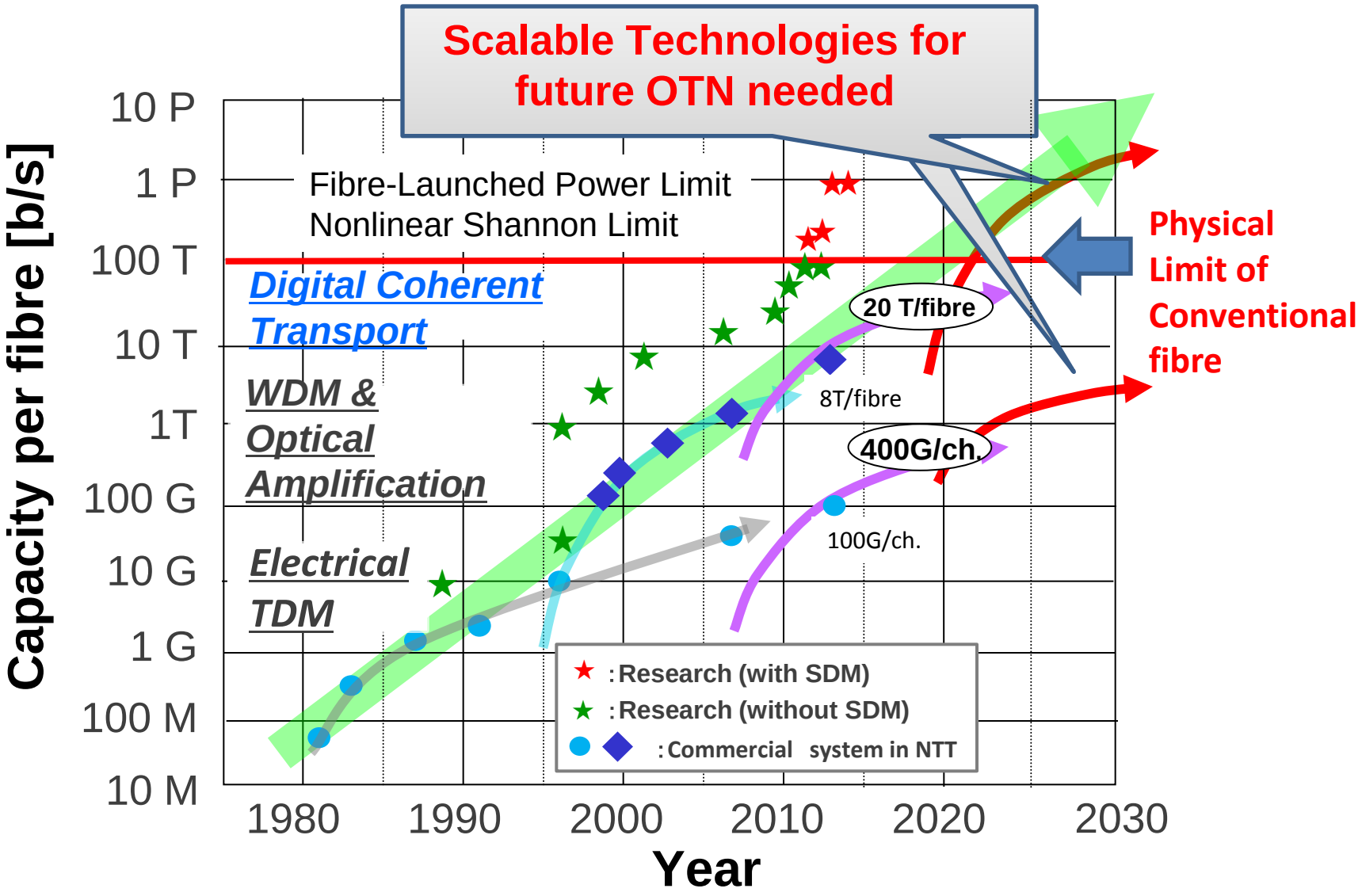
SAFARI Project

Scalable and Flexible optical Architecture for Reconfigurable Infrastructure

October 16th 2014

Technical University of Denmark *Coordinator (EU)* *Toshio Morioka*
NTT Corporation *Coordinator (JP)* *Yutaka Miyamoto*

