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Appliance of Key Link and Resource Contribution Degree for Enhancing the Mapping and Load Balancing in Fiber Wireless Networks

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ABSTRACT

The feature of network virtualization is converted to be the efficient method of restoring the problem of solidification existing in the Fiber Wireless (Fi-Wi) networks. The purpose of this approach is to improve the diverse virtual network resources association on an allocated substrate network. The key link feature considerations are handled by the complete utilization of substrate resources for the process of association and resource contribution degree (RCD) employed for the virtual networks. The procedure called "virtual network mapping" is composed of three main concepts: sorting process of both virtual node and physical node; also the virtual node mapping with the physical nodes. The virtual node ordering depicts the sequence association of Fi-Wi access network nodes. The prevailing node always appeals for numerous resource computing and it helps to attain highest priority association. In this scheme, the physical node ordering is executed in descending sequence. The node status can be acquired by mapping of the virtual node with respect to RCD. This can be implemented by resource computation, length of the shortest path and the existing bandwidth of the node. The disadvantage of performance bottlenecks can be fully eradicated by performing the length computation of the link, engaged link bandwidth and the parameters of the key link. The network performance feature "load balancing" can be enhanced and the resource utilization can be reduced by this projected method.

Keywords: Network Virtualization, Fiber Wireless networks, RCD, Virtual network mapping.

1. INTRODUCTION

The promising features of cloud computing, big data methods and applications, mobile internet and the rapid evolution of communication methods have combinely endorsed the backbone evolution of network transmission in relation to higher capacity and rates. Nonetheless, the access network evolution that performs the network transmission backbone association with the network having local user is quite slow [4]. The resulting feature of this method is the network access turning into a performance bottleneck of communication technologies. By considering the harmonizing characteristics and impending advantages of optical network and wireless network technologies, a new type of Fi-Wi method of congregated broadband network access structure is projected.

The congregated Fi-Wi broadband access networks can effectually integrate both the effectiveness of wired and wireless network technologies by affording the enriched quality of broadband services to end users at any time and also at any location. The highly specified bandwidth and stability is inherited by the projected method and also the level of affordability and flexibility can be inherited from the wireless networks [3]. The Fi-Wi network access normally approves the topology structure of "Tree-Mesh": here, each block is comprised of a Passive Optical Network (PON) of tree topology present in the back end and it also comprises of Wireless Mesh Network (WMN) in its front end. The diverse types of Different segmented Optical Line Terminal (OLTs) can be interrelated by optical fiber links to merge into a various segment connected with the Fi-Wi broadband network access. The PON existing in the back end can espouse TDM-PON terminology like Ethernet Passive Optical Networks (EPON) or Gigabit Ethernet Passive Optical Networks (GPON) and also the combination of WDM-PON and OFDM-PON to

assist the exploitation of the future generation optical networks. The open spectrum technology of Wi-Fi is adopted by the front end medium and it is depicted in figure 1.

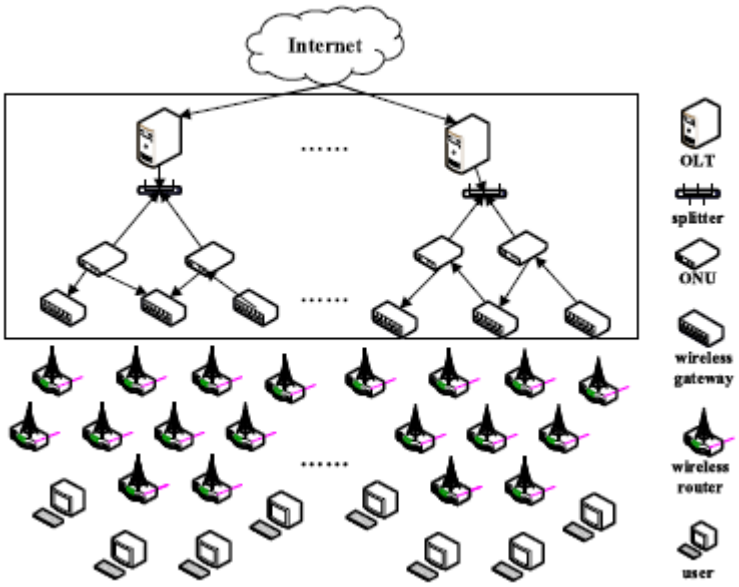


Figure No: 1 Framework of Fi-Wi Networks

The wireless network is present in the front end and the optical network access is present in the back end must reflect on the dissimilarities in capacity of the bandwidth amongst fiber and wireless medium. The front end matching rate and the Fi-Wi networks overall utilization of the resource can be enhance by back end [2].

