

CAPTURING NaaS BUSINESS OPPORTUNITIES IN THE 5G ERA

January 2020

Executive Summary

FYDENA is a business platform for NaaS developed by HFR.

- FYDENA ensures trustworthy and cost-efficient business transactions among NaaS (Network as a Service) providers, buyers, and platform providers.
- FYDENA enables SLA(service level agreement)-based offerings to meet the needs and requirements of NaaS buyers.
- FYDENA enlarges and secures business opportunities for NaaS providers with reduced costs.

FYDENA implements a software-defined business process.

- FYDENA generates enforceable software (smart contracts) from natural language-based contracts, including SLA.
- FYDENA executes smart contracts automatically and securely.

FYDENA can be applied to various types of NaaS business models.

- FYDENA is to be applied to 'Private 5G as a Service' and 'Neutral Host Service' business models in the 5G era.
- FYDENA can be easily customized for any other NaaS business applications.

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1 Emerging Network as a Service Models

Network as a Service (NaaS)

NaaS provides network services for business customers who do not have physical network infrastructure. A service provider offers network services to the customers or employees of the buyer, according to the agreed-upon business process (see Figure 1). Among the various NaaS business models, there has been a focused interest from the industry on the 'Private 5G as a Service' and 'Neutral Host Service' models.

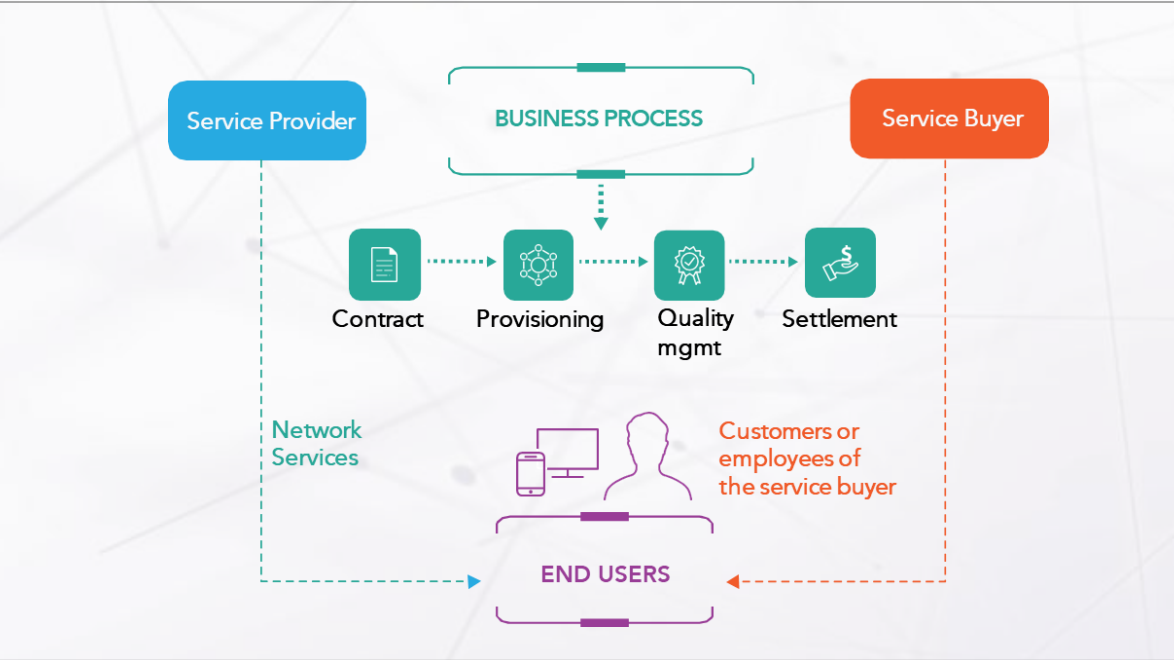


Figure 1. General NaaS business structure

Private 5G as a Service

There are various trials and deployment cases of private 5G where the technological features of 5G are taken advantage of for industrial applications to enterprises and public institutions. In particular, it is expected that the new spectrum policies such as CBRS (US) or Local 5G (Japan) will accelerate private 5G deployment. Accordingly, there has been a rise in the 'Private 5G as a Service' business model that provides all or some part of the design, installation and operation of the private 5G infrastructure. In this case, the service buyers are enterprises or public institutions, and the service providers are incumbent mobile network operators (MNOs) or emerging local service operators.

