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Security Token Offerings – Determinants of Success for Token Sales

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Abstract.

We investigate the determinants, which have a positive impact on the likelihood of successful security token offerings (STOs). In doing so, the objective is the estimation of the success probability by introducing a logistic regression model. The quantitative research analyses data from 183 STOs that raised capital between 2017 and 2020. Since security tokens are regulated financial instruments, they should have less impact on the funding process. However, the results show that this is not always the case. If token issuers choose equity tokens for the asset class, the STO is 3.34 times more likely to be a success than other asset classes. Further research findings show that the probability of a successful STO is related to signals shaping the token's financial characteristics, signals shaping the token's technical and economic characteristics, and related to signals that affect the external factors. STOs can exploit these quantitative factors that are easy to implement until the market no longer considers these as quality indicators. The given research paper is of high relevance due to the novelty of the research field and aims to contribute to the existing research debate around the opportunities of distributed-ledger-technology in the financial industry context.

Keywords: Blockchain, Security Token Offering, Initial Coin Offering, Distributed-Ledger-Technology, Token

1 Introduction

Although innovative companies have highly skilled employees, their growth opportunities are hindered by limited access to the capital markets. In 2017 and 2018, companies raised considerable capital through blockchain-based Initial Coin Offerings (ICO). Out of the ICO market, Security Token Offerings (STO) have emerged. STOs, like ICOs, promise to provide a new source of funding for companies (cf. Hall, 2009; Miglo, 2019).

In this alternative form of financing, capital is raised with a wide reach and without the involvement of intermediaries. Unlike ICOs, STOs have an underlying asset (such as stocks or bonds). They are also safer than ICOs because they are registered with the necessary regulatory bodies and must meet certain legal requirements. Most ICOs offer utility tokens to avoid regulation. While ICOs involve speculation on the tokens, with security tokens the purpose of the token is to be used (cf. Lambert et al., 2020; Rohde & Beinke, 2020).

This type of financing is particularly interesting for companies in the early-stage phase. Not all information about startups is always available which possibly results in a large information asymmetry between the token issuer and potential investor. To resolve the information asymmetry as far as possible, the token issuer can send suitable signals to the investor. Through the underlying distributed-ledger-technology (DLT) based on the blockchain, the tokens can be sold and thus collect substantial amounts of capital. In September 2020, the market capitalization of security tokens was USD 529 million (cf. Fisch, 2019; Security Token Market, 2020, B).

Several token types exist, which have fundamentally different functions. One advantage of security tokens is that, compared to traditional security, they are immediately transferable and can be traded on secondary markets at any time. Also, clearing and settlement take place within a few minutes. Furthermore, as no intermediaries are involved STOs have lower transaction costs when compared to traditional financial transactions. The transactions are transparent due to the underlying blockchain (cf. Ante & Fiedler, 2020; Lambert et al., 2020).

The first STO took place in 2017. Since then, STOs' volume has increased significantly. Trading volume has increased by 1,291 % between January 2020 (USD 193,796) and December 2020 (USD 2,695,419). According to Chain Partners Research, the STO market forecast is positive: The market will grow to USD 2,000 billion by 2030 (cf. Baker, 2019; BlockState, 2019; Han et al., 2019; Radmilac, 2021; Security Token Market, 2021; Security Token Market, 2020, A).

This research paper aims to find out what determinants affect the likelihood that STOs are successful. Since the aim is to estimate the probability of success, logistic regression is used. The general null hypothesis is that the higher the perceived information asymmetry between the token issuer and the investor, the higher the chances of an STO's success.

2 Methodology

2.1 Development of Hypotheses

The following null hypotheses in Table 1 have been generated to find out what increases the probability of success of STOs. The general null hypothesis is that the probability that an STO will be more successful is higher if the information asymmetry regarding human capital, project elaboration, social media, financial,

technical, and economic properties of the token and external factors is as high as possible.

