The methodology for communication problem in telecom sector using fuzzy sub-monoid and group theory

P Jayagowri¹, K Karpagavalli¹ and R Karthik²
¹ Sudharsan College of Arts and Science, Pudukkottai, India.
² Department of Computer Science and Engineering, Sri Sai Ram Institute of Technology.
E-mail: ¹gowrimullaimani@gmail.com; ²karthikr@velammal.edu.in

Abstract. In order to address the 'channel' problem for telecommunications operators, this study is a pioneer in the application of Fuzzy Sub monoid and Group Theory to the communication channel system. The channel entity community model was developed for the transmission of information in the channel system to analyses the operation of channel entities. The channel system network traffic equations were developed in accordance with the theory of stream conservation and the channel network matrix. The matrix dimensionality was reduced on the basis of the channel entity Fuzzy Sub monoid and group model. A solution to the flow-state transfer relationship of the channel system is obtained, which will be very useful for telecommunications operators to create a high-level mobile e-commerce application model and architecture.

1. Introduction
The latest wave of information technology, such as cloud computing and the Internet of Things, has inspired the imagination of enormous players in the business chain with the advancement of the subversive capacity of the mobile Internet and has contributed to a latest round of information revolution in recent years. In particular, Over-the-Top (OTT) affects the telecommunications industry as a major player in the reform of information technology. Over-the-Top (OTT) tends to the show where downstream third parties in the mobile Internet business chain offer a range of value-added telecom function and services as a replacement for basic telecom service providers in the mobile Internet era [1,4,6,8]. In order to avoid the possibility of marginalization and channeling, telecom service distributers must enhance and ensure service quality (QoS) in key industries by developing fine and elegance management networks and upgrading the operating platform. Quality of Service (QoS) can also be calculated quantitatively through error rates, throughput, delay in transmission, and promptly [2,5,13,17]. Some studies have been conducted to resolve this issue; for example, a smart channel with optical, sustainable returns has been suggested as a key to efficient and stable data transmission capacity for the telecommunications business. Unfortunately, only two elements of data processing and data analysis have been redefined by the proposed smart channel, without improving data traffic in the delivery and processing frameworks. A channel resource model associated with stage-level analysis was proposed to estimate the worst-case communication latency, and it was only intended to improve scheduling based on real-time analysis. The Markov Decision Process (MDP) experiment has always been used to dynamically optimize the network and enhance QoS in the time region, but the current model often faces problems with the 'State Space Explosion'; In particular, the object management problems caused by the epidemic growth of object type and quantity in the computer system and computer network make the Markov Decision Process (MDP) model unable to c. Fuzzy Sub monoid and group theory in the field of physics and chemistry has been commonly
used as a kind of abstract mathematical tool [3,7,9-11]. In the field of medical image processing, the computation time is significantly reduced by exploiting the symmetry given in breast models using Fuzzy Sub monoid and group theory to detect breast cancer. For instance, Fuzzy Sub monoid and group theory has also been used in engineering applications to reduce the multiplicative computational complexity in the production of digital holograms. Although Fuzzy Sub monoid and group theory has been used in many fields, communication networks have never been used before. This study pioneers the application of Fuzzy Sub monoid and group theory on one-dimensional channel material, which is the center of service quality, namely Quality of Service (QoS), based on our previous work on the three-dimensional channel system of a telecom provider in Shanghai [12,14,15]. First of all, to integrate the business development needs of the Internet applications of the communication industry, the one-dimensional channel system channel entity is abstracted. Secondly, Community Theory modelled the channel structure and assessed it. A discrete and symmetric transformation model is defined by Fuzzy Sub monoid and group channel entity state operation. Finally, the flow state transition communication of the channel system is identified and the transfer process of the system state in the Fuzzy Sub monoid and group operation trans-formation is specified [16,18]. The solution framework is provided for the flow state transfer communication of the channel system, which will be use full for telecom operators to structure the model and design of the top-level mobile e-commerce appliance.

2. Model of the channel system focused on fuzzy sub monoid and group theory

The channel organization is a business support infrastructure network system at the software application level of the channel system, the channel, the infrastructure channel, the payment channel, the logistics channel and the knowledge channel are included. The channel entity will connect, transport and package information at the physics and device level the pipe line entity can complete all sorts of links between objects, including payment and logistics in the application, and physical connexon nodes. The effects of link, assistance, and transmission are one-dimensional pipes in the channel system. It is an object of a related entity and a channel of information transmission. The channel infrastructure can become a forum to support higher operating performance when the channel organization is designed for scale.