The traditional type of accessing methods is compared with the Fi-Wi broadband access technologies and the positive sides are discussed:

1) This type of networks can be accessed flexibly at any time from any location.

2) The capacity level of data transmission tends to be very high and it is said to be more reliable than wireless network accessing.

3) The capability of self healing is quite more than optical networks.

4) While comparing to fixed networks (wired) this method is more cost effectual.

The Fi-Wi method of networking is listed to be capable method for the last mile because of their bandwidth i.e. the capacity of bandwidth and flexibility is very high. Even though the method is filled with more advantages it lacks in efficiency. Hence the efficiency can be enhanced by virtual network mapping.

The method of network function virtualization (NFV) affords an effectual resolution to handle with the inflexibility predicament in contemporary networks [6]. The feature of NFV can comprehend flexible and proficient cyber resource management and it is mentioned to be prospective method to persuade the requirement alterations of big data during traffic as well as it considers the cloud computing and future generation network technologies. The numerous resources existing in the network consists of their own individual patterns with the combination of utility of network resource and the quality of service (QoS) and hence this is made to be very intricate for the prevailing

optical network framework to satisfy the vibrant demands of diverse network services. In the virtual network mapping in Fiber Wireless networks (Fi-Wi), one of the methods helps to satisfy the virtual network providers belong to network infrastructure or few particular users with respect to service requisition. The Fi-Wi's are protected to enhance the level of security. The Elastic optical networks (EONs) can supplely assign bandwidth for affording the connection method and this can attain great amount of spectrum effectiveness and this can hold the various user needs with few alterations to the prevailing network infrastructure. Hence, mapping of Fi-Wi's in EON's is an imperative concern [7].

2. RELATED WORK

The numerous virtual networks can be facilitated in network virtualization and it can stay on similar resource sharing and InP. The substrate resources can be fully utilized and the resource assignment procedures are made effectual and reliable and the algorithms are built to rationally schedule and substrate resources which are aspiring to enhance the resource exploitation and the load balancing can be attained in the entire network. The existing works are projected to handle the VNE troubles faced in the virtualized Fi-Wi networks. Dai and He et al. [1], [2] proposed the feature of virtualization inside the Fi-Wi networks to eradicate the dissimilarities amongst the assorted networks, and afforded a amalgamated virtual analysis of Fi-Wi networks. These concepts have made the method very simple for flow control and different types of traffic transmission procedures are incorporated in assorted networks.

The heterogeneous networks can be operated by the well defined a virtual resource manager. The diverse paths can be permitted from source to destination. Dai also illustrated the performance of numerous paths load balancing including the entrenching nodes [3]. The experimental results demonstrates that the load balancing technique in virtualized Fi-Wi networks can extensively minimize the packet delay while comparing it to old Wi-Fi networks. In addition to this, he created a proposal for test and projected an arithmetical presentation replica of virtual Fi-Wi networks. The experimental results validated the performance enhancements in Fi-Wi network virtualization in various features that is comprised of throughput of the node, bandwidth exploitation of the link and the delay of the packets.

Furthermore, the video streaming improvisation also enhances the quality of experience (QoE). Meng et al. [4] illustrated the Fi-Wi network virtualization to raise above the dissimilarities in essential physical infrastructure and insolvent the restrictions of multi-path procedures in long-established networks. Dashti et al. [5] identified Fi-Wi networking which contains the Fi-Wi series architecture combined with high range of 100km with respect to various dynamic bandwidth allocation (DBA) methods, and projected a unit of new optical network unit (ONU) combination strategy. In this method, ONU's present in one unit can simply broadcast the control information to another type of optical line terminal (OLT) where the specified ONU's are associated to another unit by utilizing the inactive channels. Hence, the OLT can attain a positive packet delay during the projected grouping by cycle length (GCL) method.