Table 1: Development of hypothesis

Hypothesis	It is hypothesized that the probability of a successful STO is:
Hypothesis 1	unrelated to human capital signals
Hypothesis 2	independent of project elaboration signals
Hypothesis 3	independent of project social media signals
Hypothesis 4	unrelated to signals shaping the token's financial characteristic
Hypothesis 5	unrelated to signals shaping the token's technical and economic characteristics
Hypothesis 6	unrelated to signals that affect the external factors

Source: Own representation

2.2 Data collection, variables, and empirical methodology

A complete database of STOs does not exist at the current time. Therefore, the sample used from January 2018 to December 2020 was compiled manually and includes multiple sources. BlockState's dataset as part of the "Global STO study 2019" served as a basis. There were about 120 projects up until June 2019, and not all of them could be seen as a STO (cf. BlockState, 2019). For the analysis, in addition to the company, the country of incorporation, industry, target amount, amount raised, infrastructure, and asset class were taken after verification.

Building on the dataset from Blockstate first, additional STOs were sought, predominantly on the following websites: stomarket.com, stowise.com, stoanalytics.com, stoscope.com, storating.com, and icoholder.com. All these sites offer information about STOs, but none of them include all the relevant data. In some cases, the information on STOs is even contradictory between sites. In this case, the information that was represented on most sites was taken.

Once the sample was established, additional information on each STO was manually sought through primary sources, particularly through whitepapers, company websites, offer documents, social media channels, and at bitcointalk.org. Furthermore, crunchbase.com was sometimes visited for information on the funding amount. The dataset also includes ICOs disguising as STOs. These ICOs were registered for sale as securities. In these circumstances, the issuer advertises it as a security token or securities, although it is a utility token. There is a column "Token_type" in the data set that can be used to check whether a security token is "real."

Some STOs had to be excluded. On the one hand, these were pre-STOs, which were listed as STOs (in the mainsale). Several other STOs had to be excluded due to missing data, especially when a whitepaper was unavailable, the social media

channels were blocked, and the website could not be accessed even by using a Wayback search. Thus, the final sample was comprised of 183 STOs.

Dependent variable

The success of an STO can be measured by the capital raised. Most STOs are unlikely to reach their maximum target amount. Since the minimum amount that token issuers want to raise is the soft cap, this was considered a measure of success. Following Ahlers et al. (2015), a dichotomous variable (0/1) has been used as the indicator of success. The choice of an indicator variable is consistent with Rohde & Beinke (2020). If the capital raised was equal to or above the soft cap made, the STO was considered a success (1). If the soft cap was not reached, the STO failed (0). Success has thus been measured by the variable Softcap_reached.

Independent variable

The independent variables are the possible factors or signals that can influence success. All 22 independent variables are dichotomous. It was deliberately decided not to use the logarithm, for example for the presale price, because the range is between less than a penny and more than USD 170, and the high values, despite the logarithm, would have distorted the result.

Number_of_team was the variable used to indicate the number of employees associated with the project. Whitepaper is also a dummy variable and was implemented to indicate whether a whitepaper exists. Whitepaper_page_count measured the number of pages. If there were more pages in the whitepaper of the project than the median of all whitepaper pages, the variable was 1.

The LinkedIn, Twitter, Instagram, and Telegram variables were used to indicate whether the project has had an account on the respective social media platform and whether it has posted anything since the STO has been running.

Presale was implemented to indicate whether a presale had already taken place, which is usually accompanied by a lower price than in the mainsale phase. Presale_price was 1 if the price in the presale phase was higher than the median of all other presale prices. The same rule applied to the variables Hardcap and Total_supply_tokens, which referred to all tokens ever issued. The variable Mainsale_investment_min indicated whether the minimum investment in the mainsale phase was greater than the median of all other investments that must be made as a minimum.

To cover the area characterization of the token, the dummy variables Asset_backed and Equity were used. The rights that the investor receives through the security token are reflected in the variables Voting and Equity_Ownership. Ethereum was selected to indicate whether the most common blockchain was used. While it can be assumed that most tokens offered in an STO are security tokens, the Utility variable indicates whether utility tokens were nevertheless offered in the STO.

Finally, the variable USA was used to test whether the country in which most STOs take place has an influence on success. Following Ante & Fiedler (2020), the variable Finance_and_Banking was used to test whether the industry positively influences the capital raised.

Empirical methodology

To build the model, logistic regression was chosen, which identifies the relationship between the independent variables (success factors) and the dependent variable (success/ failure of the STO) (cf. Celik, 2019). Different models were tested and finally, the model with the highest pseudo-R-square was taken. This model contains 22 predictors.

