Technische Universität Braunschweig

Institut für Hochfrequenztechnik
Technische Universität Braunschweig

Vision and Accomplishments

Teratronik Group

Arijit Misra

Outline

- Introduction
- Our Vision
- Our Achivements
- Conclusion

Introduction

Technical University carolo-Wilhemina zu Braunschweig,

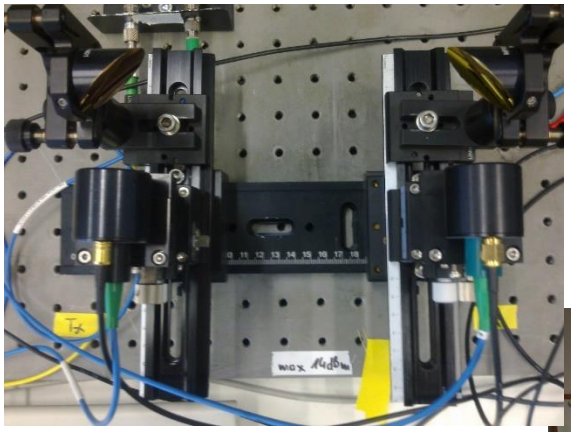
Founded 1745, Oldest TU in Germany (Wikipedia)

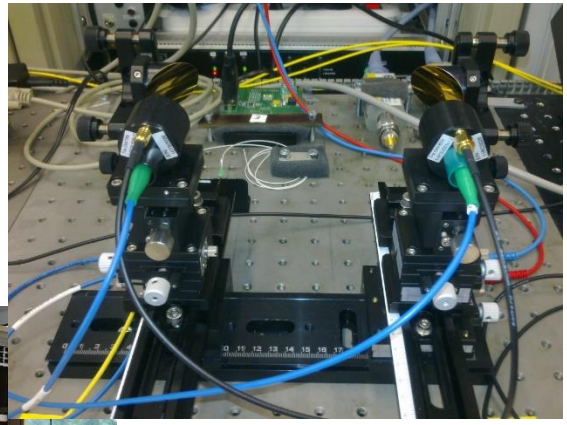
20000 Students, 6 Faculties, 125 Institutes

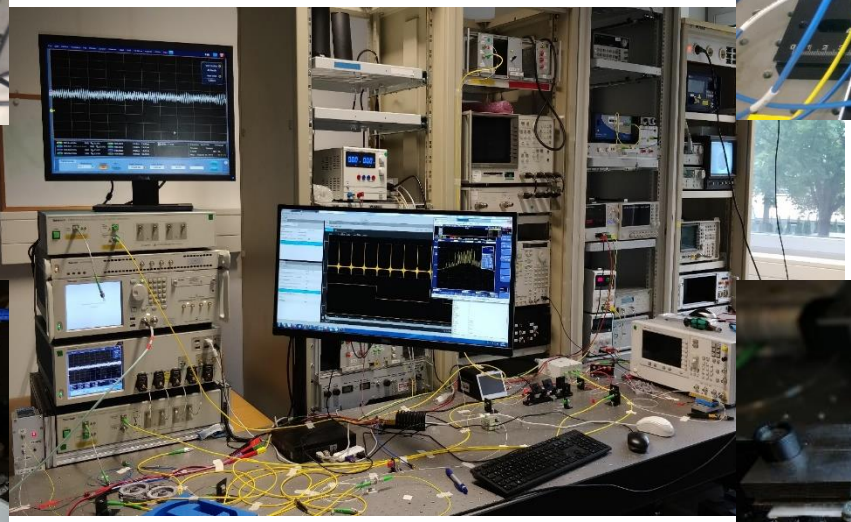
Institute for High Frequency Technology

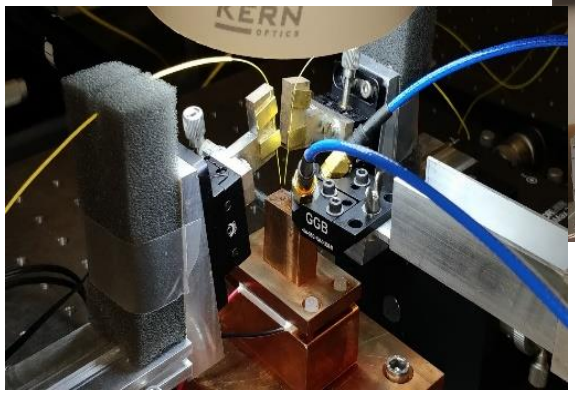
AG Teratronik (Prof. T. Schneider)