2.1 Channel entity fuzzy sub monoid and group and channel entity object

Channel Organization Definition of the Fuzzy Sub monoid and group. A Fuzzy Sub monoid and group G is a set, defined by the symbol G. A set G equipped with a binary operation, if the following conditions hold, is said to form a Fuzzy Sub monoid and group (G, ∙):

1. ∀a, b∈G, a ∙ b∈G.
2. a ∙ (b ∙ c) = (a ∙ b) ∙ c.
3. There exists an element ∈G, such that∀a∈G, a ∙ e = e ∙ a = a.
4. ∀a∈G, there existsa−1∈G, such thata ∙ a−1 = a−1 ∙ a = [19].

Definition 2.1. The channel creature category is the channel entity symmetry transformation package.

Definition 2.2. One type of synopsis process unit that has transformed the channel status, operating on an estimated and logical communication pipe line, is the channel matter feature.

The three-dimensional information space is projected to have a two-dimensional plane channel state described by the channel and its transformation within the given information plane. Similarly, the status of a channel in an information space is also projected to the channel entity in the actual space.
There is a one-to-one connexon in real space and information space between these transformed channel objects. EA and CP are therefore the channel entity’s symmetrical operations and translations; status change operations are listed in Table 1, e.g. OP, OM, PK, PB, PS, TP, TN, UM, UD, and UC, respectively. The transformations above can, according to the Fuzzy Sub monoid and group definition, be judged as part of the Fuzzy Sub monoid and group elements of the 12-order channel entity Fuzzy Sub monoid and group. Centered on the two-dimensional existence, symmetry theory, and symmetry transformation activities of the 3-order components of the information plane, the transformations can be split into 6 angles. In channel Fuzzy Sub monoid and group J, any Ri or Rj variable must be satisfied that the calculation result is Ri. In the Fuzzy Sub monoid and group R, Rj is included; the symbol " is one form of precise calculation, which is identical to the integer addition placeholder.

\[ a_1 \{R1\} + a_2 \{R2\} + a_3 \{R3, R7, R9\} + a_4 \{R4, R8, R10\} + a_5 \{R5, R11\} + a_6 \{R6, R12\} = 0. \] (1)

Only when \(a1=a 2=a 3=a 4=a 5=a 6\) can (1) be satisfied.

2.2 Channel entity object status

**Definition 2.3.** Knowledge model of artefacts in channels. OM = \{K1, K2, B,\}, abbreviated as O.

Channel object O is a vector a state quantity of k1, k2, B, so the operation of the channel entity is equivalent to the treatment of the state quantities \{K1, K2, B,\} In the pipeline system, the pipeline state model.

The state of the channel item can be split into a ready state, a running state, and a blocking state in the system where the system runs an independent state is the running state channel object.

\[ g = \sum_{i=1}^{6} R_i \lambda_i \]

\[ = (R1', R2', R3', R4', R5', R6')(\lambda_1 \lambda_2 \ldots \lambda_6) \] (2)

Channel Entity Object State Transition formula. In a functional communication channel system, the state of the object is changed by the transformation operations that work on the object. In other words, an object’s condition is in an observable state, which is a truthful reflection of the object’s existence. In the Hilbert space of the conversion operation, it is evaluated. According to Definition 3 of the state of the channel body, the channel object in the Hilbert space is determined by the state and is a space vector, R1, R2, R3, respectively, complying with the concept of Hilbert space superposition. According to the method of vector representation (2) of the channel Fuzzy Sub monoid and group in 6-dimensional space, the channel object in the Hilbert space can be defined as \( A' = gA \) g \( \in G \) basis on vector representation method (2)

\[ A' = \Sigma g_i A_i \]

\[ = \Sigma (R1', R2', R3', R4', R5', R6')(\lambda_1 \lambda_2 \ldots \lambda_6) A_i \] (3)