The coefficients must be optimized to accurately predict the success probability of the STO. For this purpose, a train-test split was performed. To develop the model, the dataset of 183 successful and failed projects was randomly split into two datasets: the test data and the training data. Of the data, 80 % was used to train the model, and the other 20 % tested the model (cf. Ibraigheeth & Fadzli, 2020).

Various statistical tests have been applied to the logistic regression model to evaluate its performance. Whether the prediction is true or false is made obvious by the confusion matrix (cf. Ibraigheeth & Fadzli, 2020). Of the STOs, 17 were correctly classified as successes (true positive), while the model incorrectly identified three actual failures as successes (false positive). In five cases, failure was incorrectly measured (false negative), and in 12 cases, failure was correctly predicted (true negative).

The accuracy, (the proportion of correct predictions to total predictions) is 0.78. The benchmark, i.e., the naive model would always take the majority class (STO failed). Since the benchmark is 0.59, the trained model exceeds the benchmark.[1] To measure the classification effectiveness of the prediction model with the test data, the receiver operating curve (ROC) can be used for visualization. The area under curve (AUC) is 0.861. The prediction model appears to be accurate for the most part and has provided efficient results.

Requirements for the applicability of logistic regression

The literature has stated that 10 or more observations should exist for each variable in the model (cf. Celik, 2019). In fact, in the present model, only variables that occur more than 25 times are present. To achieve a sufficient class distribution, all variables that exist less than 25 times were therefore deleted. Besides, care was taken to ensure that each of the two values of the dependent binomially scaled the variable Softcap_reached in at least 10 % of all cases.

[1] Optimization with different combinations of hyperparameters to further improve the accuracy of the model did not result in any relevant improvement.

One of the requirements of a regression analysis is that there is no strong multicollinearity. A correlation matrix was observed to avoid a decrease in the accuracy of the coefficient estimation. If the intercorrelation was greater than 0.75, the predictor was removed (cf. Schroeder et al., 1990).

One of the variable pairs correlated with each other at the critical limit (> 0.75). The correlation between Security and Utility was -0.78, so the variable Security was removed. All pairs of variables correlated with each other weakly or not at all, except Asset_backed and Equity. However, since the correlation was 0.72, the variables remained in the model. The variance inflation factor (VIF) is another measure of multicollinearity. VIF values of more than 10 can cause problems in estimation (cf. Chatterjee & Hadi, 2013). Since ETH has a VIF of 10.35 the variable was removed, and the multicollinearity was fixed.

In summary, the chapter explains the variables and sets up the logistic regression model. It is shown that the requirements necessary for the methodology are complied with. The "preliminary work" to train the model before the actual regression was consistent with the methodology of Ibraigheeth & Fadzli (2020). After the performance of the model is judged to be good and various diagnostic tests have been performed, logistic regression was now applicable. Therefore, the next chapter explains the results.

3 Research Results

3.1 Descriptive Results

The 183 projects have raised a total of almost USD 2.29 billion. The range is from USD 290 (failure) to USD 500 million. Since a total of 51 STOs did not raise any money at all (for example, because the soft cap was not reached and the money was repaid), the average is USD 12.5 million. Of the STOs, 79 have reached the soft cap. Conversely, this finding means that more than half (104) of the projects have raised less capital than the soft cap. Moreover, 26 STOs have reached the hard cap. The price per token ranges from under a USD penny to USD 21,000 and averages USD 123. In comparison, the average presale price is just under USD 7.

The dataset contains mainly STOs from 8 different countries of incorporation. The majority of the STOs have taken place in the USA (48), followed by the UK (20) and Switzerland (18). Cayman Island and Estonia share 4th place with a total of 10 STOs. Western Europe brings up the rear: Germany (8), Liechtenstein (7), and the Netherlands (5). The remaining 57 STOs are spread across 33 other countries. From 2018 to 2020, the UK was the country where the second most STOs occurred according to this dataset.

ETH is offered most frequently as a payment option (163 times). BTC and Fiat are close behind at a frequency of 122 and 120, respectively. In 72 % of the cases, the

token promises dividends, making it the most promised token holder right. Of the security tokens, 23 % give equity ownership rights and 19 % voting rights.