Neutral Host Service

The network roll-out cost of 5G will be significantly higher than that of the prior generations. Therefore, it is expected that the 'Neutral Host Service' market will grow to cost-effectively secure coverage and capacity. In particular, it is noticeable that deploying a new spectrum like CBRS and Local 5G in the neutral host network can maximize the advantage of sharing facilities and the pooling effect of the frequency resources, and also dissolve the interference problem. In the 'Neutral Host Service' model, the service buyers are MNOs and the service providers are neutral host network operators (NHOs).

2 Characteristics of the NaaS Business and Challenges

NaaS businesses, including ‘Private 5G as a Service’ and ‘Neutral Host service’, generally provide services by establishing networks in limited areas. This business characteristic presents two major challenges.



Figure 2. Quality management in SLA life cycle

Service quality management

Service providers need long-term contracts for adequate returns on the network investment. This means that the service provider needs to monopolize the service of a particular area during a long-term contract, and service buyers cannot help but be concerned by the possible degradation of the quality of service (QoS). According to the results of a survey on the use of ‘Neutral Host Services’, MNOs who are the service buyers pointed out the QoS assurance as the most important requirement ^{(1),(2)}. It is expected that the buyers of ‘Private 5G as a Service’ will have the same awareness on QoS, although there are no published results of a survey on that matter specifically. Therefore, the assessment of the service provider’s ability to manage QoS, including the due diligence, take up the majority of the costs before entering into an agreement. The best QoS management can be achieved by implementing appropriate service level agreements (SLA) and quality-based dynamic pricing, due to their impact on motivating the service provider to maintain the best quality, as shown in Figure 2. Of course, the SLA should be reasonable enough for the service provider and buyer to agree on. In particular, it should be designed to be flexibly applicable to the various types of 5G application services that require various QoS.

In addition, the implementation and management of SLA including quality monitoring and charging should be transparent and trustworthy.

(1) Small Cell Forum, “Multi-operator and neutral host small cell”, 2016.
(2) 5GCity, “Business Questionnaire-MWC2019”, 2019

Reducing transaction costs

The NaaS business should follow a complex and strict process, from SLA to billing & settlement, defined by the agreed-upon contract. In many cases, however, NaaS business processes are time consuming and costly, as shown in Figure 3.

Usually, a separate and independent contract and business process is needed for each 'Private 5G as a Service' or 'Neutral Host Service' for an enterprise or a particular venue. As it is difficult to simplify or omit any part of process even if the scale of business per contract is small, the transaction costs that are needed for the business do not greatly change according to the scale.

Therefore, transaction costs per contract is an important factor that determines the profitability of a NaaS business case. In other words, in order to increase the number of profitable 'Private 5G as a Service' or 'Neutral Host Service' business cases for the expansion of the market size, there should be innovations to reduce the transaction costs per contract. In particular, for the neutral host network operator (NHO), as there should be $m \times n$ number of contracts and management for service business for n number of venues with m number of MNOs, the reduction of transaction costs per contract is extremely important.

