

RESEARCH ON BENEFITS DISTRIBUTION OF IOT INDUSTRY CHAIN

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Abstract: At present, the development of Internet of things has been regarded as the information industry development strategy for the next high point in China. Internet of Things will promote the sensor manufacturers, integrators, operators and other related industries, development with a huge industry profits. In this paper, we proposed a clear composition of the industrial chain and established the IOT industry chain structure that regard the operators as leader. At last, by analyzing the current relationship that supply and demand of products and services between the parties, Use static game and dynamic game analysis of the interests distribution of Internet of Things industry chain.

1 INTRODUCTION

Internet of Things through the radio frequency identification (RFID), infrared sensors, global positioning systems, laser scanners and other information sensing equipment, connected objects to the Internet and exchange information and communication in order to achieve the object intelligent identify, locate, track, monitor and manage a network. U.S. independent market research firm Forrester predicts that by 2020 the business of IOT with the existing Internet business will reach the ratio of 30:1 China's overall scale of the industry of IOT is expected to more than 1 trillion by 2015, over 5 trillion by 2020.

With the tremendous development of IOT, Internet of Things be regard as cultivating new industries. This paper analyzes the industry leader, have the clear the relationship between the parties in the industrial chain of IOT. And use intermediate product pricing model to establish the distribution of benefits, analysis the distribution of benefits of IOT industry chain by static game and dynamic game.

2 THE INDUSTRIAL CHAIN OF IOT

2.1 The Composition of the Industrial Chain of IOT

The industrial chain means companies take different functions of value creation, more companies of the upstream and downstream industries jointly to provide services to the consumer (product) and formed the division of labor relations or networks. Europe, America, Japan and other countries divided the industrial chain of IOT into Sensors/chip providers, communication module providers, telecommu-nication operators, middleware and application. The telecom operators in China to play with IOT operators and service Providers. Therefore, our industrial chain of IOT be composed of the sensors/chip manufacturers, communication module providers, Operators and service providers, Software and application developers, system integrators.

Sensors/chip manufacturers. Currently, low frequency RFID technology is more mature, lack of UHF and microwave RFID. Engineering Research Institute under the sensor (GSII) market survey, 80% well-known sensor manufacturers have been to enter the Chinese market.

Communication module provider. At present communication module providers have the core Paper, the flames of communications, Huawei,

Datang, ZTE, ZTT, Huntoon broadcasting, optical information technology, three-dimensional communication, etc.

Operators and service providers of IOT are mainly to provide a unified terminal authentication, billing and other services, the terminal access control, terminal management, industry management, application management, operations management, platform management, etc.

Software and application developers in the country has developed a considerable number of enterprises. As IOT more obvious applications, industry characteristics, therefore, the current application software developers are primarily industry-specific businesses, providing professional software products and solutions

System integrators are based on customer demand, will achieve IOT hardware and software integration to provide a complete solution to customers of manufacturers. Application of domestic integration in the IOT have small-scale, and focus on the industry-based business, but also the lack of attention of the large multi-industry company.

2.2 Analysis of Industry Chain of IOT

Every element of Industry Chain of IOT have the close contact interaction, the main value added by all the continuous processing of information, such as collecting, sorting, classification, storage, transmission, exchange, etc., Provide information products that the user needs , To achieve the information Value added, creating more than a single corporate synergy. From the perspective of industry chain and the current status of industrial development of IOT, sensor and equipment providers and has vast room for development. Three major Operators in China have the following advantages:

(1) Wide range of communication networks

Operators have wide coverage, powerful ability communications network. Control of network, allowing operators have the right of ownership and connection from the initial end-user , this theory on industrial chain Prove that in industry chain, who owns the end-user, who will occupy the central position, because only the final the user is the source of the value chain and the most important anchor

All value of the value chain are only able to meet the end-user demand, can finally be achieved. Because operators have a customer resources, other companies only have to through Operators to

provide services to users. Finally, Operators will firmly hold the core of the industrial chain.

(2) Financial advantage

The development of Internet of Things must be supported by financial, the three major Operators in China after years of communications industry operations. Accumulated a lot of Funds, with strong financial advantage.