Demand for Scalable Optical Transport Network

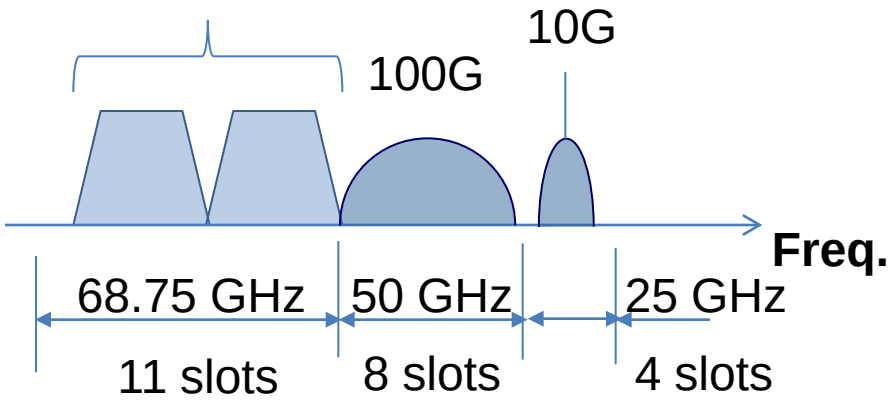


International standardisation of Flexible Grid and the first application to 400 Gbps transport over OTN

Future WDM network

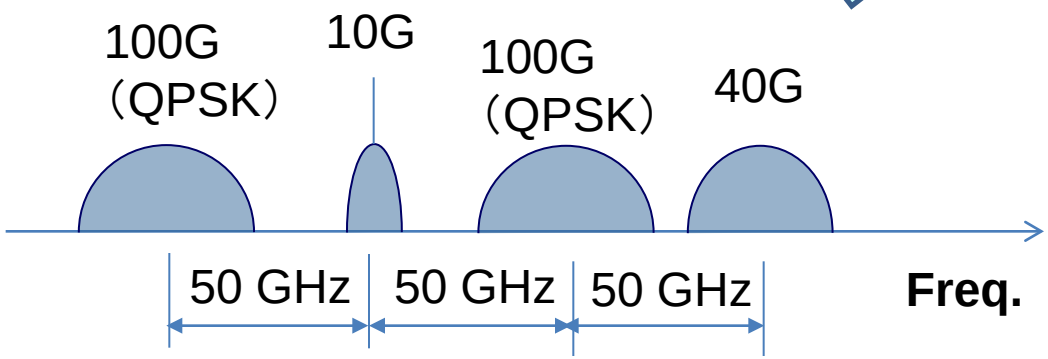
High capacity based on multicarriers (super channels)
Variable bandwidth (Freq. Slot)
⇒N x 6.25 GHz
The anchor frequency (the same)
⇒193.1 THz (1552.52 nm)

400G super channel (16QAM x 2subcarriers)



Japan has contributed significantly to the standardisation of flexible grid in ITU-T SG15

