

$R(CC)_{int,brand}$ is calculated in the same way as above; however, it only considers brand-related content.

$$F(x)_{brand} :=$$

$$\frac{R(CC)_{int,brand}}{\Sigma R(CC)_{int,brand}} \times brand\ payment \times (1-p)$$

with

- $\frac{R(CC)_{int,brand}}{\Sigma R(CC)_{int,brand}}$ as the proportional value creation that relates to the brand payment considered
- *Brand payment* as the amount of tokens paid by brands referring to the content piece
- p as the percentage reward flowing to the platform hosting the content

The distribution of the (1-p) brand payments goes directly to the content creators. Authenticators receive no rewards from

brand-specific pools. The reason is: platforms receive a portion of the content creators' payouts. Therefore, they have the incentive to position a content piece with an expected higher payout more prominently in their news feed algorithm than other content which is not being sponsored by a brand. However, authenticators shall evaluate totally independent of brand payments. Otherwise the important neutral authentication process would be biased and the push for brand-related content would become too strong.

The token price does not influence the number of tokens emitted in each period. Thus, as the WOM Economy grows in popularity, the value of the WOM Token rises which increases incentives to participate on the platform.

4.4 Reward time (payouts)

Payouts are made on a regular basis. In the beginning, payouts happen weekly. As blockchain technology advances, payments will eventually happen instantly (which creates a constant cash flow).

As soon as content creators withdraw their stakes, they lose the ability to earn WOM Tokens with the related content. Content creators are incentivized to stake their tokens for the assumed timespan of the content which is the duration the content is engaged with. Thus, the ratio of circulating tokens is kept relatively low which increases the token price. The more tokens are staked, the higher the price. Equally, the more tokens staked the more tokens need to be paid out.

5 IDENTIFYING HIGH-QUALITY WOM CONTENT

5.1 Authenticators

High-quality word-of-mouth content is identified and evaluated by authenticators. Authenticators represent the decision of the community. The term "validator" may be applicable as well, however the term "authenticator" is chosen to avoid confusion with the term "validator" in the blockchain industry. The process of evaluation is defined in the following:

For any authenticated content piece $p \in P$, there is a mapping

$$Authenticator : p \rightarrow C$$

to all authenticators C, which means that for any $p \in P$ there is a function

$$Authenticator\,(p) \in C$$

Authenticators evaluate the quality of WOM content created by content creators in the dimensions authenticity, creativity, and positivity. Authenticators prevent the market from being spammed with poor-quality content. Poor-quality content is either untrustworthy (e.g. the same content is published several times), not useful enough (e.g. merely one video linked without any further explanation) or not related to a product (e.g. no tags), or a combination of all three.

5.2 Authentication power

Authenticators need to have skin in the game to be correctly incentivized. This is why they must put something at risk. This is achieved with authentication power based on RP Tokens. Authenticators have a certain amount of authentication power which they can use to authenticate content pieces. When authenticators authenticate incorrectly, they lose authentication power which results in the loss of RP Tokens. Authentication power is directly related to the amount of RP Tokens an authenticator holds. The RP Tokens that relate to the authentication power used for a certain content piece are indirectly "staked." Therefore, RP Tokens and authentication power are used interchangeably.

Initially, authenticators receive some authentication power for free in order to be able to stake and start evaluating. This authentication power is based on RP Tokens. This minimum amount of RP Tokens can never be exchanged into WOM Tokens. Furthermore, earned RP Tokens cannot be immediately exchanged into WOM Tokens. Authenticators must wait seven days to exchange RP Tokens into WOM Tokens. All RP Tokens are backed with WOM Tokens 1:1 in full reserve.

The figure below illustrates the reflection of authentication power in RP Tokens that can be exchanged into WOM Tokens.

Subsequently, authenticators may earn RP Tokens through their authentication activity which is reflected as authentication power. The higher the authentication power put into a content piece, the higher the potential reward for correct evaluation. Conversely, the higher the authentication power put into a content piece, the higher the potential loss of RP Tokens. In summary, the higher the authentication power associated with a content piece, the more the RP Tokens are at risk, and the higher the potential upside and downside.

5.3 Defining consensus

The authentication of WOM content is decentralized. In the authentication process, participating authenticators vote on content in the dimensions authenticity, creativity, and positivity. The authenticator vote for each dimension ranges from zero to ten. The vote is weighed differently as explained later in this paper.

The calculation of the authenticity rating for a certain content piece is as follows:

$$content_{authenticity} = \frac{1}{n} \sum_{i=1}^{n} authenticator\ vote_i * weight_{authenticator\ i}$$

The calculation of the other dimensions is analogous.