(3) Large-scale users

Operators have a large user e and nationwide service channels. Once Internet of Things developed, these users must be consumers of Internet of Things. Conducive to the overall promotion and application of Internet of Things.

(4) Strong data processing capability

With the rapid development of Internet of Things, data processing capacity will be the emphasis. Massive data processing capacity will be restricting the development of Internet of Things. Analysis all aspects of Internet of Things, the three

Analysis all aspects of Internet of Things, the three major telecom operators have powerful data processing capacity, which is not available in the remaining part

As Internet of Things in the introduction stage, technology immaturity, customer lack of awareness, not formed a complete industrial chain. Operators hold the chain links of the network industry and application of two important aspects, from the upstream and downstream operators, co-led the formation of industry alliances will be key to promoting industrial development. Operators in a dominant position on the chain, up to restricting the upstream equipment suppliers, down through cooperation to improve control. Through analysis, the operator of Internet of Things as the core of the industrial chain model shown in Figure 1.

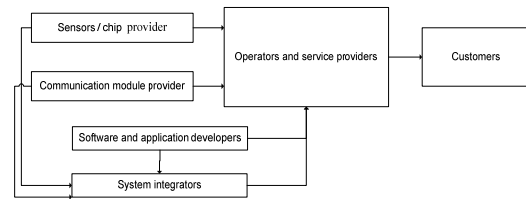


Figure 1: The model of IOT industrial chain that operator as the core.

Sensors/chip manufacturers and commu-nications module providers provide front-end equipment to IOT led by Operators, constitutes purchase relationship; systems integrator/software provider build network platform for IOT.

3 THE DISTRIBUTION OF BENEFITS OF IOT INDUSTRY CHAIN BASED ON GAME THEORY

Based on the above analysis, the various aspects of the industry chain of IOT constitutes a supply-demand relationship. On the basis of this relationship, establish. The distribution of benefits product model by Intermediate product pricing and analysis by static game and dynamic games

3.1 Model

Suppose Sensors/chip manufacturers, Communication module provider, software provider systems integrator and Three operator (China Mobile, China Unicom, China Telecom) have

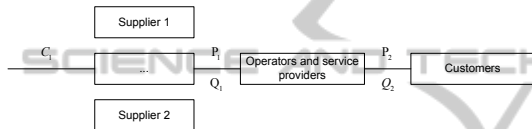


Figure 2: Supply and demand model of IOT.

Purchase relationship. sensors/chip manufacturers, communication module providers, system integrators and software providers as suppliers, operators as the demand side.

Assuming price of product that provided by upstream suppliers is P_1 , with the quantity of product Q_1 , Cost : C_1 , Profit:

$$\pi_1 = P_1 Q_1 - C_1(Q_1) \tag{1}$$

The services price that downstream operators provide to the consumer is P_2 with the volume of services Q_2 , Cost: C_2 ,

Profit:

$$\pi_2 = P_2 Q_2 - C_2(Q_2) - P_1 Q_1 \tag{2}$$

The profit of industrial chain of IOT:

$$\pi = \pi_1 + \pi_2 = P_2 Q_2 - C(Q) = P_2 Q_2 - (C_1(Q_1) + C_2(Q_2)) \tag{3}$$

Intermediate and final product relationship have fixed proportion:

$$\begin{cases} Q_2 = aQ \\ Q_1 = Q \end{cases} \tag{4}$$

Assumed $\alpha = 1$, Operators of IOT as the monopolist can determine their own capacity and the best service to maximize their profits. Assume the

final product market demand curve:

$$P = f(Q) \tag{5}$$

3.2 Static Game

Suppose both suppliers and operators cannot determine the price of intermediate products, the upstream sensor and module suppliers, choose yield maximize self-interest.