Therefore, similarly expanding to the channel object O, it satisfies the following formal:

\[ O' = R*O. \] (4)
| Definition of Fuzzy Sub monoid and group element | Transformation (concept of element) and symbol | Transformation matrix (representation) | Description of channel object |
|-------------------------------------------------|-----------------------------------------------|----------------------------------------|-----------------------------|
| R1: Part Keep                                    | PK: Part Keep                                  | \[
\begin{pmatrix}
0 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1
\end{pmatrix}
| Channel hardware keeping an identical channel entity |
| R2: Negative                                     | TN: Trend Negative                             | \[
\begin{pmatrix}
0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 1
\end{pmatrix}
| Channel hardware: an equivalent channel entity in a reverse |
| R3: Measure                                      | UM: Uniform Measure                            | \[
\begin{pmatrix}
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1
\end{pmatrix}
| Shop merchant: compared with another comparable channel object |
| R4: Plus                                         | OP: Object plus                                | \[
\begin{pmatrix}
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 1
\end{pmatrix}
| Shop merchant: add an addible channel entity Commodity payment data: add an addible channel entity |
| R5: Part Big                                     | PB: Part Big                                   | \[
\begin{pmatrix}
0 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 1 & 0 & 0
\end{pmatrix}
| Channel hardware: enlarge a flow-increased channel entity |
| R6: Conflict                                     | UC: Uniform Conflict                           | \[
\begin{pmatrix}
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 0
\end{pmatrix}
| Shop merchant: conflict with another channel object |
| G7: Entity Abstract | EA: Entity Abstract |
|---------------------|---------------------|
| Channel hardware: mapped as an information object |
| Mobile APP: mapped as an information object |
| Shop merchant: mapped as an information object |
| Commodity payment data: mapped as an information object |

| G8: Positive | TP: Trend positive |
|--------------|--------------------|
| Channel hardware: an equivalent in the same flow direction |

| R9: Concept Project | CP: Concept Project |
|---------------------|---------------------|
| Channel hardware: projected as a channel entity mobile phone APP |
| projected as a mobile phone APP |
| entity sop merchant: Projected as a merchant entity commodity payment data projected as data entity |

| G10: Object Minus | OM: Object Minus |
|-------------------|------------------|
| Channel hardware: Delete a delectable channel entity mobile phone APP: delete a delectable channel entity |

| G11: Part small | PS: Part Small |
|-----------------|----------------|
| Channel hardware: narrow a flow-decreased channel entity |

| G12: Double | UD: Uniform Double |
|-------------|---------------------|
| Shop merchant: match another channel object |
For the object of the channel entity, O is the initial state of the channel object and O is the intrinsic vector of the channel object, which is the vector of the object state of the channel entity under the renewal operation. From formula (3) and formula (4), it is possible to obtain the entity state transformation formula:

$$R \ast O_{\text{start}} = E \ast O_{\text{end}}$$  (5)

At this point, the formula of the channel object state is defined. Start is the channel system’s initial state space expression. And the terminal state space expression is O end. The entity channel is viewed in the state transformation formula (5) as a whole system. The o state changes from the initial state to the terminal state defined by the o function. Among them, with the change of state of pipe length, width, bending, and so on, the amount of flow in the transmission channel will not alter. For no cause, the amount of flow will not be produced or lost and it will remain unchanged inside the channel transmission. This is the result of applying the Fuzzy Sub monoid and group Theory on flow conservation, which represents the channel's system structure itself. Existing technology is unable to provide sufficient storage space and reduce the throughput of the network system if the state space is too high, due to the complexity of the traditional telecommunication system. There are too many artefacts in the channel, resulting in an exponential rise in time complexity and a time delay rise.

The solution of channel network flow state

Equations for Channel Network Flow. The whole structure of the channel network can be seen as a producer and consumer structure; the producer is the main service body, supplying the flow of comparatively limited resources, and the consumer is the customer, using the allocation of the producer's traffic resources. In the channel network model, both nodes are linked with multiple channel sections. According to the flow conservation law, the output flow is equal to consumer flow resources of the channel system. All traffic flowing into the node should be equal to the amount of all traffic flowing out of the node for every node in the model.

$$\sum_{i \in S_j}(\pm q_i) + Q_j = 0 \quad j=1,2,3,...,N$$  (6)

where qi is the flow of section i; Qj is the correlation sets of node j’s flow; and N is the total number of nodes in the model of the network Means the number of nodes connected with the focus section, as the section’s direction leads to the node, taking a minus sign and the plus sign representing the departure of the node. It gets a plus sign if the node flows from the traffic segment. As traffic flows into the node, it gets a lower signal. Equations for Flow. From (6), in the channel network model, node flow equations can be expressed as follows:

$$Aq + Q = 0$$  (7)

Since a large number of objects in the communication channel system and relations between complex entity variables affect each other, these contribute to the "state space explosion" entity. The correlation matrix A structure is extremely large that it is not possible to solve the state variable directly. The channel entity symmetry was applied in this paper. Features of the channel network structure under the transformation operation are analyzed from the information flow of the channel network under the state of preservation. The overall traffic inflows and outflows are equivalent in the channel system, namely, total flow conservation. In the process of sending and receiving data, the input flow rate is equal to the channel system's output flow rate. Therefore, flow is retained at any moment; that is, the flow in the channel transmission balances, as shown below.