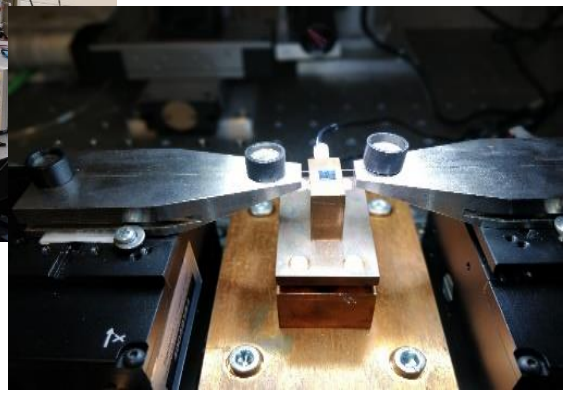
Introduction









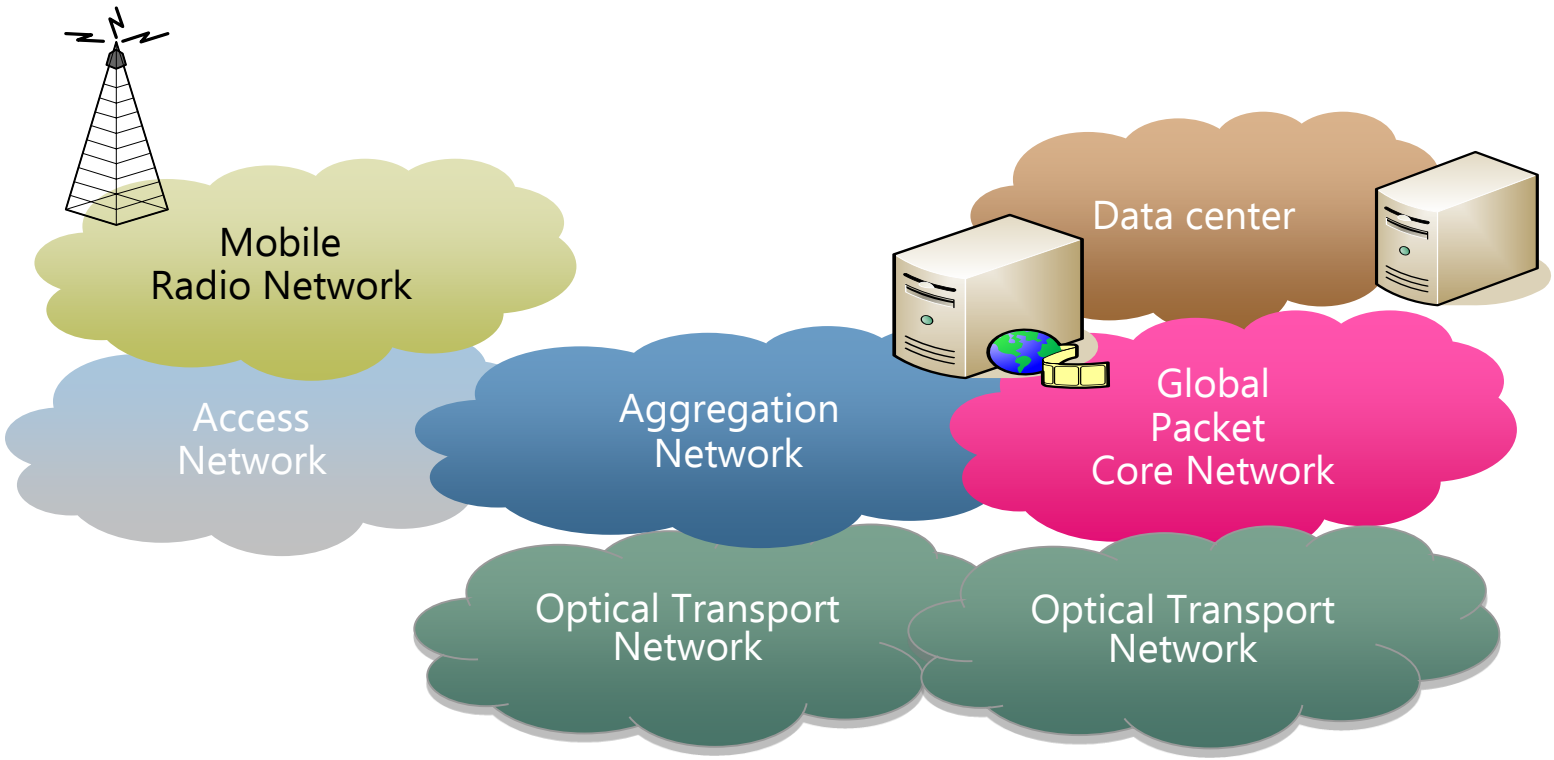


Our Vision

Our Vision

Wireless distribution with μ, mm and THz waves

Optical Transport and distribution of ultra-high data rates

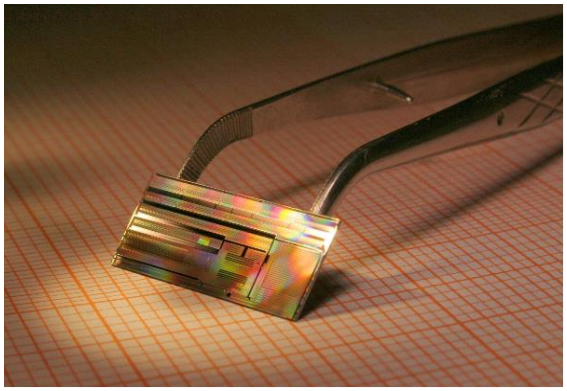


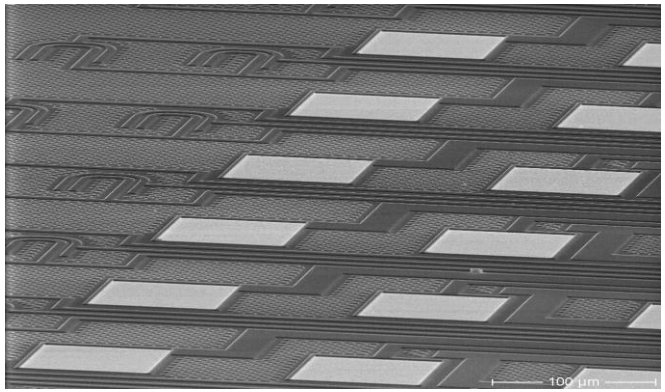
Our Vision

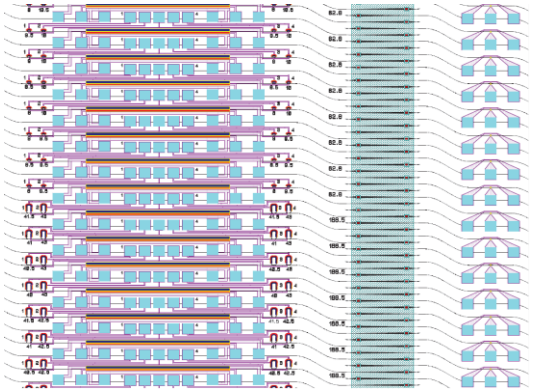