5.4 Defining the weight in the consensus process

The weight in the consensus process is defined by a proof-of-utility mechanism. This proof-of-utility mechanism incorporates several dimensions:

1) The authentication power
2) The accumulated staking time since account creation
3) The accumulated number of RP Tokens staked since account creation
4) The last staking time
5) The age of the authenticator account

Authentication power relates to the number of RP Tokens held. RP Tokens are earned through an authentication vote that closely agrees with overall authenticator sentiment and opinion. The other dimensions relate to other aspects determining past authenticator performance.

As a result, we have the following two meta dimensions that influence the weight:

1) Authentication power
2) Other aspects that relate to past authenticator performance

Both dimensions are weighed 50/50.

5.4.1 Calculation of the dimension "past authenticator performance"

Within the dimension "past authenticator performance", the four dimensions "last staking time," "age of the authenticator account," "accumulated staking time since account creation," and "accumulated number of RP Tokens staked since account creation" have different weights.

The "accumulated staking time" and "accumulated number of RP Tokens staked since account creation" are considered as the most important aspects that influence authenticator engagement. The former indicates the engagement in authentication. The latter indicates the belief of the authenticator in the correctness of their prediction.

These dimensions are followed by "last staking time" which indicates whether the user is up-to-date, and "age of the authenticator account" which has the lowest weight to ensure that authenticators that have just created an account in the beginning and then never touched it receive fewer rewards. The percentage influence is as follows:

- Accumulated staking time since account creation: 40%
- Accumulated number of RP Tokens staked since account creation: 30%
- Last staking time: 20%
- Age of the authenticator account: 10%

Since these factors together define only 50% of the weight in the authentication process (besides authentication power), the final weight is as follows:

- Accumulated staking time since account creation: 20%
- Accumulated number of RP Tokens staked since account creation: 15%
- Last staking time: 10%
- Age of the authenticator account: 5%

Which is exactly half of the numbers above.

These dimensions which are expressed in specific numbers must be translated into ratings for calculation, i.e. the numbers must be normalized (the normalization is handled analogous to the normalization of the value KPIs as explained in chapter "Value KPIs associated with WOM content").

The possible oldest number for all three dimensions is the maximum age of an authenticator account. The smallest number is zero. From this maximum to zero, ratings are given. The "accumulated staking time since account creation", the "accumulated number of RP Tokens staked since account creation" and "the age of the authenticator account" receive a low rating with a low number and a high rating with a high number. For the dimension "last staking time," the reverse is true.

	Low number	**High number**
Accumulated staking time since account creation	Low rating	High rating
Accumulated number of RP Tokens staked since account creation	Low rating	High rating
Last staking time	High rating	Low rating
Age of the authenticator account	Low rating	High rating

The numbers must be updated regularly to ensure a correct calculation. Initially, updates happen every 7 days.

The rating for all dimensions is linear. This means that an accumulated staking time that is twice as high receives a doubled ranking.

Formula that defines the weight in the authentication process

$$weight\,(authenticator) = ½ * S + ½\,(0.4 * E + 0.3 * B + 0.2 * L + 0.1 * A)$$

or

$$weight\,(authenticator) = ½ * S + 0.2 * E + 0.15 * B + 0.1 * L + 0.05 * A)$$

with

- S for the ranking of the authentication power
- E for engagement, i.e. the ranking in the dimension "accumulated staking time since account creation"
- B for belief, i.e. "accumulated # RP Tokens staked since account creation"

- L for the ranking of the dimension “last staking time” and
- A for the ranking of the dimension “age of the authenticator account”

This section explained the weight of each authenticator vote in the authentication process. The next section explains the objective function of the authenticator. There are overlaps: the authentication power influences both the weight in the authentication process as well as the reward function. The other dimensions influencing weight are not directly part of the reward function. Influence is indirect through a higher influence in the authentication result.

5.5 Objective function of the authenticator

The authenticator objective function depends on the authenticated content piece. There are two scenarios: the authenticated content piece either fits the WOM quality criteria (authenticity greater than or equal to 8, creativity greater than or equal to 7, positivity greater than or equal to 7) or not. Depending on the two scenarios, the reward for authenticators differs. In any case, a content piece needs to be authenticated by at least three authenticators. If there are fewer than three authenticators, everybody - including all authenticators and the content creator - receive their stakes back.

5.5.1 Relation between authentication and content authenticated

Content creators may only receive rewards if the authenticated content is assessed correctly. The correct evaluation is determined during the authentication process as explained above. If the assessment is wrong, authenticators lose their stake.