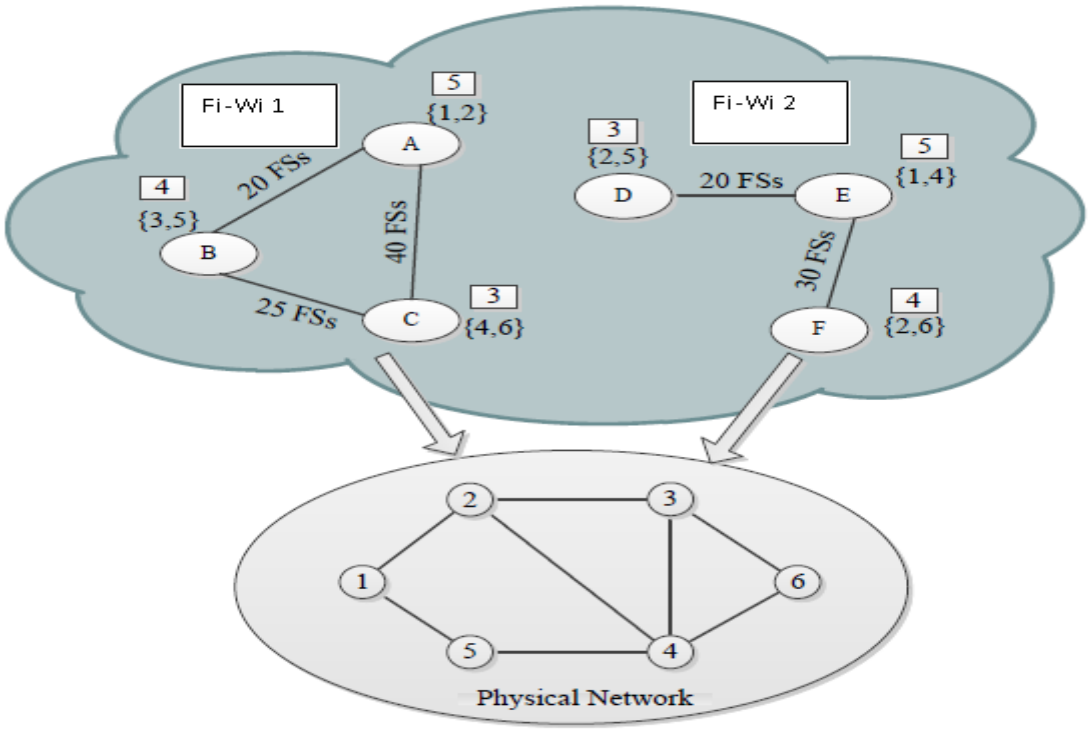
The remaining sections are described as follows: section 3 describes the materials and methods, section 4 describes the results and discussion, section 5 describes the conclusion and section 6 gives the references.

3. MATERIAL AND METHODS

3.1 Virtual Network Mapping

The mapping trouble in Fi-Wi networks are segregated into two categories. The first category is relating the virtual nodes (VN's) with the substrate network of the physical nodes and the second category is choosing the appropriate route for the virtual links (VL's) after performing the mapping of virtual nodes. The mapping of virtual node is relating between the physical and virtual nodes and sorting is done in the two groups by particular order procedures, where as the mapping of the virtual links selects the appropriate substrate network's physical path and it may start while finishing the virtual network mapping [7].

The concept of Fi-Wi networks insulated in EON's id depicted in figure 2. Consider the group of Fi-Wi network requests the rectangle symbol and the number present in it denotes the resource computation initiated by each Fi-Wi network nodes and the numbers existing in the braces depicts the set of candidate nodes in a substrate network. The number at the side of every virtual link denotes the bandwidth needs. The Fi-Wi 1 contains the resource computation of the virtual node called A which has the number equal to 5 and the physical nodes of the candidate set is $\{1, 2\}$ and the virtual link's bandwidth necessity containing *A*-*C* is 40.



