Manuscript ID: 257700

Title: (OFC)Regenerator site selection in nonlinear impairment-aware elastic optical networks

Author: Madushanka Dharmaweera; Chalmers Tekniska Hogskola

Dear Dr. Dharmaweera,

We regret to advise you that your manuscript has not been accepted for publication in the Journal of Optical Communications and Networking. The reviewer comments are included below.

Thank you for submitting your manuscript. We hope that we will be able to serve you in the future.

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Dr. Dharmaweera, please note that I diligently took my time to send your paper to many reviewers to provide a fair review process. However, with 2/3 strong rejection recommendations, I cannot recommend publication. If you want to continue to submit this work to JOCN, I suggest you read all the reviews and try to generate additional results for analyzing number of regenerators used and better optimization approaches. However, most importantly, there is a lot of previous work in this field, so you need to demonstrate to reviewers that you are submitting new and innovative results.

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Sincerely,

Robert Doverspike

Associate Editor, JOCN

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Reviewer 1:

This work has two problems -- (i) assumptions are made without sufficient justification, and (ii) the heuristic presented does not yield near-optimal performance (as calculated using ILP) [see Fig. 5]. While it is good that multiple networks are considered, in each a static traffic pattern is considered, but no work is done to show that regen site selection is tolerant to changes in this matrix.

Examples of assumptions/claims that are not justified:

1. On the first page, the authors state that "EONs significantly reduce capacity waste vis-à-vis traditional WDM networks." In a traditional WDM network traffic would be aggregated in the time domain (eg using a router, SONET or OTN switch) prior to being placed on a WDM carrier.

2. In Eqn (2) it is assumed that each span has identical characteristics. This assumption should be explicit, and justified.

3. In Eqn (6) the worst case would be a fully utilized link (if you're worried about spectral efficiency, then presumably the network is carrying enough traffic that some link in the network is fully utilized).

In Section C:

4. In the example, the authors assume that the network can only be equipped with 1 regenerator site < < justify the assumption that there can only be 1 regenerator site, yet you have the freedom to place it wherever you wish?

5. "In this study, spectral efficiency is measured in terms of the maximum spectrum slot required to support a certain traffic matrix" < < justify this assumption (I think this will be difficult).

6. Spectrum is only 1 resource. The study minimizes the spectral efficiency (as defined above) yet assumes that regenerators are free. < < this cannot be justified.

The study should seek to minimize overall cost.

Reviewer 2:

The paper considers the problem of planning an elastic optical network taking into account the physical layer. The GN model is considered to describe the physical layer and is used to estimate the quality of transmission (QoT) and the proposed algorithm places regenerators so as to avoid connections with unaccepted QoT. The problem studied is interesting and current and the paper is well written. The proposed algorithms are scientifically sound and explained to the right level.

Some points to improve the manuscript:

The authors could give a more clear description and model in more details the transmitters assumed. There is a lack of connection between the way that traffic demands are described and how they enter the optical network (discuss about the granularity of client traffic and the capabilities of optical transceivers maximum line rate, number of slots, etc.)

I personally find that the objective of minimizing the maximum spectrum slot used is not very interesting, and I would prefer to see results for optimizing the number of transmitters/regenerators considered. Also the number of regenerator sites is an interesting parameter, but again the sheer number of regenerators is the most important metric.

Apart from this, the work done in [10] which proposes the “RIA algorithm” is very related. To my understanding in [10] the authors do not consider regenerators, but take into account in a more accurate way the interference, while in the current paper the interference is accounted for with a worst-case assumption. Two points arise: (i) it seems that RIA produces better results in the small to national size networks (this stands to reason, since networks of that size do not require almost any regenerator), (ii) there are other algorithms in the literature that place regenerators taking into account the physical layer in the worst-case (e.g. different reach as a function of the spectrum/guardband used). Both these issues could be discussed in more details.