It was possible to identify a whitepaper for 142 projects (77.6 %) with 37 pages on average. The most common industry is finance and banking (38 %) followed by real estate (13 %). Most STOs are communicated on Twitter (30 %). Close behind is the LinkedIn presence (28 %) and Telegram activity (26 %) as can be seen in Figure 5.

3.2 Logistic Regression Results

Toma & Cerchiello (2020) revealed which characteristics of ICOs are significantly related to fraudulent behavior. Among other things, they used logistic regression (cf. Toma & Cerchiello, 2020). Following the procedure, the diagnostics and tests were applied to the regression to validate the model.

In this research, the logistic regression model was fitted using maximum likelihood estimation (MLE). There were 6 iterations where the predictors were injected into the model until the log-likelihood maximized as much as possible (Forward selection). Finally, 22 variables were included in the model, four of which were significant ($p < 0.05$). Table 2 gives an overview of the variables, their coefficients and standard errors, the z-value, the 2-tailed p-value and the odds. Also, the values of the 95 % confidence interval are displayed. Only Equity, Finance_and_Banking, Total_supply_tokens, and Voting have a significant impact ($p < 0.05$) on the success of an STO.

Table 2: Logistic regression results

Variables	Coefficients B	Standard error	z	P>|z|	0.025	0.975	Odds Ratio
Equity	1.205	0.508	2.373	0.018**	0.210	2.199	3.335
Finance_and_Banking	0.784	0.388	2.019	0.043**	0.023	1.544	2.190
Total_supply_tokens	-1.181	0.422	-2.801	0.005***	-2.008	-0.355	0.307
Voting	-1.381	0.503	-2.744	0.006***	-2.368	-0.395	0.251

Source: Own representation

Odds ratios

Since the estimation of coefficients (B) can only determine the significance and direction of the correlation of the dependent and independent variables, but not the strength of the correlation, odds ratios are necessary. The odds value reflects the ratio of the probability of an analyzed event to the probability of the other events. For binary variables, it is not the change in the value of the odds ratio that is interpreted but the actual value of the odds ratio. If the 95 % confidence intervals do not contain the value 1, the variable has a significant effect on the odds ratio. In this case, all four variables are significant (cf. Chatterjee & Hadi, 2013; Gujarati, 2003).An odds ratio of two to four indicates a moderately positive influence of the explanatory variables (Equity and Finance_and_Banking). The variables Total_supply_tokens and Voting

have a moderately negative influence on the success of the STO. Variable Equity has the highest odds ratio. This odds ratio value means that within the tokens in the category equity, those who classify their token as equity tokens have a 3.34 times higher probability that the token sale will be a success than those who have a different asset class.

The same interpretation can be applied to the variable Finance_and_Banking. If the token issuer belongs to the finance and banking industry, the STO has a 2.19 times higher probability of success than a project of a token issuer of another industry.

In contrast, the probability that the STO is successful is about 0.3 times smaller if more than 100 million tokens are issued than the probability that less than 100 million tokens are issued. In other words, an STO is more likely to fail if an above-average (median) number of tokens are issued. Furthermore, the probability of success with the granting of a voting right is 0.25 times smaller than with other STOs that do not offer voting rights. The following regression equation Eq. 1 can be established:

Equation 1

$$P\,(success) = \frac{1}{1+e^{-(0.35+1.20*Equity+0.78*Finance\_and\_Banking-1.18*Total\_supply\_tokens-1.38*Voting+\varepsilon)}}. \quad (1)$$

Goodness of fit

The conventional measure of goodness of fit (R-Square) does not have much explanatory power in binary regression models. Therefore, the pseudo-R-squared is used to control the goodness of fit. In the following, the pseudo-R-squared of McFadden, Cox and Snell, and Nagelkerke are given. However, in the binary regression models, the goodness of fit is of secondary importance. The expected sign of the regression coefficients and the statistical significance is of higher importance (cf. Gujarati, 2003). McFadden's pseudo-R-squared was 0.1962. This means that the pseudo-R-squared can be considered acceptable. Cox and Snells' pseudo-R-squared was 0.2352 and Nagelkerke's was 0.3157. The model summary can be found in Table 3.