a) Example of Fi-Wi Mapping

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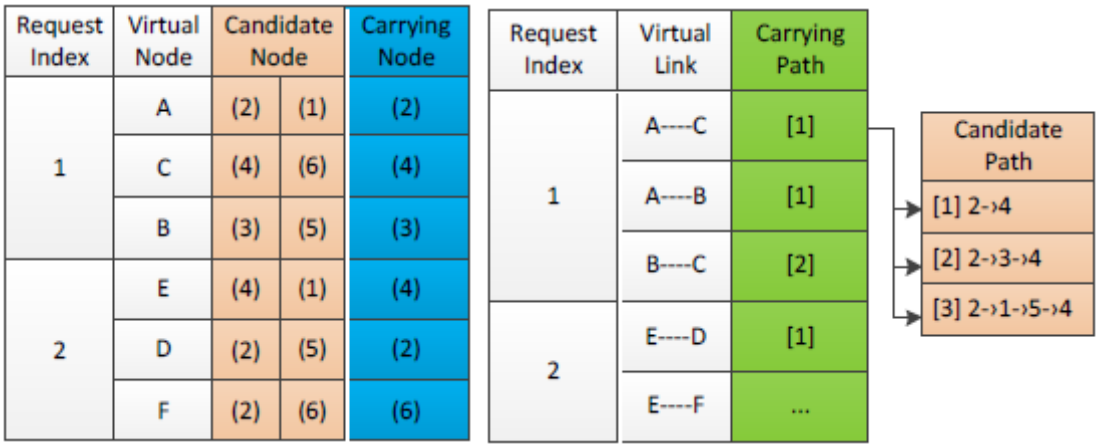

b) VN's Mapping Method **c)** VL's Mapping Method

Figure No: 1 Fi-Wi Mapping in EON and its Procedure

The particular sorting theory is employed to attain the virtual node ordering called (A-›C-›B), and the physical node is (2-›4-›3-›6-›5-›1). The physical node is chosen for the virtual node from its physical nodes of the candidate set and it is arranged in the sequence of mapping. The virtual node 'A' is associated to the physical node '2' whereas virtual node 'C' is associated to node '4' and it is figured out in figure 1b. The appropriate physical routes are selected for every virtual link and this is performed by the mapping of virtual network results. The physical link is selected from A-C and it is done from considering the three types of candidate routes present in the set of physical path and it preferred by k-shortest path (KSP) algorithm.

The network load can be balanced and this work represents a KLRFWM method based on the Fi-Wi analysis and the physical network from overall perspective where the constituents of Fi-Wi characteristics, resource status of the spectrum and the topology of the physical network are taken [9].

3.2 Key-link and RCD Based Fi-Wi Mapping (KLRFWM)

- **Sorting of Virtual Nodes**

The mapping of virtual node has to tag on to a particular sequence because various sorting algorithms may provide diverse mapping effectiveness [8]. The sorting can be performed by considering the requisition of bandwidth of virtual links and the resource computation of virtual nodes and the average resource request utilization is used to denote the resource requisition of every virtual node and it is given by,

$$V_{request}^{m_i} = c_v^{m_i} \times \sum_{k=1}^{|E^m|} t_v^{m_k} / t_{\max}^{m}$$

- **Sorting of Physical Nodes**

The nodes present in the network with the similar type of existing resources may differ in the feature because of the diverse locations existing in the topology of the network. The field gravity is considered in this paper because the feature of resources contribution degree (RCD) of a node is employed to illustrate the physical node capacity and

the sorting can be executed for the physical nodes of the network by RCD. The impact of the network topology can greatly estimates the node capacity. Hence, the dynamic sorting method can be afforded for Fi-Wi mapping and it enhances the mapping performance. The gravitational theory says that, even though there are numerous particles present in the space and each particle has an effect on another one. The distance can be increased and the impact may go off. The gravitational force between the particles are given by,

$$F_{i,j} = G_C \times M_i \times M_j / d_{i,j}^2$$

The method of RCD is projected to calculate the node capacity. It is connected to three types of features like resource computation, shortest path computation between the nodes and the bandwidth availability of the path [10].

$$P_{C_i} = \sum_{j=1}^{N} \left(MinBW_{i,j} \times \left(c_p^i \times c_p^j / d_{i,j}^2\right)\right), \forall j \neq i$$

Here,

P_{ci} → RCD of the physical node

$d_{i,j}$ → shortest path

$MinBW_{i,j}$ →minimum bandwidth on the shortest path and the node containing the higher level of P_{ci} containing the greater priority of mapping.