"…with cutting-edge super-computers, the trick is to keep them from melting."
Nature 492, 174 (2012)

* Photo Courtesy: www.fortune.com

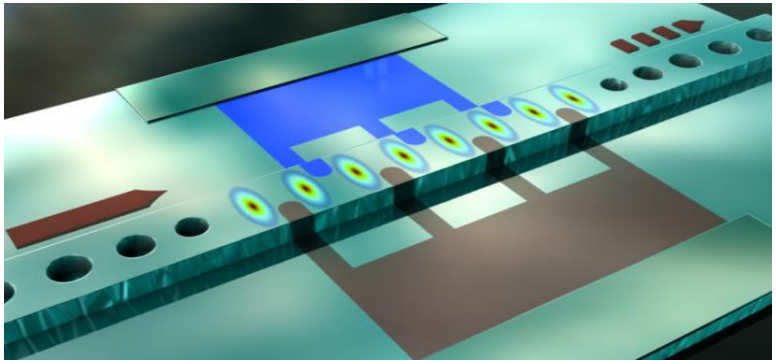
Our Vision

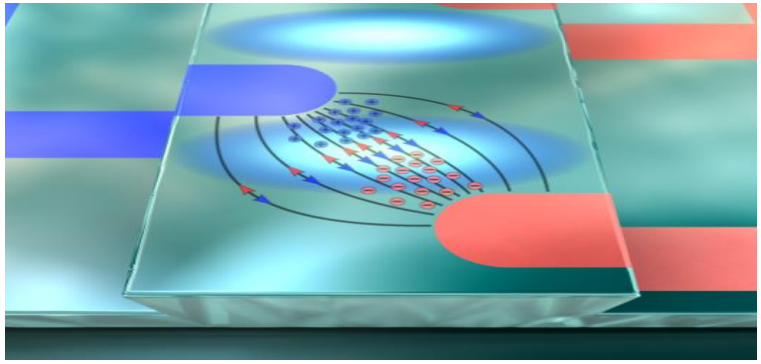




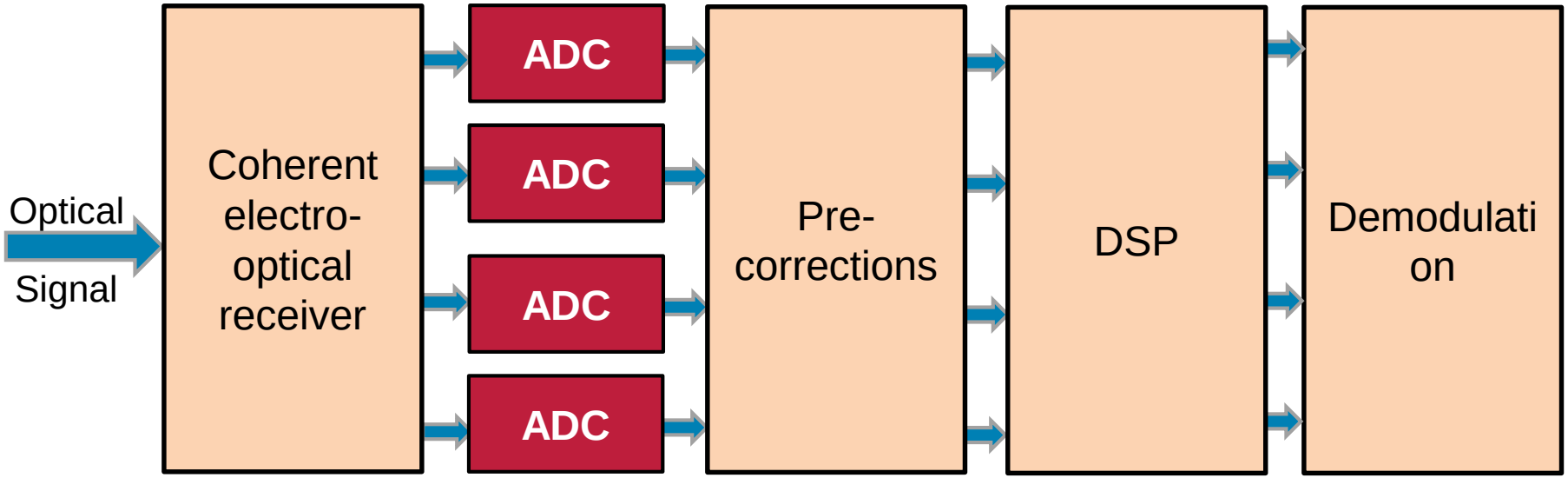


Solution : Optical Transport and processing at ultra high data rate with low foot print and energy efficient devices