if $MC(Q_1)$ is Marginal cost, assume the output Q_1 of the sensor supplier Unknown. According to $\pi_1 = P_1 Q_1 - C_1(Q_1)$. Can be drawn from the first-order conditions for profit maximization:

$$P_1 = MC(Q_1) \tag{6}$$

The operator determined yield based on business size and type of production can be seen as in accordance with the demand curve $P_2 = f(Q_2)$. Suppose operators as monopolist, According to $\pi_2 = P_2 Q_2 - C_2(Q_2) - P_1 Q_1$. Can be drawn from the first-order conditions for operators, profit maximization:

$$P_1 = f(Q) + Q f'(Q) - MC_2(Q) \tag{7}$$

Equations (6) and (7) obtained maximize the yield Q_m , Satisfy the following equation:

$$f(Q_m) + Q_m f'(Q_m) - MC_1(Q_m) - MC_2(Q_m) = 0 \tag{8}$$

Substituting Q_m to (3-8), obtained Price P_m of intermediate products

$$\begin{cases} P_m = MC_1(Q_m) \\ P_m = f(Q_m) + Q_m f'(Q_m) - MC_2(Q_m) \end{cases} \tag{9}$$

The two corporate profits π_1, π_2 :

$$\begin{cases} \pi_1 = P_m Q_m - C_1(Q_m) \\ \pi_2 = P_m Q_m - C_2(Q_m) - P_1 Q_m \end{cases} \tag{10}$$

If the suppliers and operators have no price decision, the parties select the production (operator select the demand) to maximize their own profits, all of the game equilibrium can be achieved to maximize the overall profit, in order to achieve their own and overall profit Consistent.

3.3 Dynamic Game

Operators of IOT have the right to determine the price of intermediate products, operators act first to select the price. Upstream equipment suppliers based on prices of intermediate products, the cost to select intermediate products that can maximize suppliers'

profits. By the dynamic game of backward induction, the upstream equipment suppliers to make their maximum profit, in line with network operator's pricing of intermediate products P_1 to decide yield,

The first order conditions:

$$P_1 = MC_1(Q) = \psi(Q) \tag{11}$$

Assumed to be monotonic functions:

$$Q = \varphi^{-1}(P_1) \tag{12}$$

Operators know the upstream equipment vendors based on intermediate products' price to determine the amount of service, so the price of intermediate goods to be considered to achieve operators' profit-maximizing

$$\begin{aligned} \max_{P_1 \geq 0} P_2 Q_2 - C_2(Q_2) - P_1 Q_1 &= \max_{P_1 \geq 0} P_2 Q - C_2(Q) - P_1 Q \\ &= \max_{P_1 \geq 0} f(\varphi^{-1}(P_1)) \times \varphi^{-1}(P_1) - C_2(\varphi^{-1}(P_1)) - P_1 \times \varphi^{-1}(P_1) \end{aligned} \tag{13}$$

First-order conditions:

$$\begin{aligned} f'(\varphi^{-1}(P_1)) \frac{d\varphi^{-1}(P_1)}{dP_1} - \varphi^{-1}(P_1) + f(\varphi^{-1}(P_1)) \frac{d\varphi^{-1}(P_1)}{dP_1} \\ - MC_2 \varphi^{-1}(P_1) \frac{d\varphi^{-1}(P_1)}{dP_1} - P_1 \frac{d\varphi^{-1}(P_1)}{dP_1} - \varphi^{-1}(P_1) = 0 \end{aligned} \tag{14}$$

Comparison the distribution of profits of Static game and dynamic game, Equation(12)and (7) obtained static equilibrium solution with P_1^* , Assumed to (14) get Equilibrium P_2^* by dynamic game. Shows that $P_1^* \neq P_2^*$. Learned from the above formula, IOT operator get more profits from the dynamic game more than static game, the overall profit from dynamic game is more than static game, suppliers gain the profits from dynamic game less than static.

When the downstream business can determine the price of Intermediate products. The first gamer player in the dynamic game earned more profit than the static game. Therefore, the industrial chain of IOT on the basis cooperation, the parties will take dynamic game, the first game will be a larger profit side.

4 CONCLUSIONS

With the development of IOT industry, operators, as the leader of IOT industry's position will become increasingly clear that the operator determine the price of intermediate goods, with the price of making the "first-mover advantage" in the interests of the industry chain distribution process gain

advantage. However, to promote the development of the industrial chain of IOT, we must take into account the profitability of other sectors. Operators determine the intermediate goods prices, taking into account its own interests should proceed to maximize the overall development of intermediate goods prices. In this way, IOT that can ensure the profitability of all sectors of the industry chain and will help the industry grow and develop.

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