Furthermore, the likelihood ratio (LR) test is performed to test the overall model (cf. Chatterjee & Hadi, 2013). When the null model is fitted with the intercept only, the log-likelihood is -125.13. A significant improvement occurs when the model is used with all 22 predictors (log-likelihood = - 100.59. The LR test (Chi-square test) is 49.09. The fit improvement is highly significant ($p < 0.001$). Thus, the full model can be preferred to the null model.

Table 3: Modell summary

Log-likelihood	LL-null	McFadden's pseudo-R-squared	Cox and Snell's pseudo-R-squared	Nagelkerke's pseudo-R-squared
-100.59	-125.13	0.1962	0.2352	0.3157

Source: *Own representation*

In summary, the model (LLR $p < 0.001$, $n = 183$) as well as the four coefficients Equity, Finance_and_Banking, Total_supply_tokens, and Voting are significant.

3.3 Testing the hypotheses and critical discussion

The results of the research were briefly outlined in Table 4.

Table 4: Hypothesis test

Hypothesis	**It is hypothesized that the probability of a successful STO is:**	rejected/ fail to reject ist
Hypothesis 1	unrelated to human capital signals	Fail to reject
Hypothesis 2	independent of project elaboration signals	Fail to reject
Hypothesis 3	independent of project social media signals	Fail to reject
Hypothesis 4	unrelated to signals shaping the token's financial characteristic	Rejected
Hypothesis 5	unrelated to signals shaping the token's technical and economic characteristics	Rejected
Hypothesis 6	unrelated to signals that affect the external factors	Rejected

Source: Own representation

Human capital signals

The variable Number_of_team has no significant influence ($p > 0.05$). This means that having more team members on average than in other projects exerts no effect on the probability of success. This finding is consistent with that of Ante & Fiedler (2020).

Project elaboration signals

Both the existence of a whitepaper (Whitepaper) and whether the whitepaper has an above-average number of pages (Whitepaper_page_count) have no significant influence. The result regarding the existence of a whitepaper is in line with the results of Ante and Fiedler (2020) on STOs and Fisch (2019) on ICOs, who found only a little evidence of significance.

Social media signals

The STOs' social media activity on Twitter, LinkedIn, and Instagram show no significant influence. The existence of a Telegram group (Telegram) is significant at least at the significance level ($p < 0.1$) but does not meet the set significance level of 0.05. The results are largely consistent with those of Ante and Fiedler (2020), although this research paper generally measures whether there is activity, and the two authors used the number of followers as a measure. The only difference is with Twitter, which showed a significant effect in the other research.

Token financial characteristics

Of the seven variables tested, three predictors are significant. The variable Total_supply_tokens is highly significant ($p < 0.01$). However, the influence of the number of tokens issued is negative. This means that if there are more security tokens than average, the probability of success of the STO decreases. Thus, it makes more sense for the token issuer to issue fewer tokens (but with a higher price, for example) to collect more capital. The result differs from the previous state of the literature on ICOs (e.g., Fisch, 2019). The reason could be due to psychological effects. While many small investors participate in unregulated ICOs, there are different minimum investment amounts in STOs depending on the state and regulation used. Accredited investors may prefer to own few but valuable tokens rather than buy tokens with junk prices.

The variables Hardcap (negative influence) and Fiat (positive influence) are only significant at a significance level of 0.1. Surprisingly, a prior presale has no impact on the probability of success. Thus, the result differs from the studies on ICOs (e.g., Adhami et al., 2018). In summary, the total number of tokens has a significant impact on success.

Token technical and economic characteristics

Regarding token holder rights, the variable Voting has a highly significant influence ($p < 0.01$). Unexpectedly, however, the influence of this right is negative. This result means that the probability of success decreases if the security token promises voting rights. In contrast, Lambert et al. (2020) found a significant positive impact on voting rights. The authors assumed that the separation of voting rights and cash flow rights is negatively correlated with STO success. When insiders (managers and controlling shareholders) control the firm, the firm value decreases. At the same time, however, they acknowledged that the negative impact of decoupling the two rights is less clear in the STO context because securities are recorded on the blockchain (cf. Lambert et al., 2020).