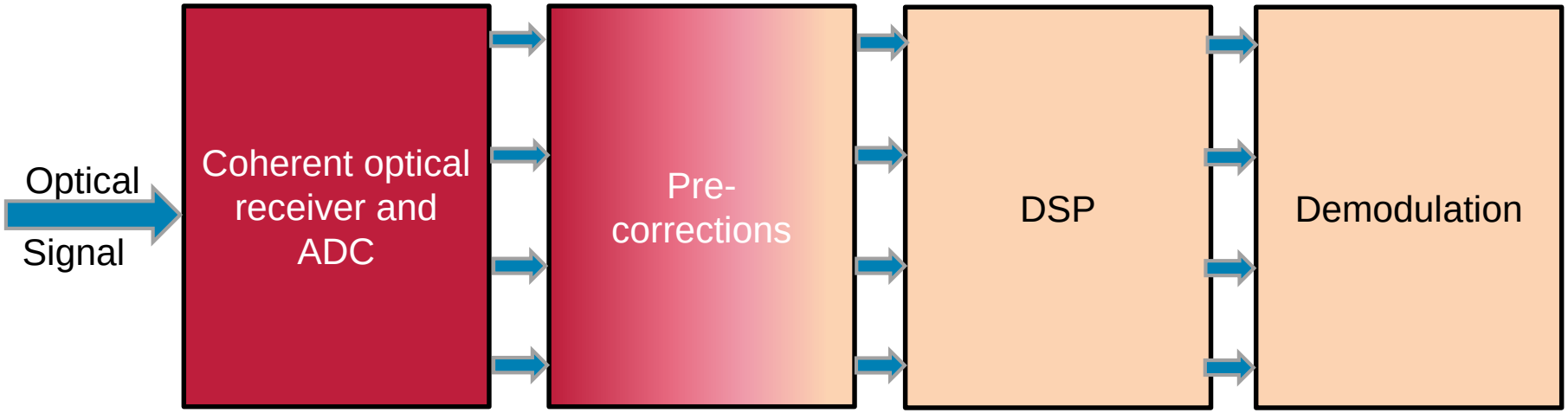




Our Vision



Receiver architecture recommended by Optical Internetworking Forum


Optical
Signal
Coherent optical receiver and ADC
Pre-corrections
DSP
Demodulation

