Virtual Optical Network Mapping Approaches with Inter-Core Crosstalk in Space Division Multiplexing Elastic Optical Data Center Networks

Abstract

With the rapid development of cloud computing, video, smart home, and Internet of things (IoT), the bandwidth requirements for communications networks are also greatly increasing. The internet is facing new demands and challenges. Space Division Multiplexing (SDM) is an approach to increase the channel bandwidth capacity to explore potential spectrum resources in the spatial dimension with a multi-core fiber (MCF). Thus, this paper mainly proposes a spectrum-efficiency VON mapping approach with the inter-core crosstalk to reduce the spectrum occupancy and the inter-core crosstalk values in Space Division Multiplexing Elastic Optical Data Center Networks (SDM-EODCNs). Simulation results show that the proposed VON approach can efficiently reduce the spectrum occupancy rate and average inter-core crosstalk.

Methods

In order to map each VON, we proposed the virtual link and virtual node priority mapping approaches based on the inter-core crosstalk perception with setting, XT_{max}, named the VLP-XT and VNP-XT mapping approaches.

➢ VLP-XT Mapping Approach

The main principle of the VLP-XT mapping approach is that the virtual links versus the physical links with the link importance degree based on both bandwidth requirements and computing resources.

➢ VNP-XT Mapping Approach

The VNP-XT mapping approach is different from the VLP-XT mapping approach, since we consider the virtual node priority based on the node important degree that is related to the required computing resources of the virtual nodes and the computing resources providing of the physical nodes.

An Example of A VON Mapping

In Fig.2. (a), we show an example of a VON mapping, where virtual nodes, a, b, and c, are mapped to the physical nodes, A, C, and B, since the providing computing resources on date centers located at physical nodes, A, C, and B, are larger than the required the number of the computing resources of the virtual nodes, a, b, and c, respectively. The virtual links, a-b and b-c, are mapped to the physical links, A-C and C-B, where the spectrum state of different cores in the fiber links A-C and C-B is shown in Fig. 2 (b).

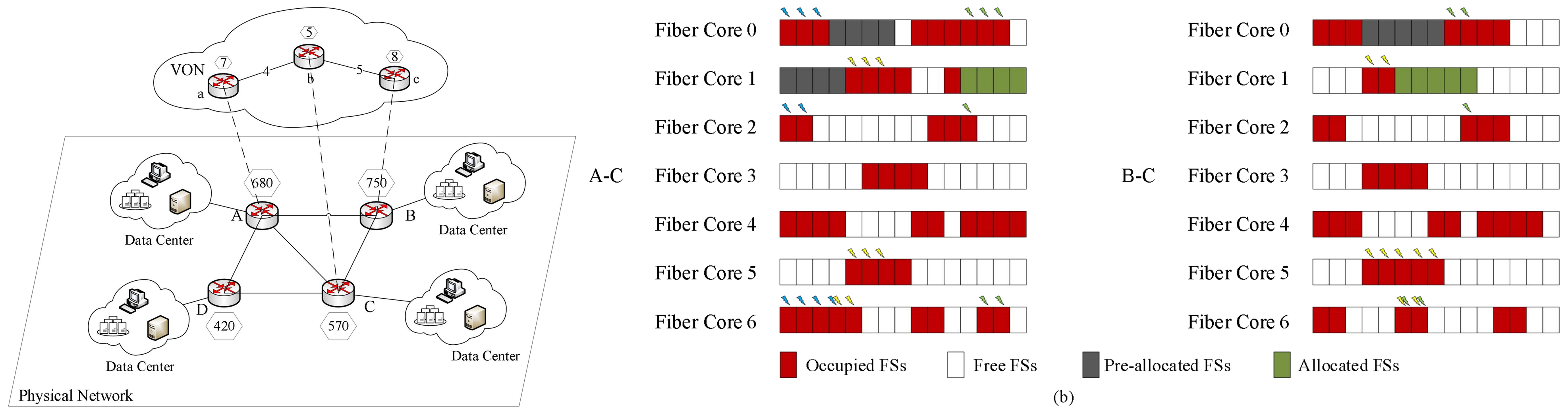

Fig.2. (a) an example of a VON mapping and (b) the spectrum state of fiber links A-C and C-B

Results

In Fig. 3, we calculated spectrum occupancy rate and average inter-core crosstalk of the physical network under different mapping approaches.