There are four different scenarios:

1) The authenticated content is WOM content & the authenticator voted correctly ⇒ The authenticator can earn rewards depending on content performance and keeps their stake. Additionally, the authenticator receives the stake of those that voted incorrectly.
2) The authenticated content is WOM content & the authenticator voted incorrectly ⇒ The authenticator can not earn rewards and loses their stake.
3) The authenticated content is not WOM content & the authenticator voted correctly ⇒ The authenticator receives the lost stakes (content creator stake & stake of those authenticators that assessed wrong) and keeps their stake.
4) The authenticated content is not WOM content & the authenticator voted incorrectly ⇒ The authenticator can not earn rewards and loses their stake. The outcome of an incorrect assessment is, therefore, independent of whether the content is WOM content: in both cases the authenticator can not earn rewards and loses their stake. Rewards are only possible in case of correct assessment. The rewards received differ whether the content is WOM content or not.

Authenticator incentive	Correct assessment	Incorrect assessment
Content = WOM	Keep stake, earn rewards depending on content performance, receive lost stakes of authenticators that assessed wrong	Lose stake, no rewards
Content != WOM	Keep stake, receive lost stakes (content creator stake & stake of those authenticators that assessed wrong)	Lose stake, no rewards

Authenticators define their share of the content reward through the voting process. Details on the rewards authenticators receive in case of content that fits WOM criteria are explained in subsequent sections. But first we show that the mechanism design supports a Nash equilibrium that incentivizes content creators to create high-value content.

5.5.2 Nash equilibrium

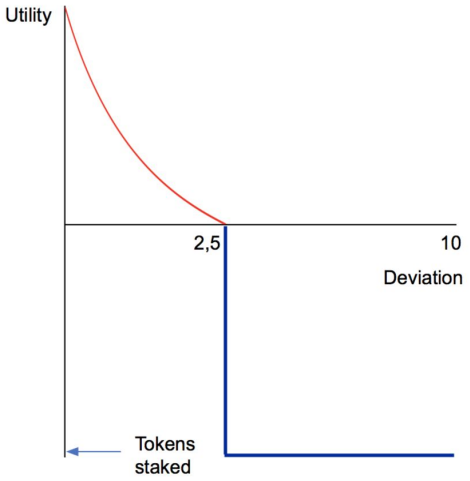
Assume: all authenticators vote the same (we assume collusion), the stake of the content creator is 1, payouts to authenticators are considered combined, the content creator earns the equivalent of their stake with low-value content of which 1/3 is attributed to authenticators, platform payout is neglected for simplicity.

	Authenticate as WOM Content		Authenticate as WOM Content	
High value Content	10	7	- 1	1
Low value Content	0.7	0.3	- 1	1

No player has an incentive to unilaterally deviate from a Nash equilibrium. In our model, we have one nash equilibrium which is dominant namely the one in the first row first column. Content creators are incentivized to create high value content and authenticators are incentivized to authenticate such content as WOM content.

5.5.3 Scenario 1: The content piece is not considered WOM content

The content creator loses their stake for content that is not evaluated as WOM content. The content creator’s stake is then distributed to the authenticators that voted close to the majority authenticator vote. Authenticators that did not vote in alignment of the overall authenticators lose their stake as well. These stakes are also distributed to the authenticators that voted in alignment of the overall authenticators’ vote.



At a certain deviation from the overall authenticator vote, authenticators lose their complete stake. Below this deviation, authenticators receive RP Tokens. The amount of RP Tokens received depends on:

1) The authentication power
2) The deviation from the overall authenticator vote
3) The time of voting since content was published online
4) The Value Creation Fund allocation

The calculation of the authenticator reward which is in alignment with the overall authenticators is the same as the calculation in Scenario 2. The sole difference is that Scenario 2 entails a reward for the content creator whereas Scenario 1 punishes the content creator with a loss of stake. As a result, in Scenario 1, the authenticators receive the stake of the content creator and in Scenario 2, authenticators participate in the rewards that content creators receive. In both cases, the staked tokens of authenticators who are not in alignment with the overall authenticator reward are distributed to the authenticators that are in alignment.

5.5.4 Scenario 2: The content piece is considered WOM content

The objective function for the authenticator is defined as follows:

$$R(C) :=$$

$$max\, F(P \times D(Cur) \times D(M) \times V(t))$$

with

- P := Authentication power
- D(Cur) := deviation D from all authenticator (Cur) votes and
- D(M) := deviation from the middle
- V(t):= time of voting (V) since content online and
- F(x) depends on the Value Creation Fund allocation which includes brand payments

The dimensions P, D(Cur), D(M), and V(t) define the rating of each authenticator among the overall group of authenticators. The function F(x) sets the individual authenticator reward in relation to the overall content authenticator reward. At the same time, the share of the Value Creation Fund that flows to the content creators and the platform is deducted. Thus, the first aspect concerns the portion of reward within the group of authenticators and the second aspect concerns the portion of reward within all actors of the WOM Economy.