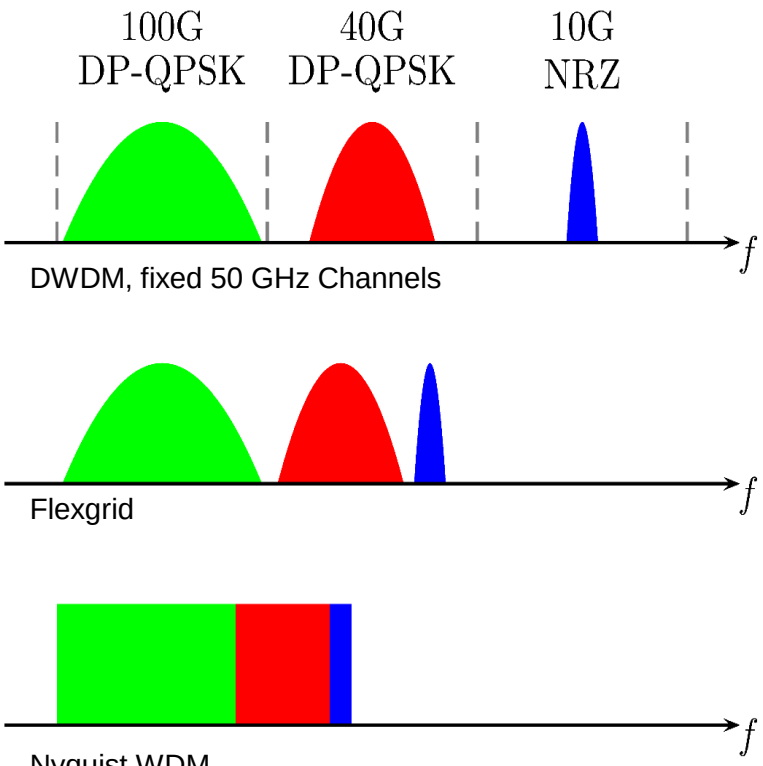
Our Achievements

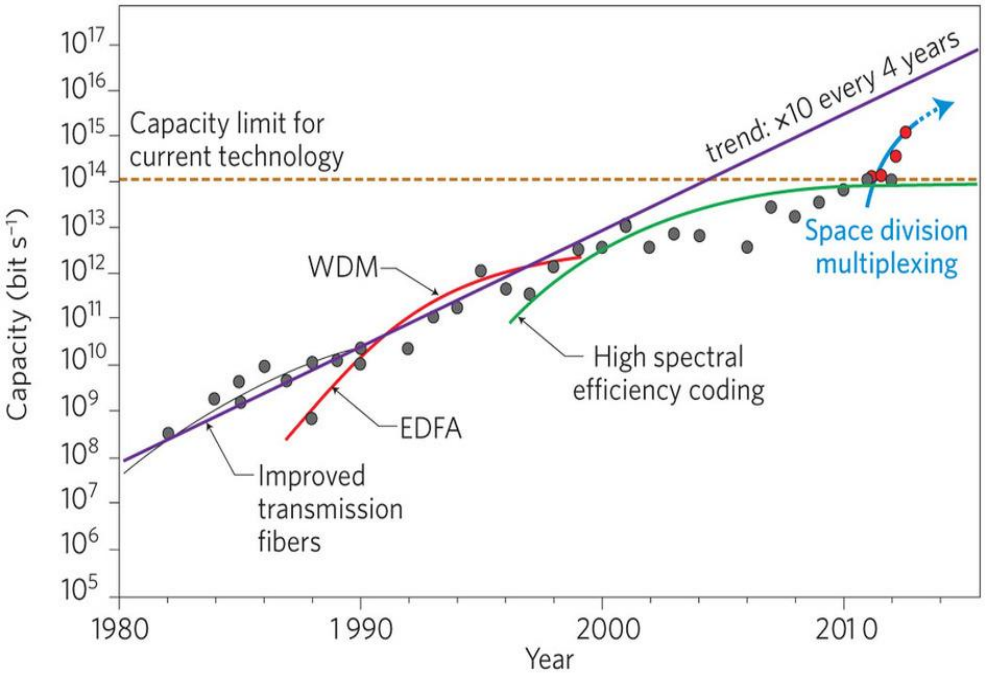
Our Achievements

- Communication with ultra-high data rate
- High sampling rate optical ADC
- High sampling rate optical DAC
- Tunable, wide-bandwidth, rectangular filters
- THz-wireless communications

Our Achievements

Ultra-high Bitrate Data Communications

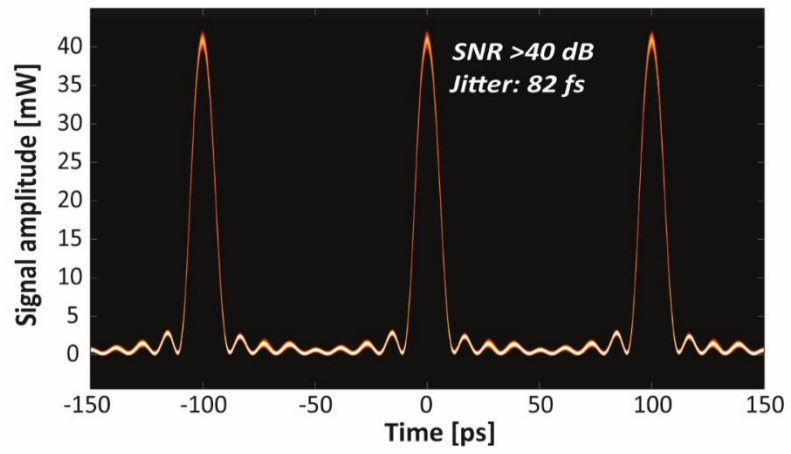


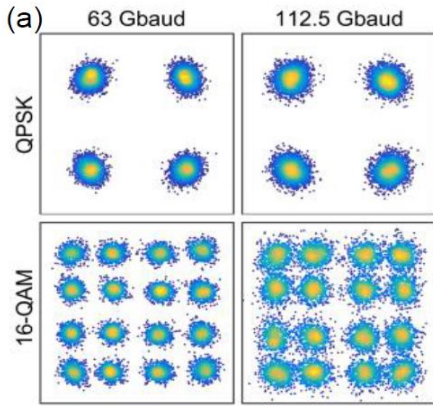


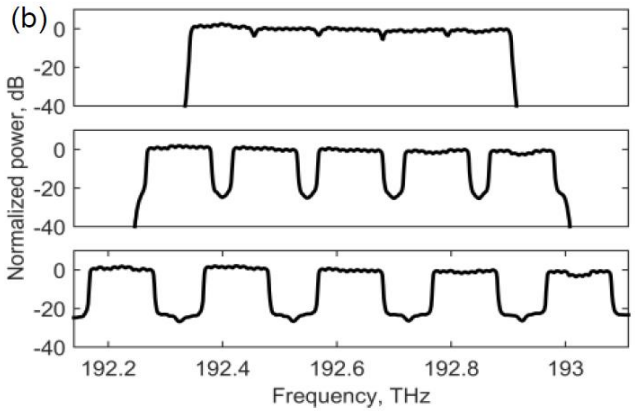
Space-division multiplexing in optical fibres
•D. J. Richardson, J. M. Fini & L. E. Nelson
Nature Photonics **7**,354–362(2013)