➢ We can see that the VLP-XT mapping approach achieves the lower spectrum occupancy rate than the NID, LID, and VNP-XT mapping approaches.

➢ We can also see that both the VLP-XT and VNP-XT mapping approaches have lower average inter-core crosstalk than both the LID and NID mapping approaches, respectively.

Obviously, the proposed VLP- XT and VNP-XT mapping approaches are better than the LID and NID mapping approaches, respectively.

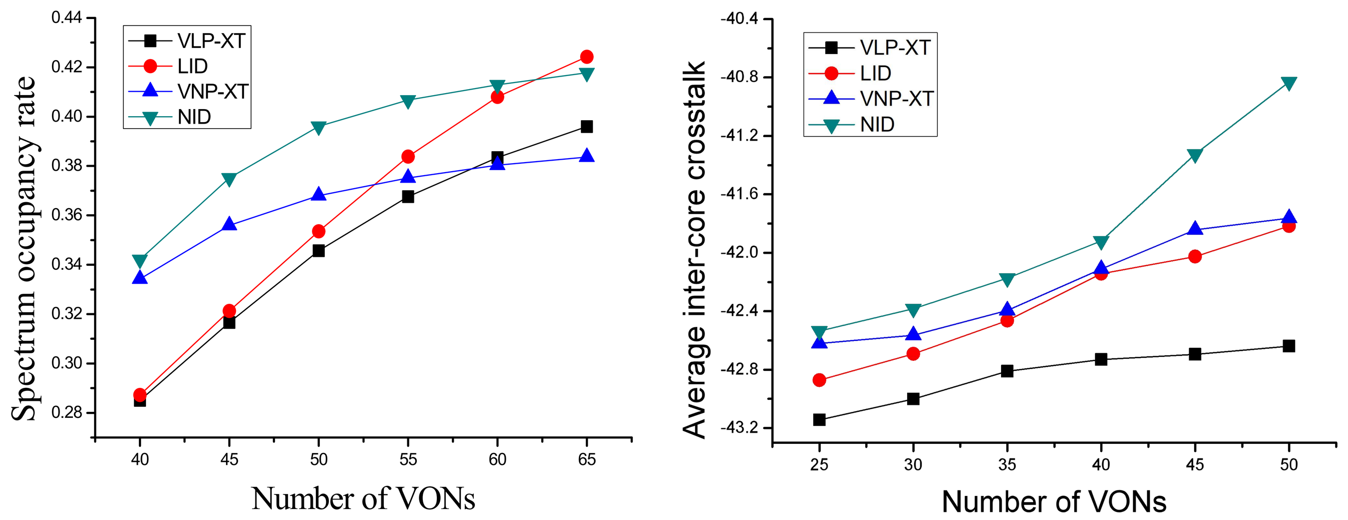

Fig.3. Spectrum occupancy rate and average inter-core crosstalk of different VON mapping approaches

Conclusion

In this paper, we mainly investigated the VON mapping approaches with the inter-core crosstalk in SDM-EODCNs. Considering the characteristic of virtual links and virtual nodes, we proposed the VLP-XT and VNP-XT mapping approaches based on the largest tolerable inter-core crosstalk threshold to improve the spectrum efficiency and to reduce the inter-core crosstalk. Simulation results show that the VLP-XT mapping approaches achieves better performance in terms of spectrum occupancy rate and average inter-core crosstalk compared to the NID, LID, and VNP-XT mapping approaches.

References

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