Predicting Optical Power Excursion in EDFAs with Neural Networks

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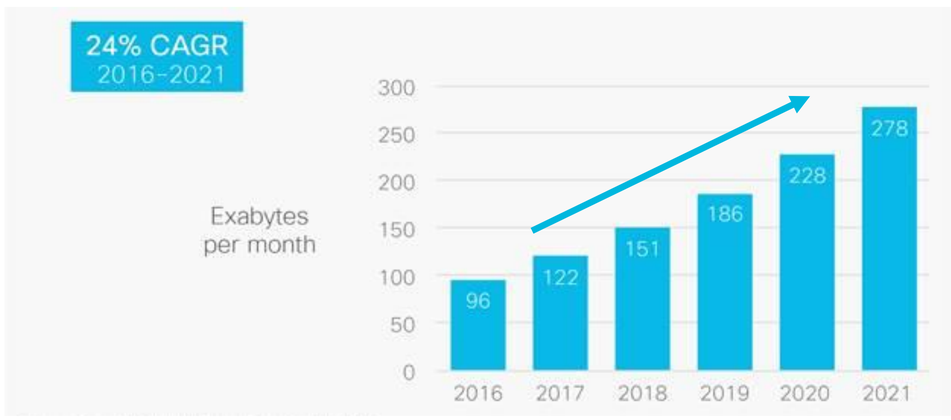
Context

► **Motivation** – Exponential **traffic growth** requires to increase the capacity of optical networks, by means of:

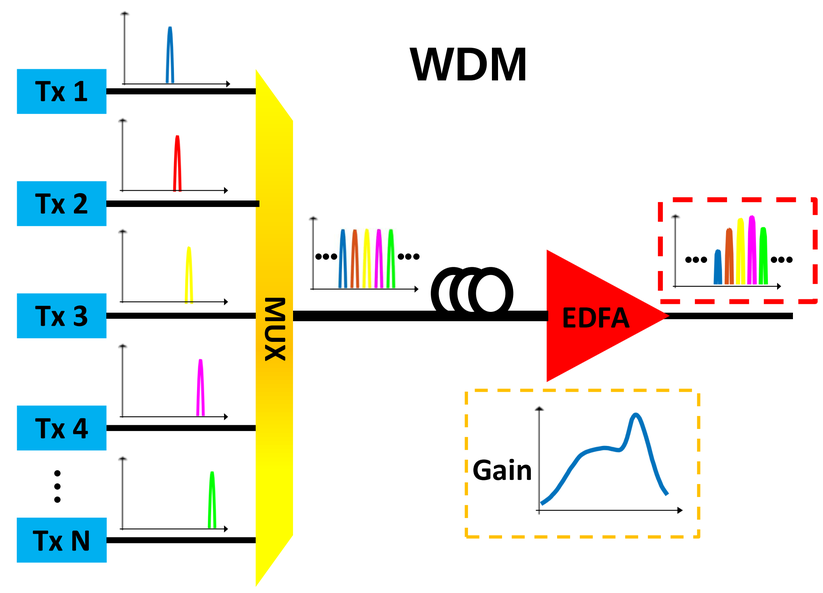
- High spectral efficiency
- High bandwidth allocation, e.g. **WDM** (Wavelength Division Multiplexing)



Cisco VNI Global IP Traffic Forecast 2016-2021 [1]

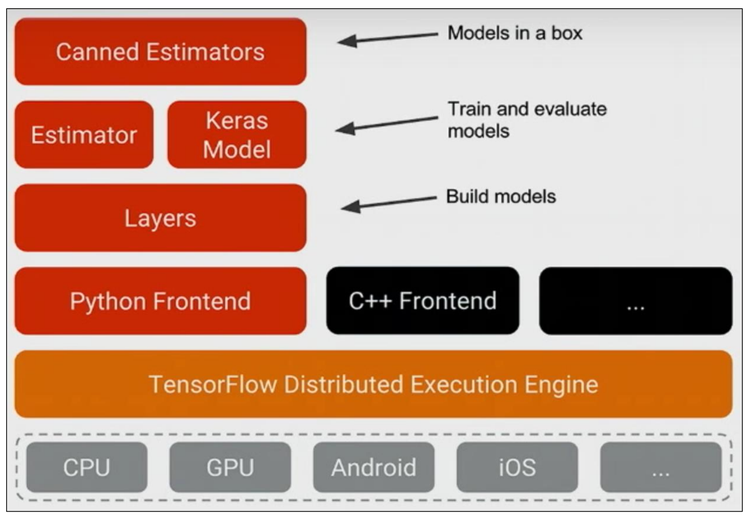
► **Problem statement**

- **EDFAs** (Erbium-Doped Fiber Amplifiers) used in optical networks present **wavelength dependent gain** leading to power excursion, even when automatic gain control is used [2]
- **Power excursion prediction** is a complex task, due to the dependence on several parameters as amplifier gain ripples or tilt
- As demonstrated in literature, **ML (machine learning) techniques** can be a suitable way to address these challenges [3]