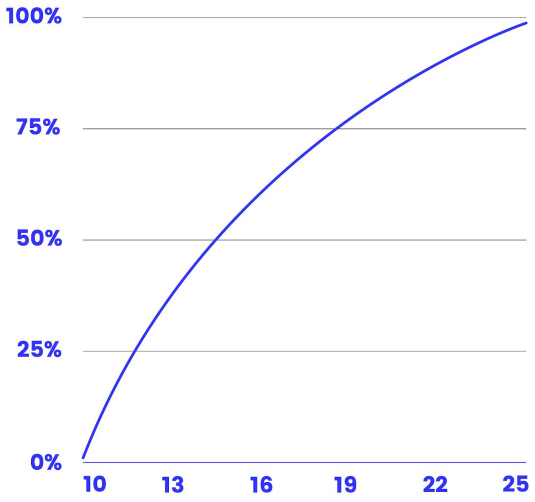
5.5.5 The higher the authentication power, the higher the potential reward

Authentication power increases with increased reputation which is the percentage of correct votes among authenticators. With higher authentication power, authenticators may earn a greater reward. Conversely, they have more to lose. This higher risk correlates with a more sophisticated evaluation. As a result, the protocol values such evaluations higher and rewards authenticators accordingly.

$$P = 1 - 0.5^{tH}$$

with
P = Authentication power
t = Amount of reputation tokens held
H = Steepness of the curve, i.e. how many tokens must be held so that half of 100% authentication power is reached

H defines the steepness of the curve. H defines precisely how many tokens must be held so that half of 100% authentication power is reached. This factor is initially set at 10, but it adapts to the development of the protocol (initially fewer tokens are needed for the same amount of authentication power).



The formula includes an upper limit on the influence of authentication power on the vote. This means it is not possible to have an infinitely high influence due to infinitely high authentication power--which ensures decentralization.

5.5.6 The deviation from all authenticator votes influences authenticator reward

The objective function of the authenticator depends on the overall authenticator votes.

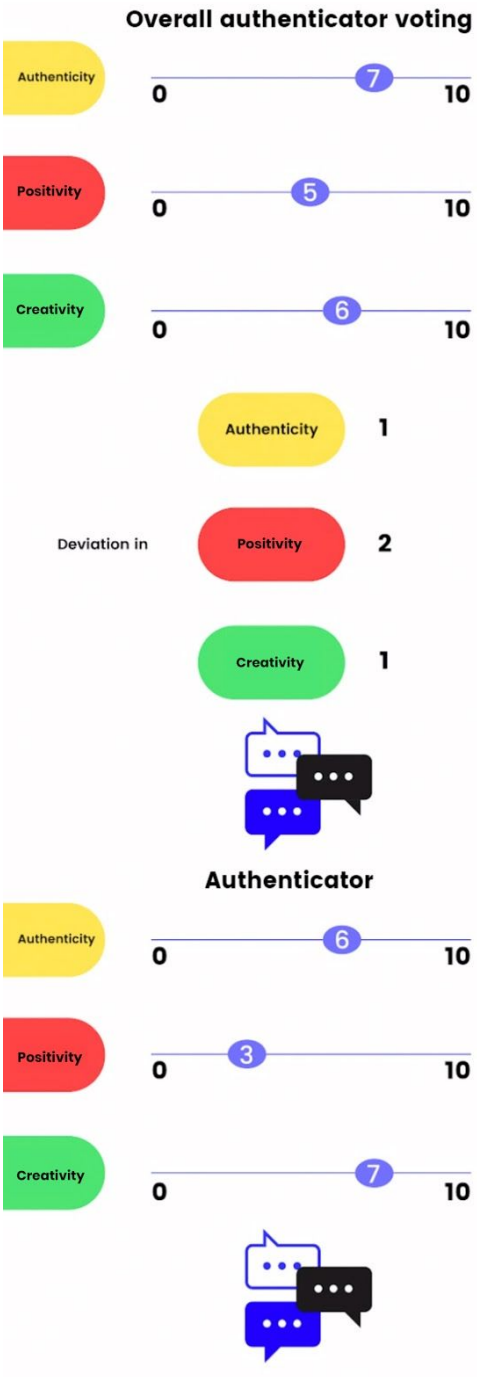
$$D(Cur) := u(dev(authenticator\ vote))$$

with dev := deviation, the function u(x) is defined in second part of this section.