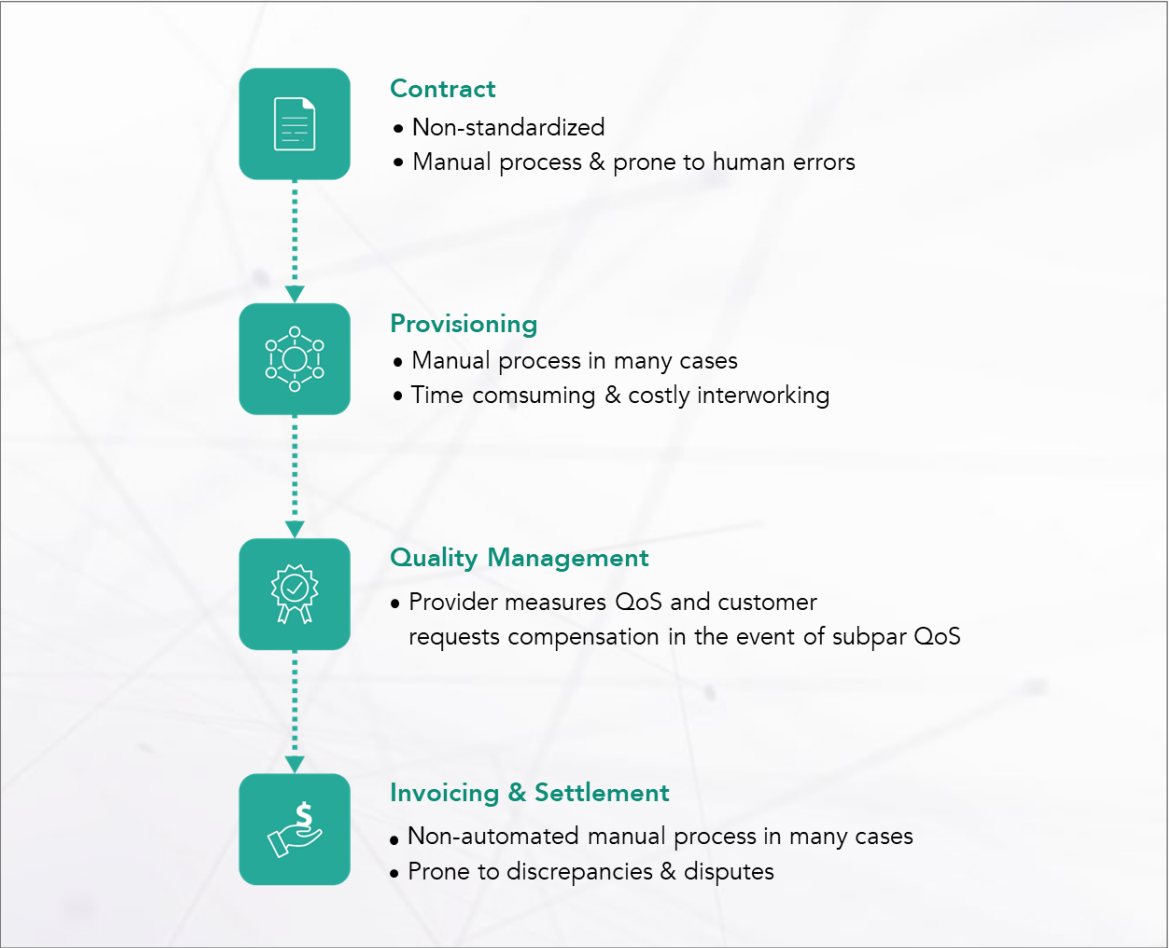


Figure 3. NaaS business process should be improved

3 Introduction to FYDENA

FYDENA is a business platform specifically for the NaaS business with numerous service providers and buyers. The purpose of FYDENA is to make the drafting and implementing of contracts including SLAs easy and automatic to meet the needs of service providers and buyers at low transaction costs.