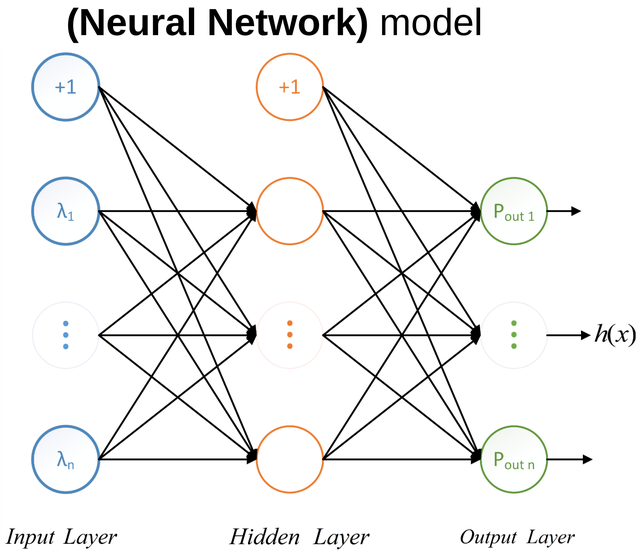
Neural Network Approach

► **Keras/TensorFlow** architecture model

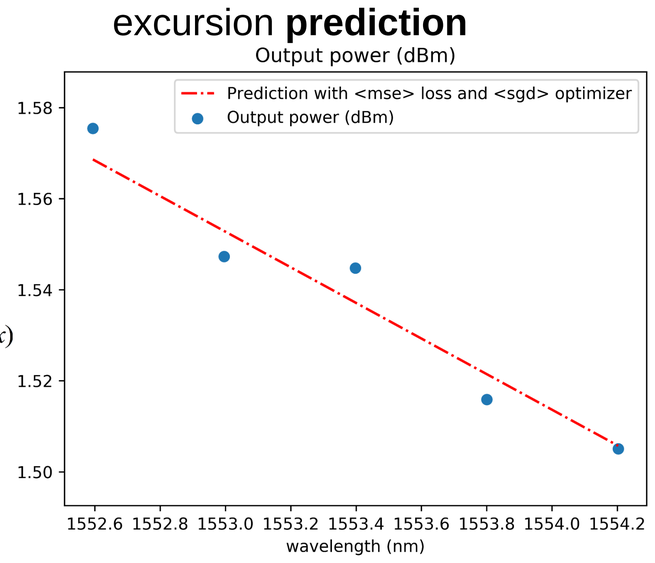


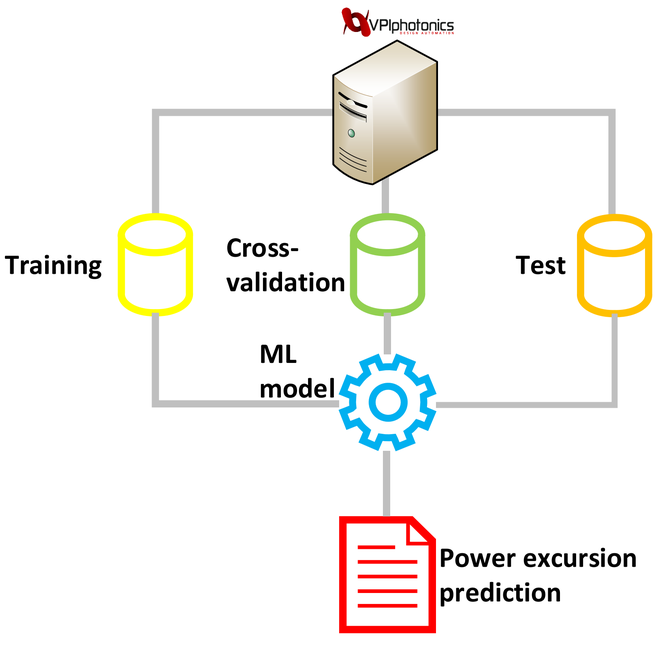
Interface to TensorFlow [4]

► Creation of the Keras **NN (Neural Network)** model



► Training model and power excursion **prediction**





Ongoing & Future work

► Generation of training, cross-validation and test datasets by using **VPIphotonics**, software for simulation of optical systems [5]

► Development of the presented NN model to predict power excursion. Other **ML algorithms** (VGG-16, PCA-QDA, MLPbest, …) will be considered

► Validation and **performance assessment** of the proposed solution

References

[1] Cisco VNI Global IP Traffic Forecast 2016-2021
[2] Junio, J., Kilper, D.C. & Chan, V.W., Channel power excursions from single-step channel provisioning. *Journal of Optical Communications and Networking*, 4(9), pp.A1–A7, 2012
[3] Huang, Y. et al., 2016. A machine learning approach for dynamic optical channel add/drop strategies that minimize EDFA power excursions. *42nd European Conference on Optical Communication,* In *ECOC 2016*
[4] R Interface to TensorFlow, https://tensorflow.rstudio.com/tfestimators, accessed 13 June 2018
[5] VPIphotonics, https://vpiphotonics.com/index.php, accessed 13 June 2018

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