5.5.7 Calculating deviation

If the authenticator evaluation is not in alignment with the overall authenticator vote, the authenticator loses staked RP Tokens. If the evaluation is in alignment, the authenticator receives tokens. The threshold at which WOM Tokens are lost due to a strong deviation from overall authenticator vote and consumer likes is illustrated below.

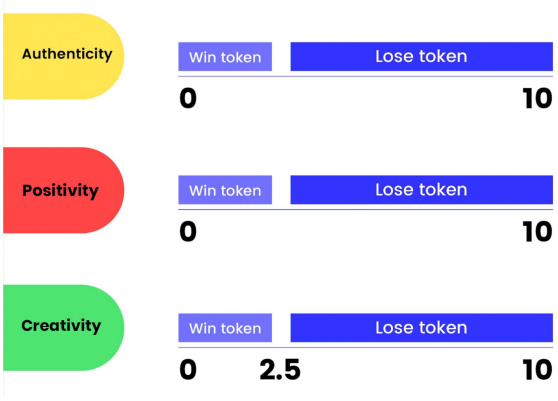
In the following example, an authenticator rates content with an authenticity score of 6. The overall authenticator vote is 7. Thus, there is a deviation of 1 in the authenticity score. The deviation in all other dimensions are similarly calculated.



The overall authenticator vote is slightly different to the single authenticator vote.

5.5.8 Calculating the input factors for the utility function

For defining the correctness of an authenticator evaluation, all dimensions are treated equal. A deviation higher than 2.5 is considered as bad and therefore punished.

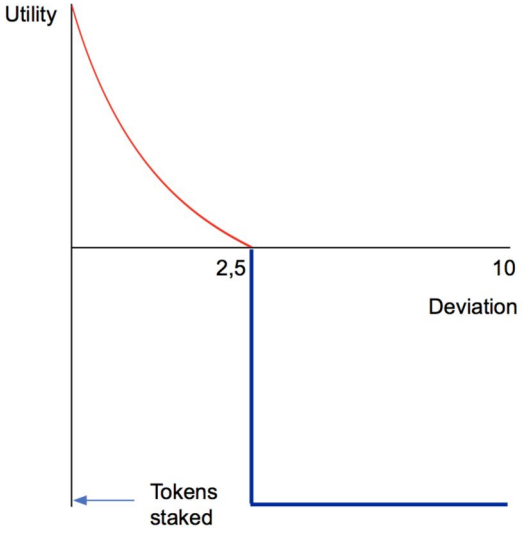


For a deviation of more than 2.5 in any dimension, authenticators lose all staked tokens. For a rating of 10 in all dimensions, the factor that is related to deviation in authenticator votes receives maximum value.

5.5.9 The utility function

The function u(x) of $D(Cur) := u(dev(authenticator\ vote)))$ is exponential which means that a doubled deviation results in less than half of the rewards than a single deviation. The function returns a low value for high numbers and a high value for low numbers.

Illustrating the utility function:



In this graph, the loss curve is binary and the gain curve is exponential. This means that the evaluation must have little

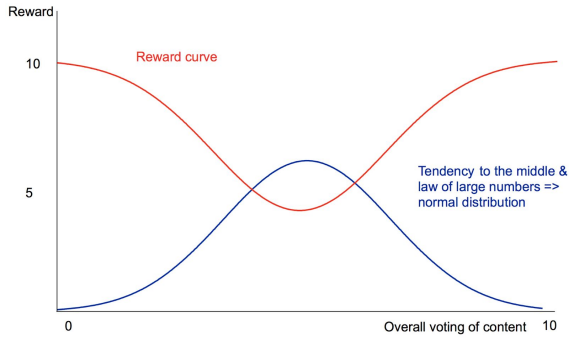
deviation from the consumer opinion to receive a high reward and as soon as the evaluation deviates from the overall rating by consumers to more than four points, loss is immediately severe.