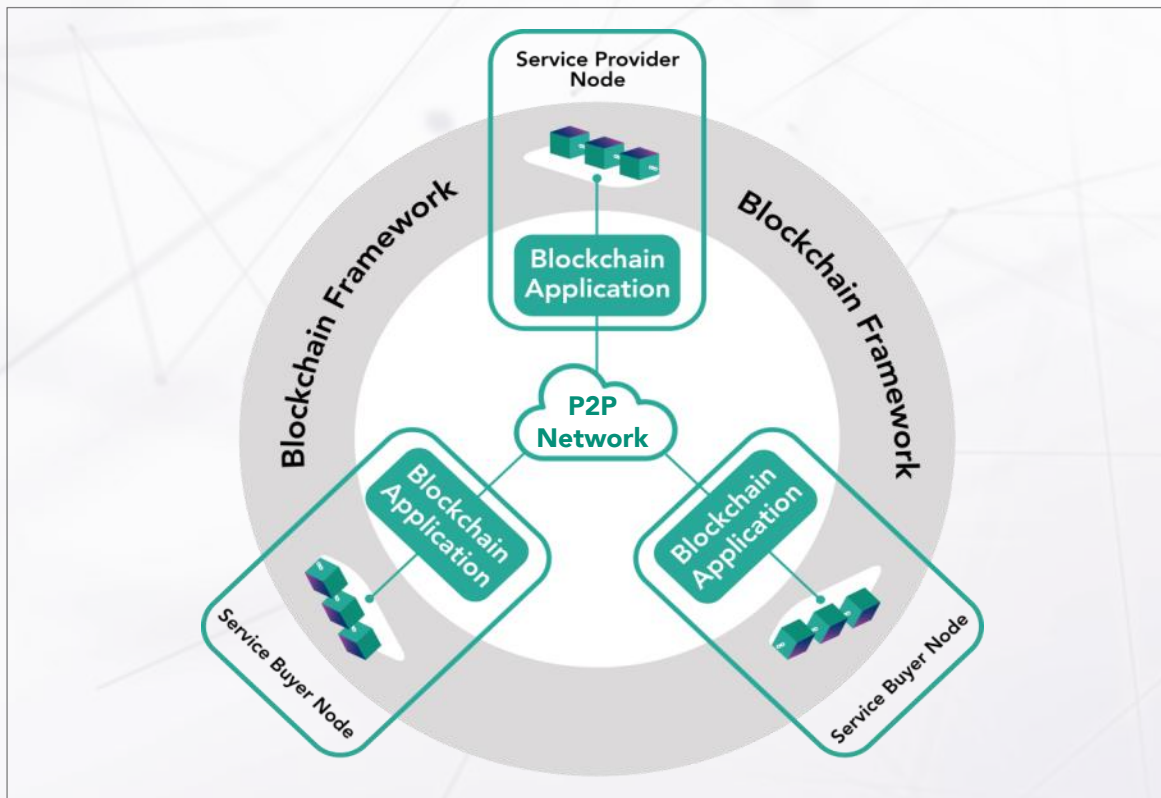


Figure 4. FYDENA decentralized architecture

Decentralized ledger system

FYDENA is a decentralized system using blockchain and a platform on which participants can easily organize and manage their businesses. Blockchain is an immutable and append-only ledger that is essentially a consensus of replicated, shared and synchronized digital data spread across multiple nodes or peers. As described in Figure 4, the blockchain application for each node utilizes the functions provided by the blockchain framework and builds a peer-to-peer network among nodes.

Therefore, whereas it easily achieves data integrity and transaction security by applying the inherent functionalities of the business blockchain framework, it also eliminates single points of failure and dissolves issues that can arise in dominant centralized platforms such as the monopoly of data and pricing control. Though every node in a business blockchain has the same ledger, confidential transaction data are available only to allowed nodes - for example, the nodes of contracting parties.

Another advantage when using blockchain is the deployment of smart contracts. A smart contract is generated by programming the corresponding contract and can be executed automatically and safely by deploying to the blockchain.

Software defined business process

FYDENA comprises of four core functions based on blockchain optimized for the Naas business structure; automatic generation of smart contracts, service quality monitoring and verification, billing & payment, and service access control (see Figure 5).

Firstly, the natural language-based human-readable contract document is converted into a smart contract that is automatically generated and deployed onto the blockchain (see Figure 6).

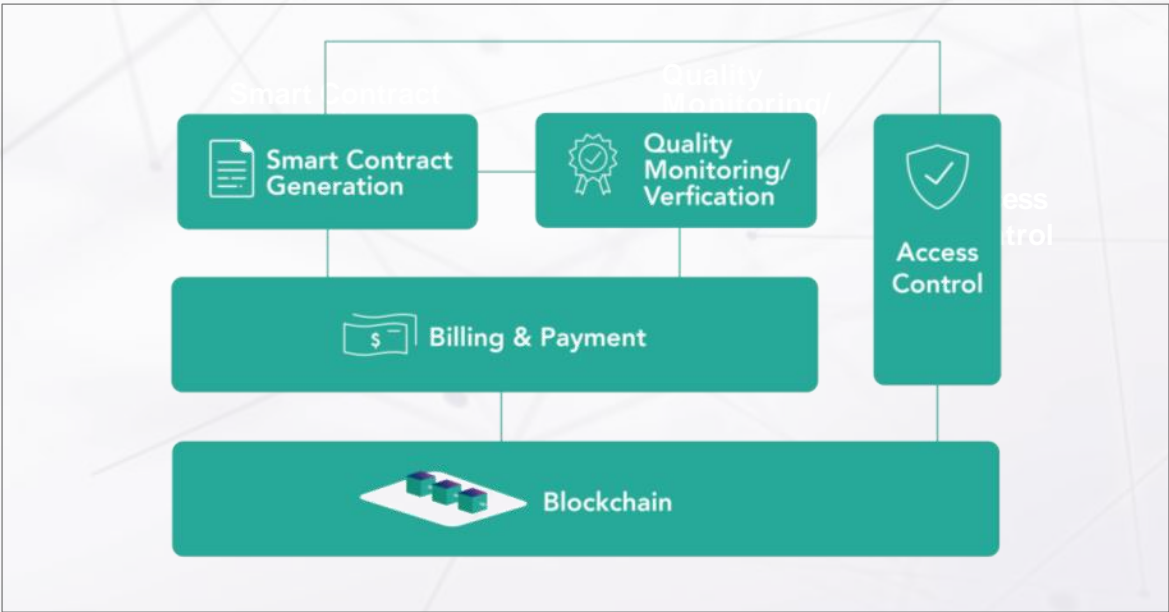


Figure 5. High level functional architecture of FYDENA

The contracting parties can make the agreed-upon business processes into software and automatically implement the processes without any additional programming. A smart contract, in other words, is the business process defined by software, and includes methods for service quality monitoring and transaction verification, its pricing scheme and charging & payment methods. Once the smart contract is deployed onto the blockchain, it can be regarded as immutable and automatically come into effect with the distributed processing provided by blockchain.