- **Key Link Based Mapping**

The outcome of the mapping helps to link and choose a shortest path comprising of higher bandwidths and the links with the lower bandwidths are not preferred. The link used for mapping the link is described as follows:

$$\psi_{i,j}^r = a(L_{i,j}/L_{\max}) + b\left(\left(fs_{l_{i,j}}^u\right)/|F|\right) + c k_{i,j}\left(\left(fs_{l_{i,j}}^u\right)/|F|\right), \forall j \neq i$$

When the value of c is zero then the link has to be omitted. This methodology can be used to determine the degree effect of the key link theory.

In KLRFWM, the entire requests are calculated for every virtual node with the physical node. Then all the element sets are sorted in the descending sequence and mapping is executed. Next step is to determine the weight of every link. The K-shortest path maps are utilized to identify the shortest path. The network load can be calculated by,

$$S_D = \sqrt{1/(N_l - 1)\sum_{l_{i,j} \in E}\left(\max\left\{\left|F_{l_{i,j}}\right|\right\} - \mu_{fs}\right)^2}$$

$$\mu_{fs} = \sum_{l_{i,j} \in E} \max\left\{\left|F_{l_{i,j}}\right|\right\} / N_l$$

This equation depicts that the network with lower S_D has high load balancing performance [11].

4. RESULTS AND DISCUSSION

The sorting method of Fi-Wi networks helps for virtual node prioritization to the physical nodes with respect to the existing resources with the help of RCD. The link mapping is executed by considering the length as well as the bandwidth occupied in the physical links. The load distribution can be minimized by the key link features and it is represented in table 1 and figure 3.

S.No	KLRFWM		PON	
	Standard Deviation	The Connectivity Probability	Standard Deviation	The Connectivity Probability
1	10.5	0.1	25	0.1
2	10	0.2	26	0.2
3	10	0.3	28	0.3
4	12	0.4	27	0.4

Table No: 1 The connectivity Probability of Virtual Nodes

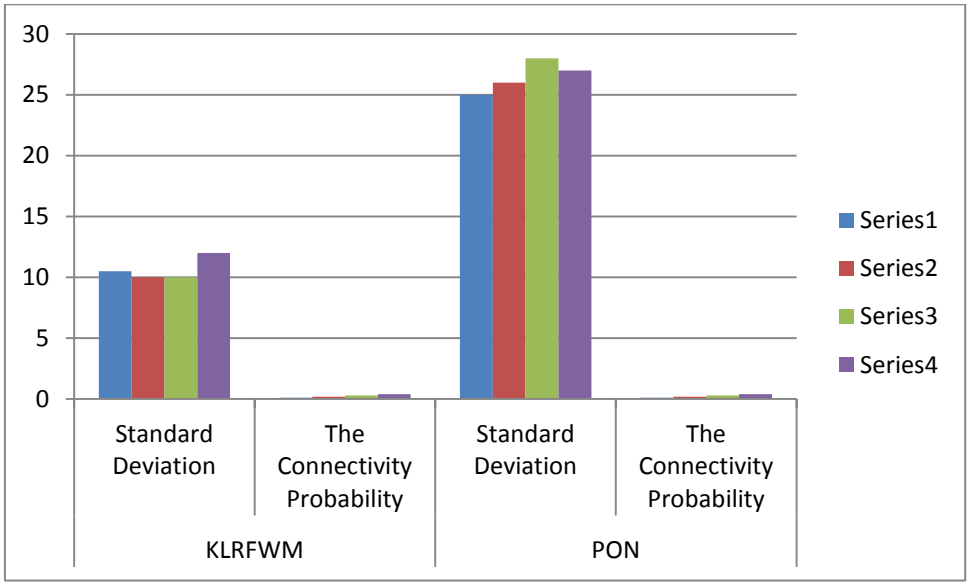

Figure No: 3 Connectivity Probabilities of Virtual Nodes

5. CONCLUSION

By considering the previous works, this paper projected a KLRFWM algorithm which is composed of service order, properties, resource computation of the physical node, bandwidth availability and the key link features. The RCD is proposed in virtual nodes by affording the physical node selection. The key link mechanism is proposed in virtual linking and this attains a higher performance rate in load balancing. The experimental result shows that KLRFWM is efficient while comparing to other methods.

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