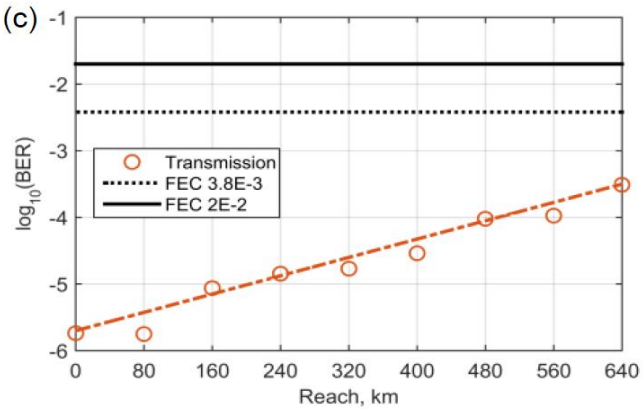
Our Achievements

Ultra-high Bitrate Data Communications





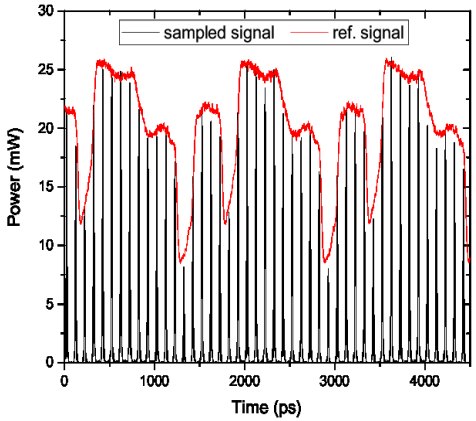


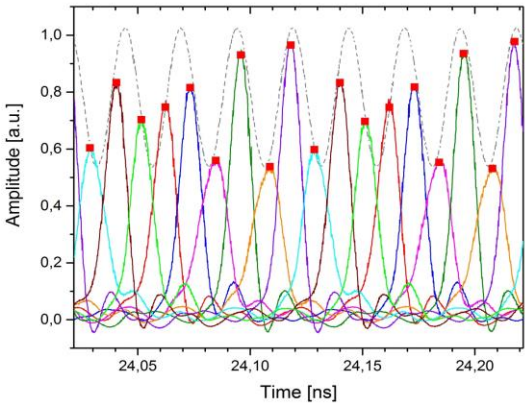


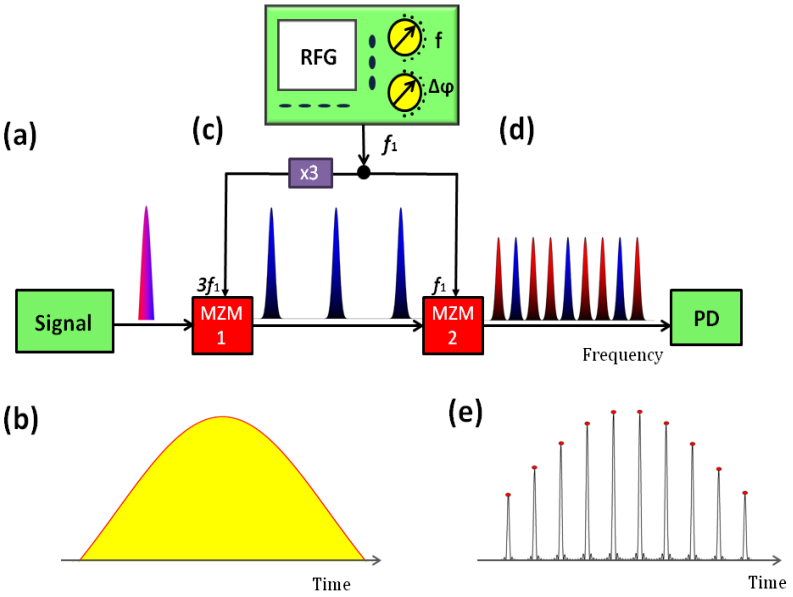
Nature Commun. 4:3898 (2013)
IEEE Phot. Journal 8, 10.1109/JPHOT.2016.2523978 2016