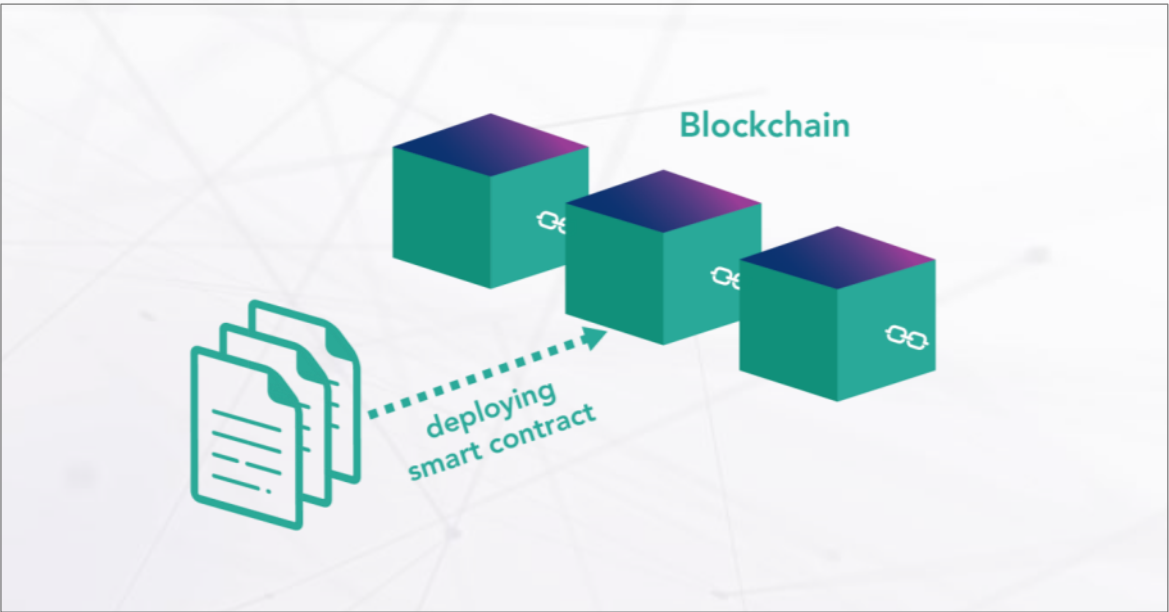


Figure 6. Software defined business process using smart contract

Off-chain data integrity service

All of the data processed within the blockchain is secure. However, for the NaaS business process, it is critical to ensure that the events and data outside the blockchain (for example, quality monitoring, etc.) are securely processed and deployed onto the blockchain. FYDNA provides off-chain service functions to guarantee the integrity of the quality monitoring data by using anti-tampering and anomaly detection technologies. As shown in Figure 7, FYDNA compares the quality data measured on the end user device and the network server to detect the abnormal difference between them.

How can FYDNA reduce transaction costs?

FYDNA provides methods for transparently implementing and managing SLAs using various quality indicators and compensation schemes to reduce the cost of quality management capability assessment. Furthermore, quality monitoring, verification, billing and payment can be automatically processed through the smart contract to eliminate the transaction costs from manual processes after entering into a contract. Additionally, when the authentication systems of the service provider and buyer need to be interconnected for access control, FYDNA acts as a brokerage system to greatly reduce the costs. Please refer to “FYDNA: Business Blockchain for Network as a Service” for more detailed information.