1. Strong incentive for correct evaluation
2. Strong disincentive for bad evaluation

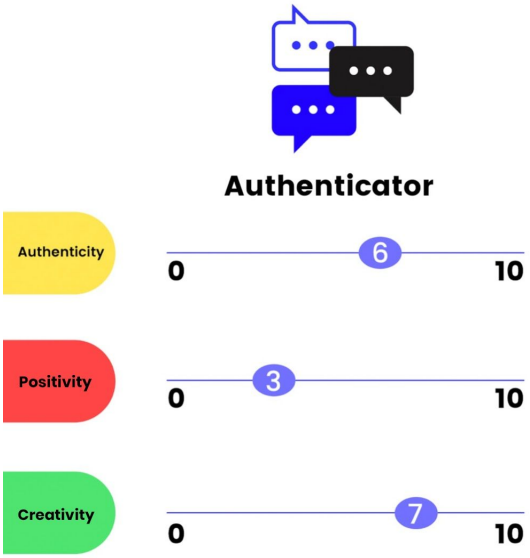
5.5.10 The more the vote deviates from the middle, the higher the reward if voted correctly

The authenticator's reward function

$R(C) := max\,F(P \times D(Cur) \times D(M) \times V(t))$ is influenced by the factor D(M) which is defined as the deviation from the middle. The value range of D(M) lies between five and ten. The value of D(M) is defined by the deviation of the vote from the middle in the dimensions authenticity, creativity, and positivity. For example, an authenticator vote of five in all dimensions receives the minimum D(M) value of five. An authenticator vote of zero in all dimensions receives the maximum D(M) value of ten. The following graph illustrates the reward curve in relation to the tendency towards the middle and the law of large numbers.



For each dimension authenticity, creativity, and positivity, the deviation from the middle is calculated. These deviations are then divided by three, the number of dimensions. Adding five to the result gives the value D(M).



In the given example, the deviation from five in the dimension Authenticity is 6-5 = 1. The deviation from five in the dimension Positivity is 3-5 = -2. The absolute value of the deviation is important, therefore the deviation in the dimension Positivity is 2. The third dimension is calculated in the same way. The average deviation is (1+2+2)/3 = 1,67. Thus, D(M) = 5+1,67 = 6,67 which is rather low.

The range is set from five to ten to ensure a reward in the case that the correct assessment is five. A range from zero to ten would completely eliminate rewards when content is valued at average. This must not be the case, as a correct assessment must be incentivized. The incentivization of D(M) removes the tendency to trend to the middle.

The final authenticator reward is determined by the time when the vote was made which is explained below.

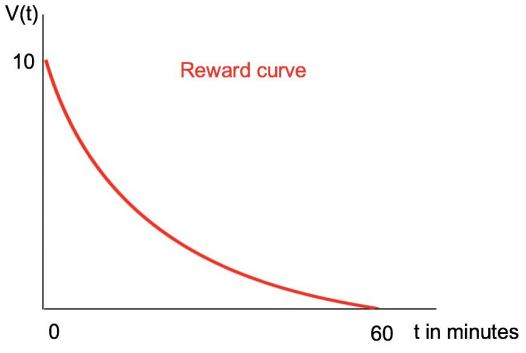
5.5.11 The earlier the vote, the higher the reward

The authenticator's reward function

$R(C) := max\,F(P \times D(Cur) \times V(t))$ is influenced by the factor V(t) which is defined as the time of voting after the content was published. The values of the function V(t) range from zero to ten.

Authenticators see the amount all other authenticators have staked to authenticate one particular content piece and eventually receive rewards with. Due to the design of the authenticator's objective function, the overall amount of staked tokens indicates the value of the content piece. This signal is valuable to other authenticators.

As a result, when authenticators see this signal, they will receive fewer potential rewards. Authenticators who come in later see whether there is a high expected value mirrored by the overall stake in the content piece. Conversely, authenticators receive higher potential rewards when there is no signal as they cannot rely on an indication set by earlier authenticators. This aspect is implemented with the function V(t) in the authenticator objective function. The below figure illustrates this relation.



The time frame for assessing content is initially set for 60 minutes. With further growth of the ecosystem, the time frame will be reduced since more authenticators are active.

Since the authenticators receive their reward for assessing content 60 minutes after the authenticated content was

published, the value of the function V(t) returns 0 when minute 60 is reached. Authenticators are only incentivized to vote when their vote influences the classification of WOM content. This is crucial to keep the system effective.

5.5.12 The Value Creation Fund allocation influences authenticator rewards

For the following calculations, the term $P \times D(Cur) \times V(t)$ is defined as $R(C)_{int}$ for intermediate result without the function F(x) applied.