As a pipe entity vector, the traffic flow is assumed. According to the equations for flow conservation (7) and the equation for object state (5),

$$\sum_N q + \sum_M Q = \text{Flow} = \lambda \ast \text{Flow},$$  (8)
where q is the output flow rate of any segment (if the negative value is taken in the opposite direction from the channel flow); Q is the input flow rate of any node (if the negative value is taken in the opposite direction from the channel flow); N is the number of all sections; and M is the number of all the nodes.

The Channel Network Flow Transmission Model and Solution. The channel network is M nodes and one node connected to I channels, with one channel linking two nodes. The largest network connexon status of the channel network is thus established by M nodes and M(M-1)/2 channel components. In the information plane, the model properties of the channel entities are as follows, after mapping and projection operations.

(1) The network system of channels consists of N channel section s and M nodes.
(2) It is possible to link one node to several channel sections, and only two nodes can be linked to one channel segment.
(3) No intersection occurs between the parts of the channel.
(4) Knowledge flow follows environmental law as an object of channel transmission.

\[
\begin{bmatrix}
1 & \cdots & k_1j & \cdots & k_1m \\
k_21 & \cdots & k_2j & \cdots & k_2m \\
\vdots & \cdots & \vdots & \cdots & \vdots \\
k_{11} & \cdots & k_{ij} & \cdots & k_{im} \\
k_{1i} & \cdots & knj & \cdots & 1
\end{bmatrix}_{N \times M}
\]

(9)

Element k_{ij} indicates whether or not nodes I and j are is associated; when k_{ij} = 0, nodes I and j are is associated; when k_{ij}=1, nodes I and j are is not associated. Particularly when I = j, k_{ij}=0.0,

The properties of the node and channel section are different for the multi point cross over channel network, so it is difficult to define the symmetrical characteristics of the network in the two-dimensional plane. Large volume channel network system status issues are historically difficult to solve; thus, the Fuzzy Sub monoid and group theory solving steps are structured as follows. For a channel network created by nodes and channel parts, the channel network flow where nodes are linked to each other is transformed under the channel entity Fuzzy Sub monoid and group symmetry transformation operation. Channel network traffic incidence matrices designed and channel parts and nodes flow expressions are as follows according to the demand response model of channel network.

\[
\text{Flow}_I = \Sigma t_i \text{Bps} \ast \text{Flow} \ast t \text{Bps}^*(\text{vector})\text{Flow}
\]

(10)

For N channel e section,

\[
\Sigma N q = \Sigma N \text{Flow} = \Sigma N \Sigma 3 t_i \text{Bps}^*(\text{vector}) \text{Flow}
\]

(11)

\[
\text{Flow}_{\text{n}} = \frac{P_n}{t_n} \ast \text{Flow}
\]

Final flow state of channel network is as follows:

\[
\Sigma M Q = \Sigma M \text{Flow}_{\text{n}} = \frac{P_n}{t_n} \ast \text{Flow}
\]

(Initial) Flow = \Sigma M \frac{P_n}{t_n} \ast \text{Flow}_{\text{n}}

(12)

(13)

If, according to (14) and (15), the channel network structure is in its initial and final state, the traffic balance formula can be obtained:

\[
\text{Flow}_I = \Sigma N t_i \text{Bps}^i \ast \text{Flow} \ast \Sigma M \frac{P_n}{t_n} \ast \text{Flow}_{\text{n}}
\]

(14)
According to (14), the matrix form of the traffic demand response mode is calculated as:

\[
\begin{pmatrix}
0 & t^i_1 Bps^i_1 I_1 & \ldots & t^i_1 Bps^i_1 I_1 & t^m_1 Bps^m_1 I_1 \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
0 & t^m_1 Bps^m_1 I_M & \ldots & t^i_1 Bps^i_1 I_M & 0 \\
\end{pmatrix}^{M \times M}
\]  

(15)

The variance in the transmission channel system, the rate of information transfer, the information potential strength of the channel structure characteristics, and the entity Fuzzy Sub monoid and group G are known by the potential difference node that makes the channel network a GM matrix; assume that the channel network consists of M nodes and N channel parts. Under the G Fuzzy Sub monoid and group operation, channel sections and nodes connect to a network, and the GM matrix is constructed to reflect the channel network.