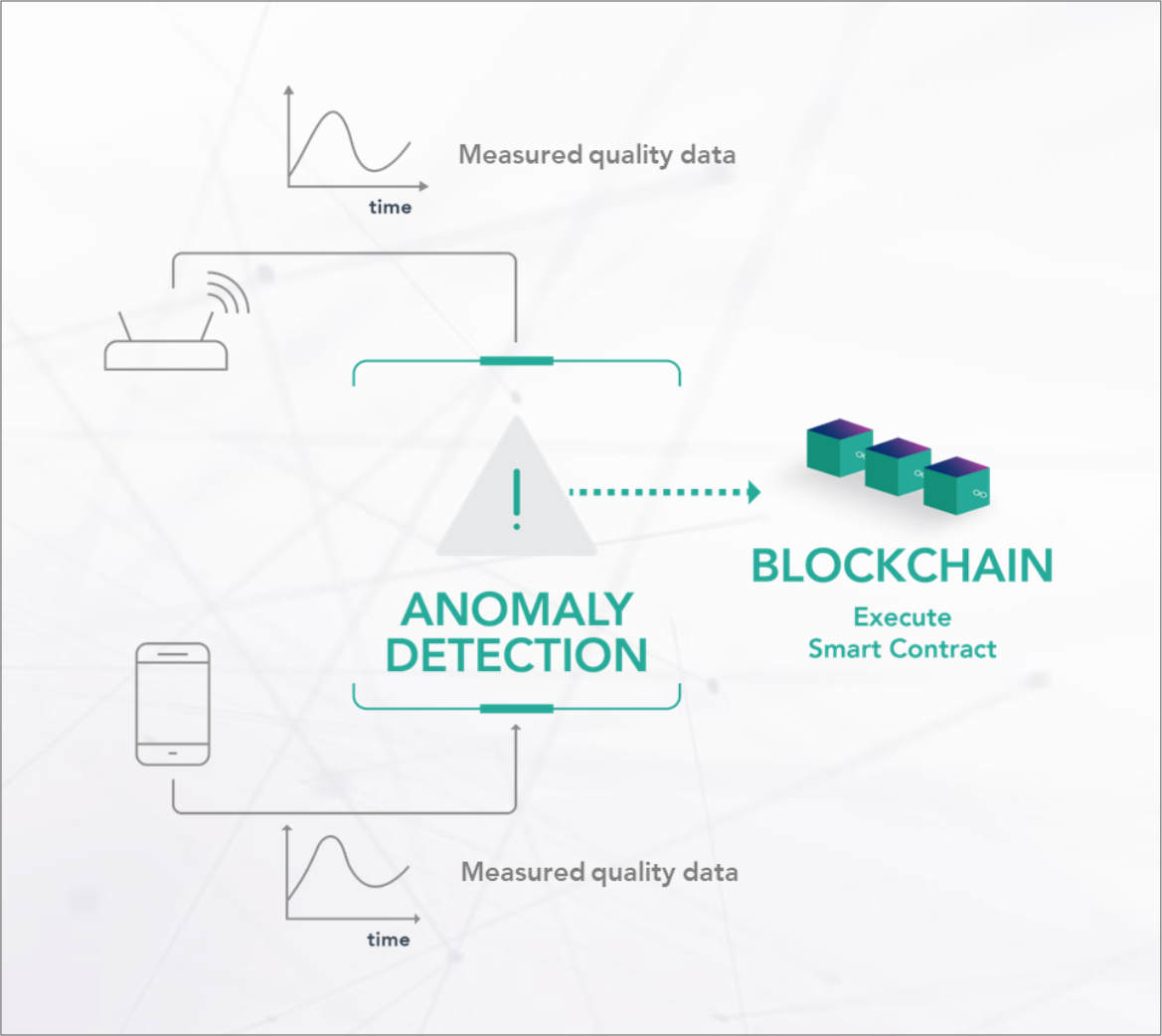


Figure 7. Verification of quality monitoring data

4 FYDNA Service Business Model

FYDNA is a platform that can be applied to various types of NaaS, and can be flexibly realized to act as a single-sided or multi-sided platform based on the business model.

Single-sided platform model

In the single-sided platform model, a NaaS provider uses FYDNA to reduce transaction costs and offer differentiated value propositions. For example, a **‘Private 5G as a Service’** provider builds and operates FYDNA and offers trustworthy SLA management at low costs. As nodes of the blockchain, enterprise customers participate in transaction verification and block generation according to the contract.