The reward the authenticator depends on are the tokens emitted by the Value Creation Fund (value creation reward) and the lost stakes of authenticators that are not in alignment with the overall authenticator vote. The portion each authenticator receives is:

$$F(x) :=$$

$$\frac{R(C)_{int}}{\Sigma R(C)_{int}} * (⅓ * Value\ creation\ reward + lost\ authenticator\ stakes)$$

with

- $\frac{R(C)_{int}}{\Sigma R(C)_{int}}$ as the individual intermediate authenticator reward as defined above
- 1/3 as the portion which flows to the authenticators (2/3 flows to content creators, minus the reward for the platform)
- Lost authenticator stakes that relate only to the content piece in consideration

In the beginning, there are fewer participants interacting with the ecosystem which results in higher potential rewards per participant. This incentivizes early users to become active participants in the ecosystem. Additionally, the high distribution of tokens in the first three years kickstarts participation.

5.6 Fraud and collusion prevention

The possibility of individuals acting as content creators to create bad content and then authenticate it is eliminated due to design. In this scenario, staked tokens are merely redistributed.

In case content creators and authenticators collude to positively authenticate bad content, the subsequent reward is dependent on consumer interaction. Poor-quality content will not have good value KPIs that represent consumer interaction. As a result, incentives for collusion are diminished by design.

The votes of the authenticators are not publicly visible until the voting period ends. Otherwise memeing would occur, i.e. authenticators acting like the other authenticators to receive a high reward.

5.6.1 One authenticator holds a larger stake than all others combined

If one authenticator has an influence greater than 50% in the authentication process, then the authentication is not successful. In all cases, a prevention mechanism is deployed that directs authenticators in a way so a 50% influence does not happen by design. We cannot make any restrictions in the beginning since there is no data available yet. However, as an example, after half the time of the authentication process, the tool may only allow certain numbers until the threshold of 40% weight is reached.

Later on, authenticators may again modify their vote until the authentication time frame is finished. An alternative is to place a limit to the authentication power which may be used on a content piece. One authenticator could also make several accounts, but there are several reasons that disincentivize an authenticator from this strategy, as explained next.

Since the price of the WOM Token depends on the soundness of the network, large stakeholders have more to lose if the currency falls in value through abuse than they might gain by voting for themselves.

5.6.2 Several authenticators cooperating

It is possible for many smaller stakeholders to nullify the voting power of collusive groups. They have an incentive to do so since they obtain the stake of the colluders (this is the crab mentality that many people have when they perceive that one individual is profiting at the expense of everyone else and it allows good people to keep bad people down). Here again, large stakeholders have more to lose if the currency falls in value due to abuse than they might gain by voting for themselves since the price of the WOM Token depends on the soundness of the network.

5.7 Payouts

Payouts in the form of RP Tokens are made after the authentication process is finished. Until the protocol is developed to make instant payments, rewards are bundled and emitted in regular time intervals. In the beginning, emissions are processed once per week to keep fees low.

6 CREATING A MARKET FOR VALUABLE WOM CONTENT

Thus far, we have discussed the supply side for valuable WOM content. Next we analyze the demand side to create a market for valuable WOM content.

6.1 Platforms

Platforms act as value intermediators. These platforms host WOM content. A news feed algorithm determines which content has higher visibility. The aim of these platforms is to maximize their return by maximizing user experience.

6.1.1 Reward function

The platform reward function is defined as a percentage of all content creator rewards:

$$R(P) := p \times R(CC)$$

6.1.2 News feed algorithm

As a result, the news feed algorithm considers at least the following four dimensions:

- Quality of WOM content
- Value KPIs
- Brand payments
- Age of the content

It is important to note that the platform can decide on the exact design of its own news feed individually.

The following formula illustrates a possible news feed algorithm:

$$NFA := \\ quality\ (WOM) \times rating\ (value\ KPIs) \\ \times brand\ payments \times age\ of\ content$$

The aim of this news feed algorithm is to promote high quality WOM content to ensure that the platform provides content which is interesting to the consumer. Content that has received a good value KPI rating (i.e. consumers showed that the content was interesting) is promoted even more. The more consumers interact with the platform, the higher the value of the platform, and the higher the rewards the platform receives.

If certain content is receiving an "extra" brand payment, the platform is incentivized to increase the visibility of that content in the news feed to increase the engagement and the reward for creators and authenticators and ultimately itself. This visibility increase of "branded" content needs to be in an equilibrium with non-branded content, because otherwise the platform will reduce the experience for its consumers and risks losing active users long-term.

Platforms track consumer interaction with WOM content. The data from the interactions must be forwarded to the WOM Protocol to ensure accurate content creator and authenticator rewards.