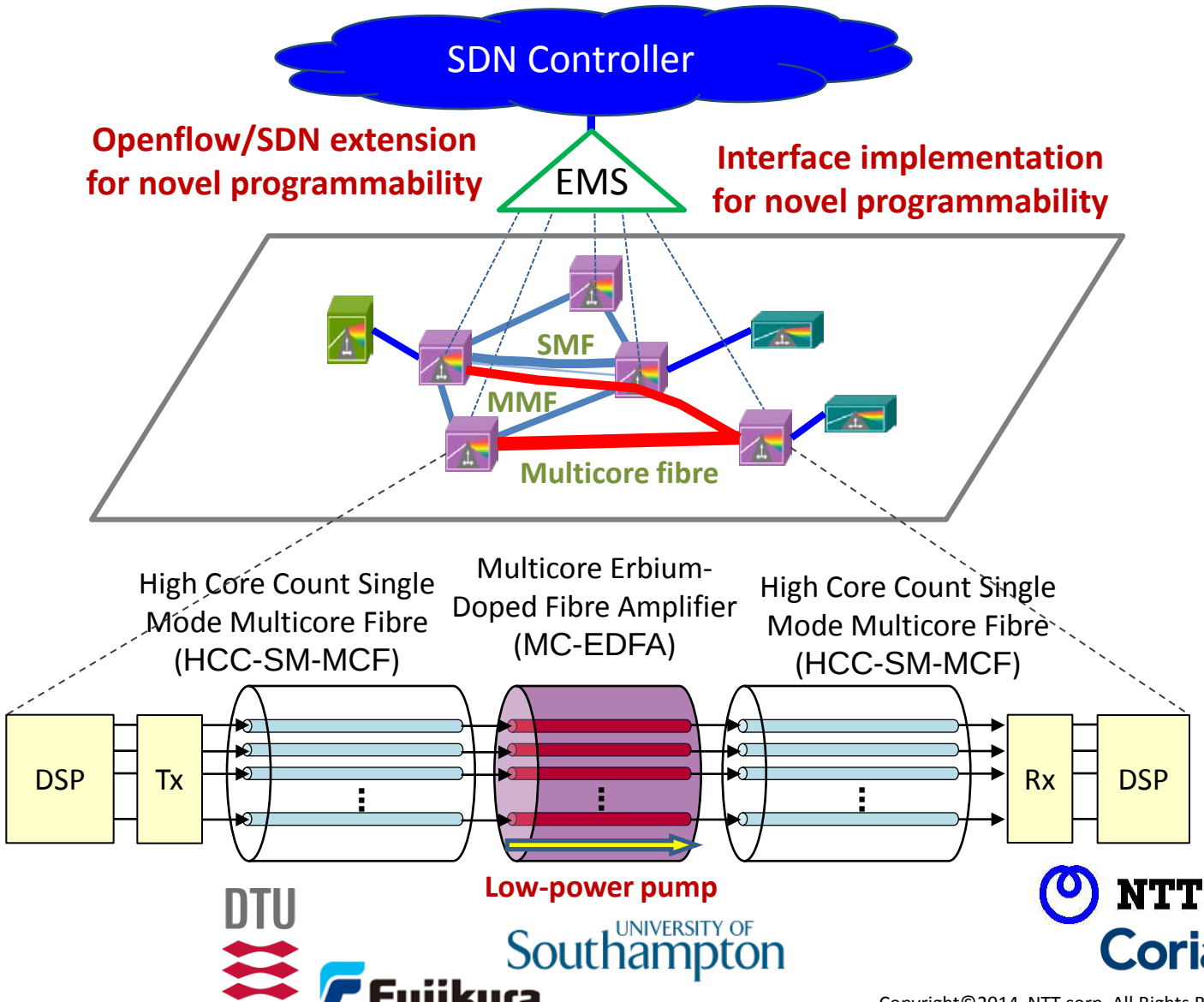
Today's WDM network



High speed single carrier signal
Fixed Frequency Grid:
⇒N x 12.5 GHz
The anchor frequency (the same)
⇒193.1 THz (1552.52 nm)

QAM: Quadrature Amplitude Modulation

Overview of the SAFARI project

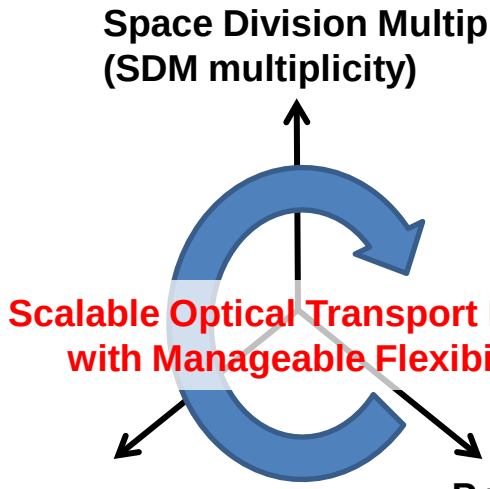


EU and Japan collaborations on the SAFARI project

(**S**calable and **F**lexible optical **A**rchitecture for **R**econfigurable **I**nfrastructure)

EU team

- *Technical Univ. of Denmark (DTU)*
- *Southampton Univ. (UOS)*
- *Coriant R&D GmbH (COR)*