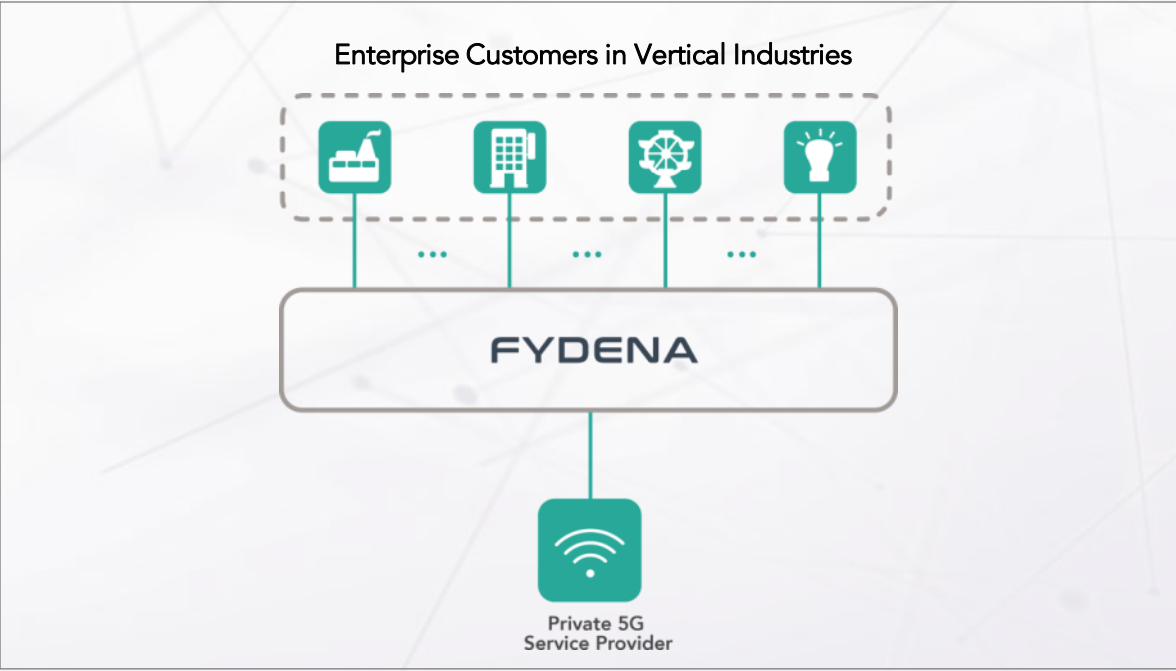


Figure 8. Single-sided FYDNA example

Multi-sided platform model

In this model, separate business entities provide FYDNA services to multiple NaaS providers and buyers. In the case of **‘Neutral Host Service’** businesses, contracting NHO and MNO act as nodes that perform transaction verification and block generation along with the FYDNA service provider nodes. The FYDNA service nodes also provide off-chain services.

A FYDNA service provider can charge platform usage fees as in centralized models. However, as FYDNA is realized based on a decentralized ledger system, multiple business entities can participate and act as FYDNA service providers. This is a departure from centralized multi-sided platforms where a single business entity monopolizes the data and is responsible for secure transactions.

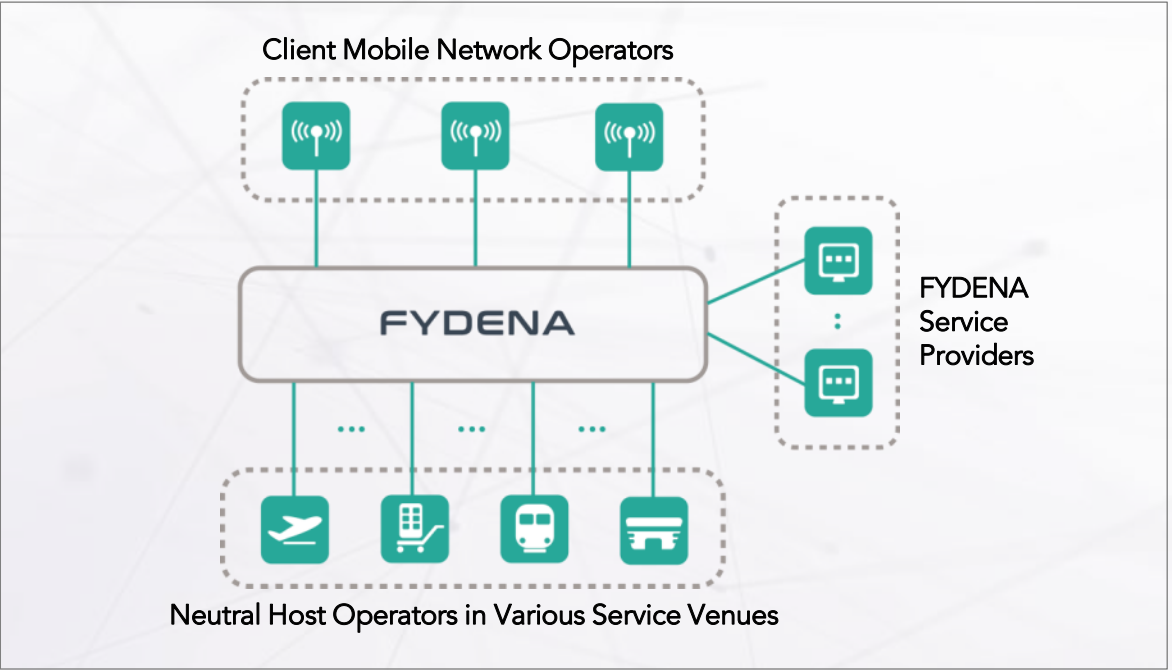


Figure 9. Multi-sided FYDNA example

5 Proof of Concept System and Future Roadmap

A proof of concept (PoC) system that applies FYDNA to the neutral host Wi-Fi service case has been developed, and is currently going through a closed beta service since November 2019. Hyperledger Fabric was used as the blockchain framework, and the blockchain applications were developed to be applicable to the 'Neutral Host Service' business.

For the off-chain service of the service nodes, the automatic generation of smart contracts functionality which converts natural language-based SLA to Node.js codes was implemented.