Our Achievements

Optical ADC



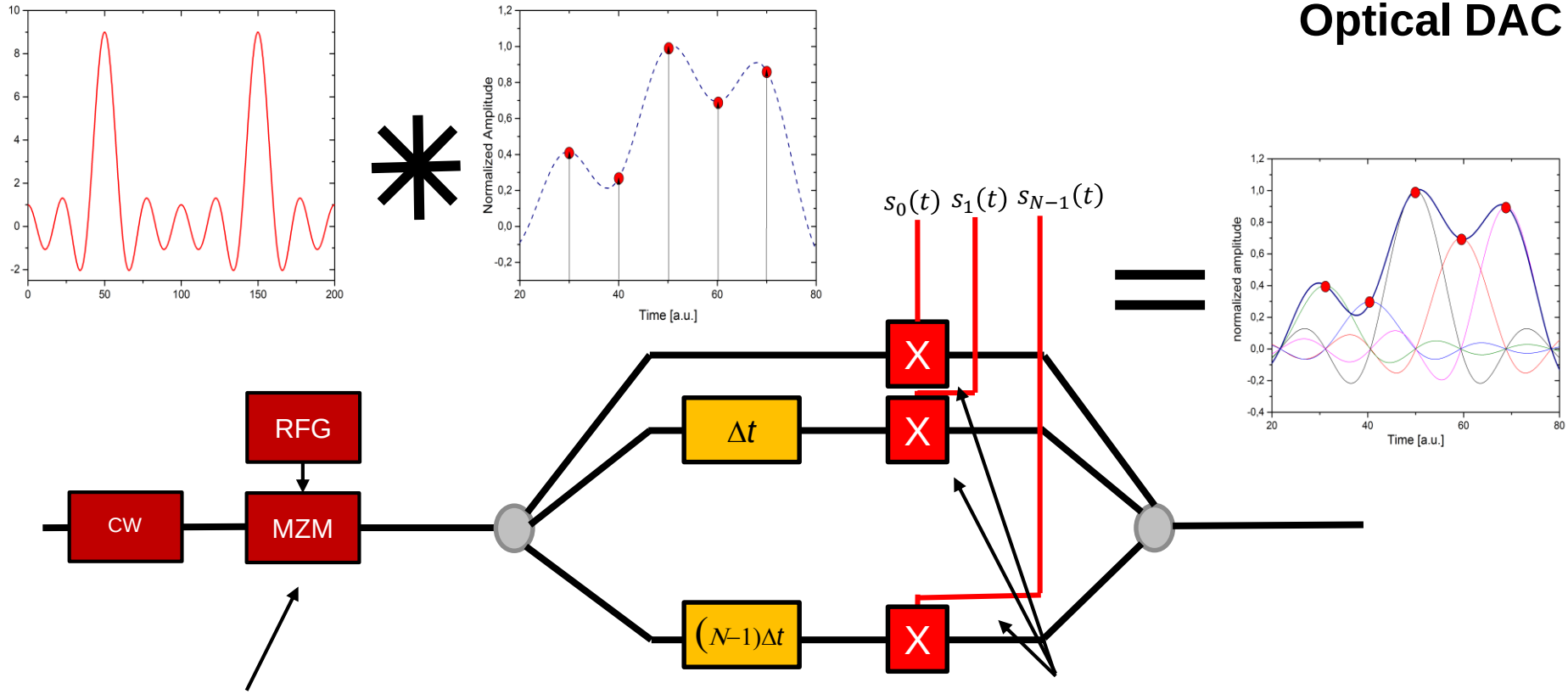




Scientific Reports 6:34500, doi: 10.1038 (2016)

Our Achievements

Optical DAC

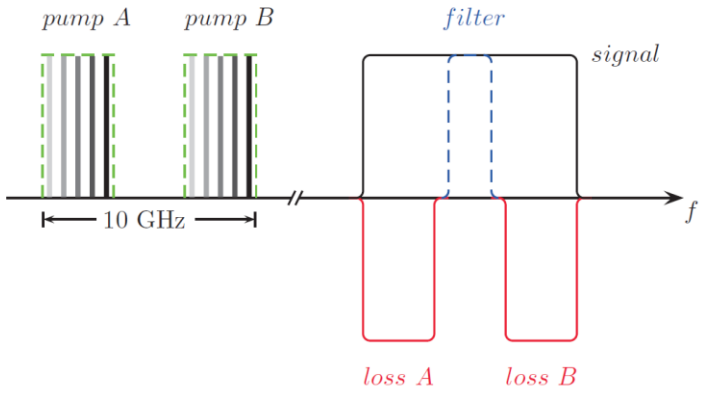


Generation of precise optical sinc-shaped pulse sequences (Nyquist pulses) w/o rect. BPF

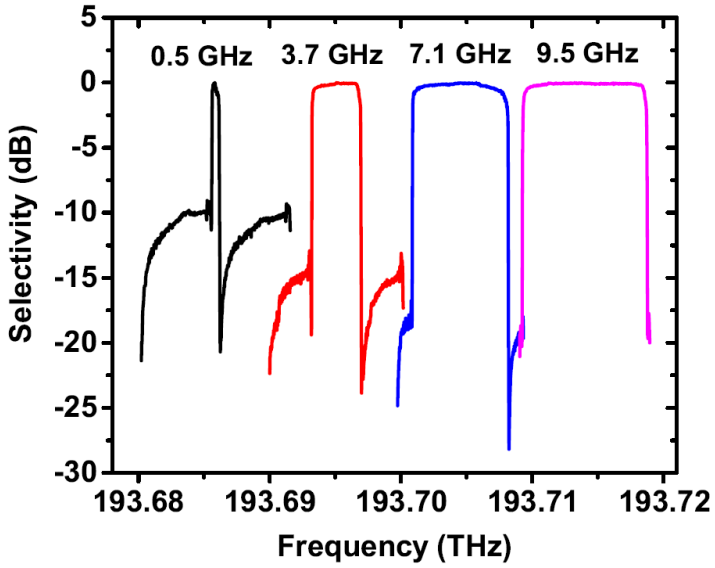
BW limitation of MZMs and electronics requires time-interleaved architecture