\[
\begin{pmatrix}
0 & t^i_1 Bps^i_1 I_1 & \ldots & t^i_1 Bps^i_1 I_1 & t^m_1 Bps^m_1 I_1 \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
0 & t^m_1 Bps^m_1 I_M & \ldots & t^i_1 Bps^i_1 I_M & 0 \\
\end{pmatrix}^{M \times M}
\]  

(16)

\[\text{Flow}_{\text{channel section}}\]

\[
\begin{pmatrix}
P_1 \ast k & 0 & \ldots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
0 & 0 & \ldots & P_m \ast k \\
\end{pmatrix}^{M \times M}
\]  

(17)

\[\text{Flow}_{\text{node}}\]

\[
\begin{pmatrix}
0 & t^i_1 Bps^i_1 I_1 & \ldots & t^i_1 Bps^i_1 I_1 & t^m_1 Bps^m_1 I_1 \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
0 & t^m_1 Bps^m_1 I_M & \ldots & t^i_1 Bps^i_1 I_M & 0 \\
\end{pmatrix}^{M \times M}
\]  

(18)

\[\text{RM General}\]

\[
\begin{pmatrix}
0 & t^i_1 Bps^i_1 I_1 & \ldots & t^i_1 Bps^i_1 I_1 & t^m_1 Bps^m_1 I_1 \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
0 & t^m_1 Bps^m_1 I_M & \ldots & t^i_1 Bps^i_1 I_M & 0 \\
\end{pmatrix}^{M \times M}
\]  

(19)

Fuzzy Sub monoid and group metamorphism in channel entity Fuzzy Sub monoid and group R Fuzzy Sub monoid and group \{g\}, R Fuzzy Sub monoid and group \{Rm\}. Fuzzy Sub monoid and group theory, irreducible representation method, GGM Fuzzy Sub monoid and group metamorphism in channel entity Fuzzy Sub monoid and group R Fuzzy Sub monoid and group \{g\}, \{Rm\}. Fuzzy Sub monoid and group, under the condition of channel network flow protection, such that the network structure has nothing to do with the number of nodes. GM matrix is defined by node flow, Flow1, Flow2, ..., FlowM, while Fuzzy Sub monoid and group is defined by Fuzzy Sub monoid and group transformation, f1,f2,f3,f4,f5,f6. GM matrix can therefore be represented in a linear combination of 6-dimensional spaces. Homomorphism of the transformation matrix in the channel entity Fuzzy Sub monoid and group.

\[R'1 = \{R1\}\]
\[ R_2' = \{R_2\}, \]
\[ R_3' = \{R_3, R_7, R_9\}, \]
\[ R_4' = \{R_4, R_8, R_{10}\}, \]
\[ R_5' = \{R_5, R_{11}\}, \]
\[ R_6' = \{R_6, R_{12}\}, \]

In the channel entity Fuzzy Sub monoid and group, \( G_1, G_2, G_3, G_4, G_5, G_6 \) are linearly independent; according to characterization of Fuzzy Sub monoid and group of element matrix there is set of real numbers \( a_1, a_2, a_3, a_4, a_5, a_6 \), which makes the equation below hold:

\[ R_M = a_1R_{1}' + a_2R_{2}' + a_3R_{3}' + a_4R_{4}' + a_5R_{5}' + a_6R_{6}'. \]

Channel Network System Application

In the channel network system under the channel entity Fuzzy Sub monoid and group application, the changing flow behavior of the channel system can be described as the Application Layer, the Business Object Layer, and the Application Layer Network Node Layer when the channel entity is changing. A functional unit in the Application Layer is the output behavior of the channel object, which is the initiator of flow altering behavior. Traffic flows from units to \( A_j \) to complete the business process of transmission and sharing of information when a certain task is performed. Node Layer Network Node the Node Layer Network Node consists of the physical nodes in the channel system. Company Object Layer sends and obtains information when the Application Layer initiates any usable behaviors. In the meantime, the Network Node Layer seeks the best solution for the critical path and completes the flow of information delivery and receipt.

3. Conclusion

This paper defines the channel entity operating Fuzzy Sub monoid and group and the channel entity object state formula according to the current situation of the mobile Internet, in order to facilitate the increasingly complex service quality of the telecom operating system. The time variable is computed by a combination of six base vectors of the channel network matrix \( GM \) through the line, according to the channel system flow conservation law, the channel network flow equation and the channel entity state transfer matrix. This paper introduces a new method of optimization of the general information network system, offering a good idea for the potential optimization of the information network system.

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