The SLA includes the rules to calculate the fees based on network usage and quality. As another important off-chain service, QoS monitoring and data verification functions were developed.

In addition, other important functions for 'Neutral Host Service' business processes such as billing & payment and access control, were realized and validated.

There are ongoing development efforts to apply FYDNA to 'Private 5G as a Service' and 'Neutral Host Service' using Local 5G and CBRS. All are expected to be completed by December 2020 for field trials.

Furthermore, privacy preserving personalized application service functions for creating additional platform-based business opportunities are being developed.

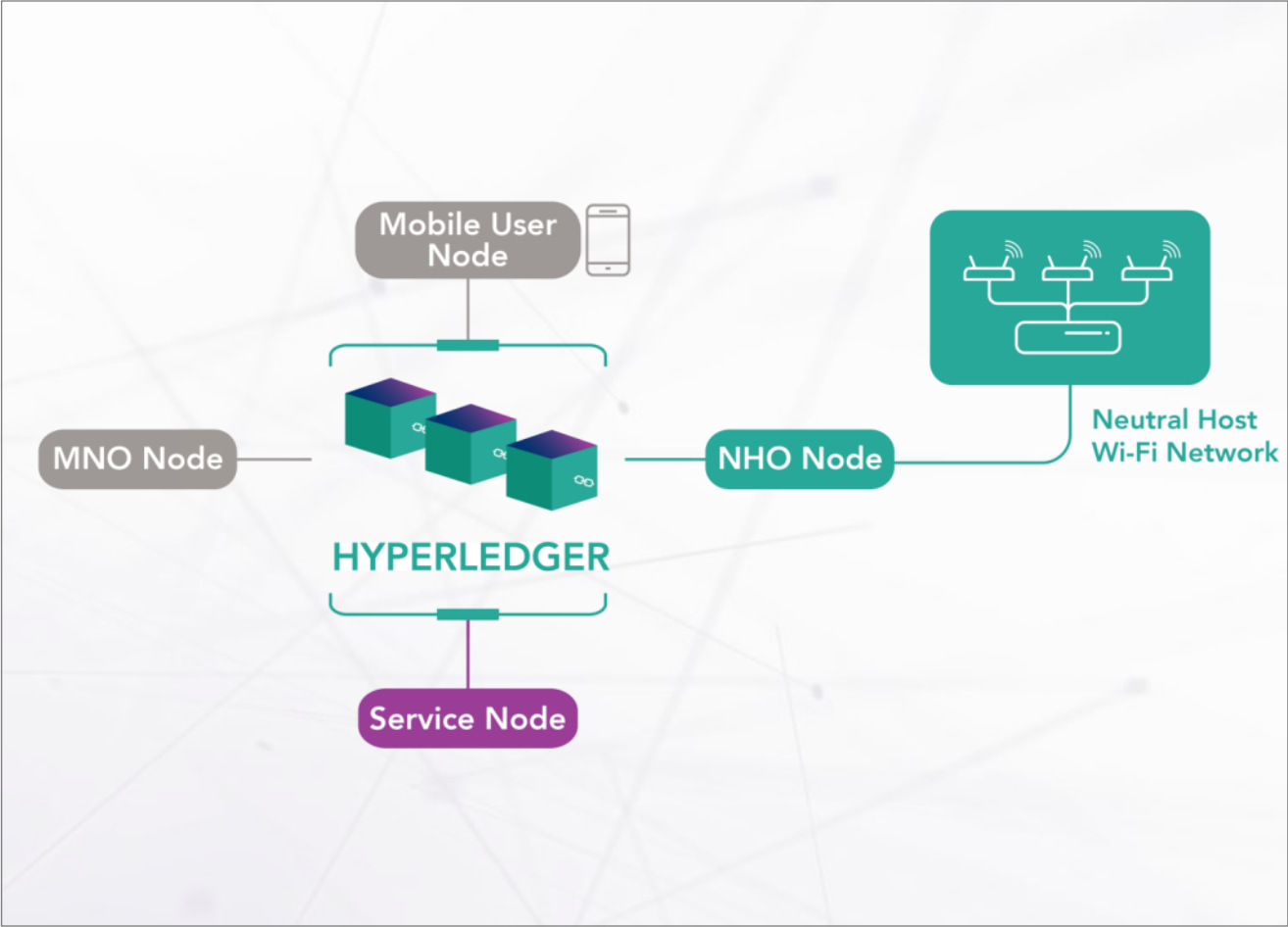


Figure 10. FYDNA PoC System



FYDENA

BUSINESS PLATFORM
FOR NETWORK AS A SERVICE

FOR MORE INFORMATION, PLEASE CONTACT

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