In the analyzed dataset, there are 34 STOs offering voting rights. Of these STOs, 25 count as failures (soft cap not reached). A closer look at the projects reveals that more than three-quarters of the STOs that guarantee voting rights also promise dividends. The token issuers advertise in the whitepaper of the security token "Liqio" that token buyers will receive dividends. The fact that there are also voting rights is only mentioned in a single sentence in the whitepaper, and no information is given about the subject areas to which the voting rights relate (cf. LIQIO, 2020). The same applies to the "Digitorney" token; the whitepaper also mentions voting rights in just one sentence (cf. Digitorney Group, 2018). Anyway, what the voting right includes exactly is not sent as a signal to the investor.

However, the investor needs to know in which areas the investor can participate in decision-making, as the topics relevant to co-decision-making are not regulated by law. It makes a difference, for example, whether the investor receives voting rights

for issues relating to the crypto area (e.g., listing on exchanges) or voting rights relating to corporate governance decisions (e.g., dividend payment).

Nevertheless, the voting rights are included in the pricing of the token. The assumption is as follows: Considering that investors often do not know what specific voting rights they have, they see no added value in voting, not because they are fundamentally not interested in voting, but due to the lack of information from the token issuer. Therefore, investors prefer to invest in other STOs that instead offer only dividends, for example, but provide a lower price.

Looking at the asset classes, Equity has a significant positive impact ($p < 0.05$). One possible reason for this may be that investors prefer shares to other assets. Debt securities are embodied in debt tokens (cf. Jünemann and Wirtz, 2018). The investment in debt securities is legally more uncertain than, for example, in the case of an equity token due to regulatory hurdles. Equity tokens are classified in the classic securities and shares category. The fact that equity tokens increase the probability of success may also be related to the associated rights. Even if voting rights have not proven to be a success factor, it is still unexplored whether profit-sharing or dividends are the actual reason why equity tokens increase the probability of success. The blockchain, on which the token runs, has an insignificant influence.

External factors

While the country of incorporation (USA) has no influence, projects located in the finance and banking industry have a positive influence on the probability of success ($p < 0.05$). Both findings are consistent with the results of Ante and Fiedler (2020). In an OLS regression by Lambert et al. (2020), the USA also showed no significant influence.

In terms of industry, companies from the financial sector can take away that it is more likely that they will succeed in an STO than if they belonged to other industries. Conversely, this finding means that companies from other industries should look around for other forms of financing, as the probability of failure is higher. One possible explanation is that STOs are still new and tend to be viewed with scepticisms. When investors invest their money, they want a company that is an expert in the field of finance. Investors are more likely to entrust their money to a fintech, which is assumed to have more experience with innovative forms of financing, than, for instance, a toy manufacturer, with no prior experience with IPOs or other complex forms of financing.

4 Conclusion

This research paper has provided an overview of security tokens and STOs, which are used for corporate financing. The research aimed to find out which variables influence the probability of success of STOs. The analysis was done from the perspective of a company that wants to raise capital.

It has been determined that the existing literature focuses mainly on ICOs. Empirical studies dealing with STOs have investigated the determinants of success using OLS regressions. However, no study is known to have previously explored the probability of success of STOs using logistic regression. The given research work adds to the existing research through its investigation of the success probability of signals that token issuers can send to potential investors.

This research analyzed the determinants of success of 183 STOs that raised capital between 2017 and 2020. Since security tokens are regulated financial instruments, they should have less impact on the funding process. However, the results show that this is not always the case. If token issuers choose equity tokens for the asset class, the STO is 3.34 times more likely to be a success than other asset classes.

If the STO project is assigned to the finance and banking industry, the probability of success is 2.19 times higher than for other industries. The financial sector meets new types of financing such as STOs. Investors are, therefore, most likely to entrust their money to an expert in the field. Regarding the number of issued tokens, the probability of success is 0.3 times lower if an above-average number of tokens are issued. Token issuers should therefore issue fewer tokens and instead set higher prices for each. Voting rights also have a negative impact on the probability of success: If the security token offers voting rights, the probability of success is 0.25 times lower than for STOs that do not provide voting rights.

Thus, three of the six null hypotheses can be rejected: The probability of a successful STO is related to signals shaping the token's financial characteristics, signals shaping the token's technical and economic characteristics, and related to signals that affect the external factors. STOs can exploit these quantitative factors that are easy to implement until the market no longer considers these as quality indicators.

Future research should also look at the duration of STOs, as little evidence was found in this research that hard cap may be related to the length of an STO. As this study has focused on quantitative success factors, further research could also investigate the quality of signals.

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