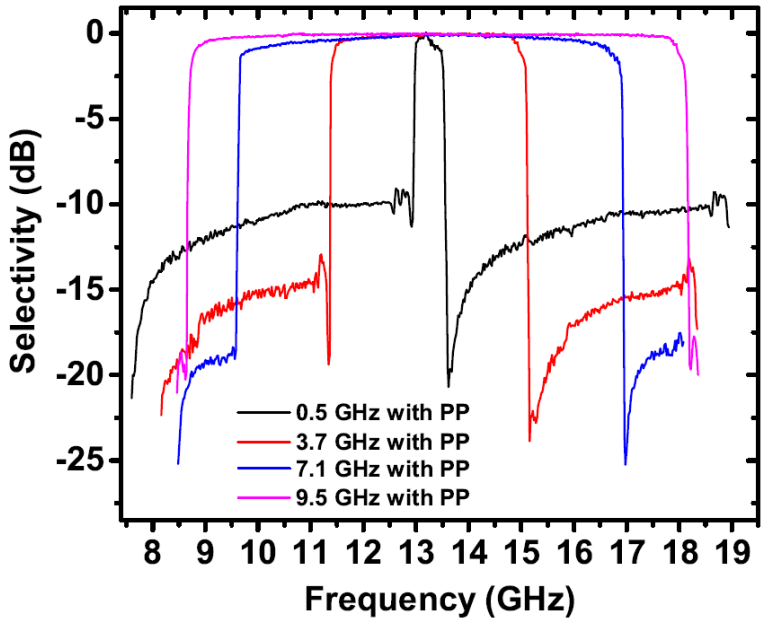
PONyDAC Block Diagram

Our Achievements



Tunable, wide-bandwidth, rectangular filters

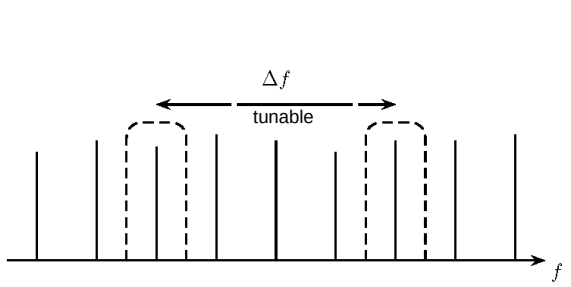




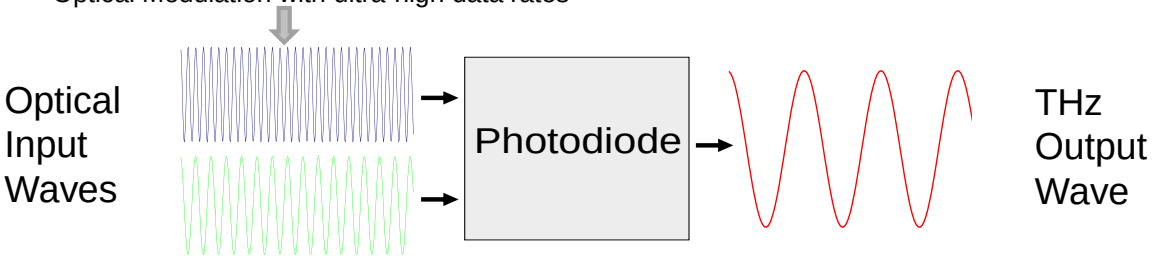
Photonics Research 6 (2), 132 – 137 (2018)

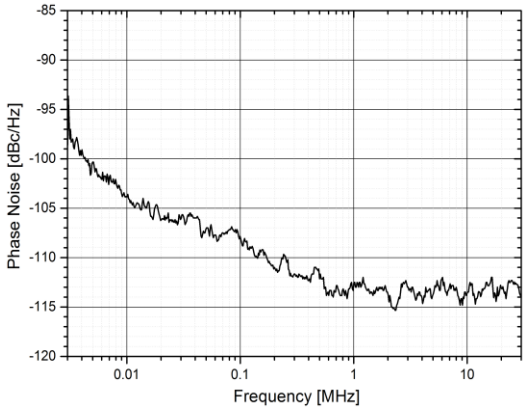
Our Achievements

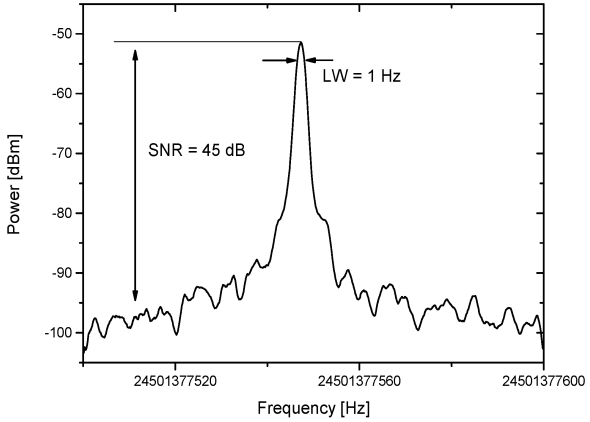
Extraction of two correlated lines out of a frequency comb for high qualityTHz generation

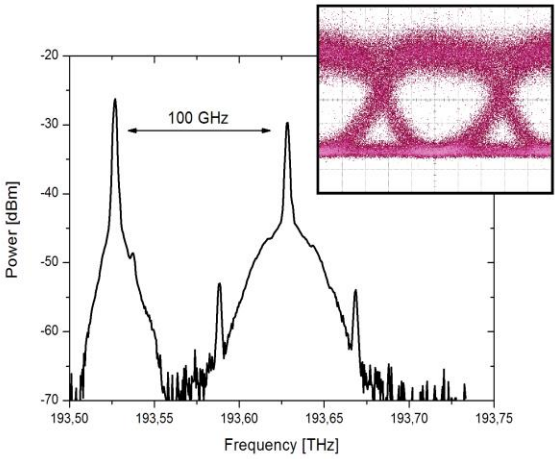


Optical Modulation with ultra-high data rates









Conclusions

Conclusions

Vision

- High bandwidth signal processing and data transmission better in optical domain

Achievements

- Optical ADC 4 times bandwidth of electronics
- Optical DAC 2 times bandwidth of electronics
- Data transmission without guard band
- Tunable THz generation with ultra-low phase noise
- Rectangular, tunable filters with ultra-high steepness

Acknowledgements

- German Research Foundation (DFG)
- Volkswagen
- Deutsche Telecom
- Audi