6.2 Brands

Brands participate in the WOM Ecosystem to access user-generated, authentic WOM content. The WOM Protocol incentivizes the creation and reach of content about brands and products. The creation and distribution of this content is completely controlled by the content creators, authenticators, and platforms. Accessing the WOM Ecosystem means to consume this value creation by having the ability to influence the creation and reach of specific WOM content. Exercising influence over WOM content consists of three different aspects. A brand can:

1. Purchase the right to add a link to specific organic content
2. Boost the reach of specific organic content
3. Instigate the creation of specific new content

Point 2 and 3 are achieved by design: content that is supported by a brand receives further rewards as explained in chapter "Brand support influences content creator rewards." As platforms receive a share of this reward, they are incentivized to increase the visibility of brand related content.

Brands want to access valuable WOM content. Valuable content from a brand perspective is content which drives engagement. Content only can drive engagement if it is valuable for consumers. For WOM content to be valuable to consumers, it must be honest, creative and diverse.

The WOM Protocol ensures that there is a broad variety of content about diverse products and brands which results in a diverse economy. This diversity is important in keeping content valuable for its consumers and allowing creativity to thrive. Therefore, the fees brands pay to access specific WOM content will be distributed to the whole ecosystem value creation. Every content creator, authenticator, and platform will benefit from brands accessing the WOM Ecosystem to increase their influence.

7 FORMULA OVERVIEW

Quality of WOM content

$$quality\ (WOM) \quad := \tfrac{1}{2}\ rating_{authenticity} + \tfrac{1}{4}\ rating_{creativity} + \tfrac{1}{4}\ rating_{positivity}$$

Rating of the value KPIs

$$rating(value\ KPIs) := n(\tfrac{1}{500}\#(views) + \tfrac{1}{4}(likes) + \tfrac{1}{3}\#(comments) + \#(clicks))$$

with $likes := \tfrac{1}{2}\ \#(authenticity) + \tfrac{1}{4}\#(creativity) + \tfrac{1}{4}\#(positivity)$

Content creator reward

$$R(CC) := max\ F((\tfrac{1}{3} \times u(quality\ (WOM)) + \tfrac{2}{3} \times rating\ (value\ KPIs))$$

- the function u(x) either transforms the quality of the WOM content into a negative value which results in losing staked tokens or in a positive value through which rewards may be obtained (details defined in the economy paper in a subsequent section); if u(x) is negative, then R(CC) becomes the value of u(x) and all other factors are neglected.
- F(x) depends on the Value Creation Fund allocation which includes brand payments and is defined as follows:

$$F(x) := \frac{R(CC)_{int}}{\Sigma R(CC)_{int}} \times value\ creation\ reward \times \tfrac{2}{3} \times (1-p)$$ with

- $\frac{R(CC)_{int}}{\Sigma R(CC)_{int}}$ as the individual intermediate content creator reward and
- *value creation reward* as defined by the distribution pattern of WOM Tokens as explained in the whitepaper
- 2/3 as the portion which flows to the content creators and platforms (1/3 flows to authenticators)
- p as the percentage reward flowing to the platform hosting the content as defined by the platform.

$$F(x)_{brand} := \frac{R(CC)_{int,brand}}{\Sigma R(CC)_{int,brand}} \times brand\ payment \times (1-p)$$ with

- $\frac{R(CC)_{int,brand}}{\Sigma R(CC)_{int,brand}}$ as the proportional value creation that relates to the brand payment considered
- *brand payment* as the amount of tokens paid by brands referring to the content piece
- p as the percentage reward flowing to the platform hosting the content

Consensus

$$content_{authenticity} = \frac{1}{n} \sum_{i=1}^{n} authenticator\ vote_i * weight_{authenticator\ i}$$

The dimensions "creativity" and "positivity" are calculated accordingly.

Authenticator reward

$$R(C) := max\ F(P \times D(Cur) \times D(M) \times V(t))$$ with

- P := Authentication power
- D(Cur) := deviation D from all authenticator (Cur) votes and

- D(M) := deviation from the middle
- V(t):= time of voting (V) since content online and
- F(x) depends on the Value Creation Fund allocation which includes brand payments

$P = 1 - 0.5^{(\frac{t}{H})}$

- t = Amount of Reputation Tokens held
- H = Steepness of the curve, i.e. how many tokens must be held so that half of 100% authentication power is reached

$F(x) := \frac{R(C)_{int}}{\Sigma R(C)_{int}} * (⅓ * Value\ creation\ reward + lost\ authenticator\ stakes)$ with

- $\frac{R(C)_{int}}{\Sigma R(C)_{int}}$ as the individual intermediate authenticator reward as defined above
- 1/3 as the portion which flows to the authenticators (2/3 flows to content creators, less rewards for the platform)
- lost authenticator stakes that relate only to the content piece in consideration

Platform reward

$R(P) := p \times R(CC)$

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