Reviewer 3:

The article is well written and easy to read. The content is well organized. The illustration of figures, equations and tables are very logical and critical to help me to follow the development of the article. The topic is closely related to an important issue in the transport optical network. It is closely related to the current development of new technology.

Following is some issues I have the article:

Clarifications needed:

1. In your introduction (paragraph 1 on page 2), you mention many works try to reduce the number of regenerators, but you in this article try to reduce the number of regeneration site. What motivates you to investigate the selection of regeneration site over regenerators? Did you do any comparison of the resulting objective using two approaches? Did you check how many regenerators are needed using your approach? Do you have references suggesting regeneration sites are as important as if not more than the regenerators?

2. In Fig. 1, there are solid lines and dash lines with different colors, dash line squares within multi-flow transponders and triangles along the lines. Please explain their meanings either in the graph, such as a text with pointed arrow for dash line box similar to that used for the multi-flow transponder box, legends or in the caption of the graph.

3. In Fig. 2: It would be helpful to mark that the x-axis is frequency. Also what does the height of the rectangular which represents the connection mean? I.e., does y-axis have a meaning? If so, why are the heights of all connections the same?

4. In Eq (5), the mathematical expression of the inverse hyperbolic sine: arcsinh would be more clear.

5. In Eq (4), what is value of light frequency used here, i.e., \nu. Is it the central frequency for each connection therefore G\_{ASE}^0 should be connection-based?

6. In section II B, 2nd paragraph from the bottom on the left of page 3, What is readily known: bit rate, modulation format or spectrum assignment? What is the complexity of this problem? Did you compare your approach with the approach with more accurate XCI calculation in running time?

7. In Section II C second paragraph, explain what is "offline traffic connections" or choose another phrase.

8. In your illustration with Fig. 3 as well as through out the numerical evaluation, for fairness, you need to point out the trade-off between different selection of regeneration site. For example in Fig. 3, (d) requires one more regenerator than (c) does.

9. What is the complexity of your ILP?

10. In section III B, first paragraph in page 5 on the right, it should be "n+2 to the destination node"

11. In section III B, first paragraph in page 5 on the right, is "the lowest maximum subcarrier index" for each connection only, or for the accumulative index from all the assigned connections? According to \kappa, this should be the number of subcarriers occupied by this connection, instead of the resulting accumulative subcarrier index. I suggest you to clarify this.

12. In section IV first paragraph, need to point out, whether [10] does not include the factor of regeneration sites in their algorithm or does not allow regeneration. It is therefore trivial to discuss that adding regeneration increases spectral efficiency.

13. Explain the advantage of RSIE over RIA.

More serious issues:

1. In your introduction (paragraph 2 on page 2), you emphasize the importance of "realistic impairment-aware EON", mentioning reference [27]. Yet in this article, you proposed a "worst case" approximation of cross-channel interface, i.e., a worst case approximation of reach. What is "realistic" about your proposed algorithm? In last paragraph of page 1, you claim "transmission reach (TR) of the different modulation schemes are assumed to be independent of the bit rate and the network topology" as inaccurate for PLI, yet your approximation is based on modulation schemes only as well. Bit rate and network topology do not affect the reach. (R\_{ik}, in page 4).

2. In section III B, the biggest issue I have with this heuristic algorithm is that: the selection of regeneration site does not take consideration of modulation and spectrum assignment, and to a great extend not even has to do with routing (as in stage 2, the routing used in stage 1 is replaced). So the proposed algorithm is rather a RSA algorithm based on a regeneration site preselection. The fact that RSA is performed after regeneration site is selected damage the claim of the "realistic" algorithm.

3. In section IV A last sentence "Based on these observations, we conclude that the approximation method provides a good estimation of XCI for both large and small networks at all traffic volumes if the PSD is small.", This is not accurate. You are comparing the "maximum subcarrier index", not the approximation of the XCI. Maximum subcarrier index is affected by factors other than XCI as well, for example your RSA, regeneration site selection, etc. If you want to compare XCI, you should derive the reach of RIA and RSIE separately and compare them.