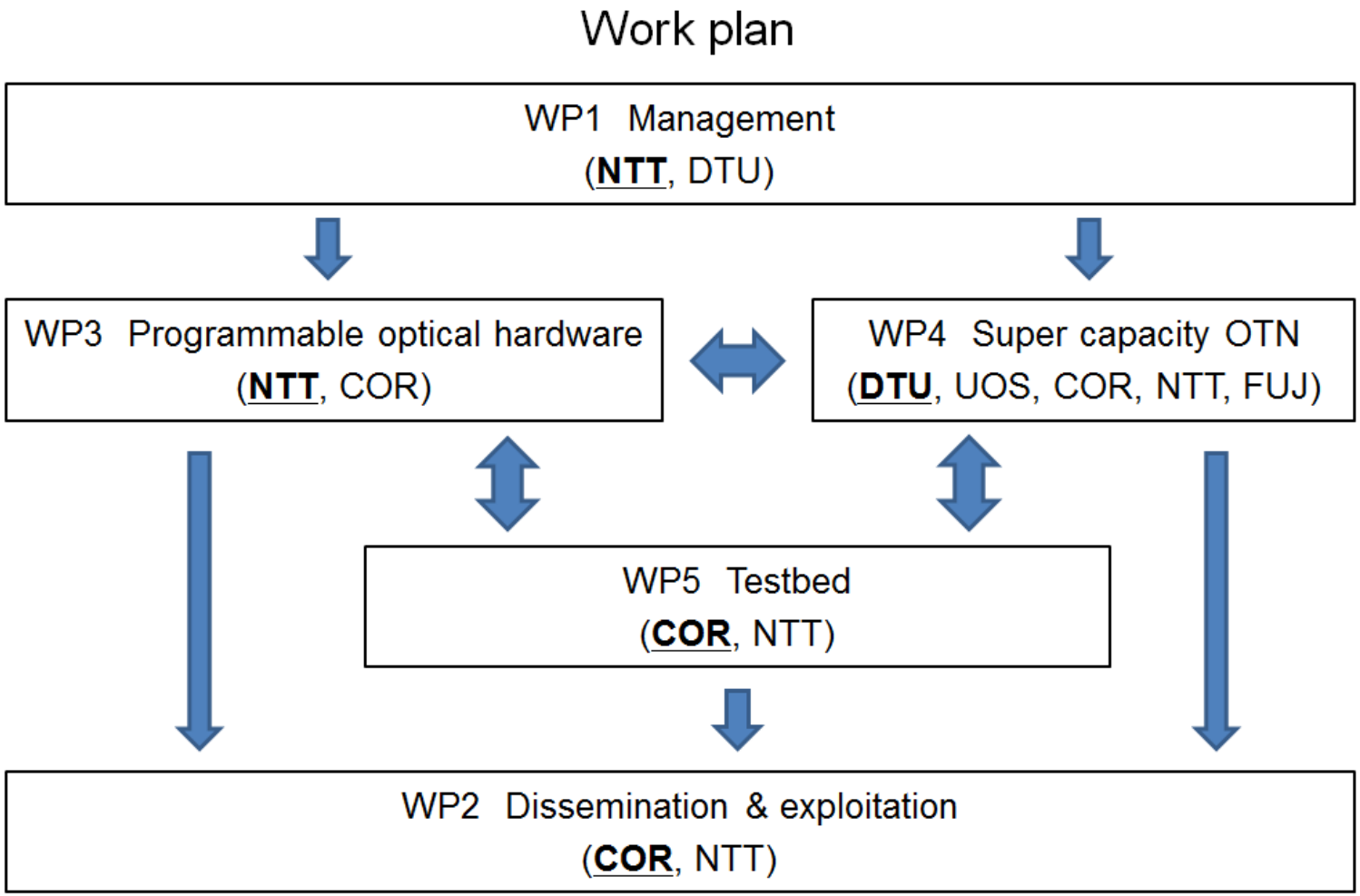


Japan team

- *Nippon Telegraph and Telephone Corporation (NTT)*
- *Fujikura Ltd. (FUJ)*

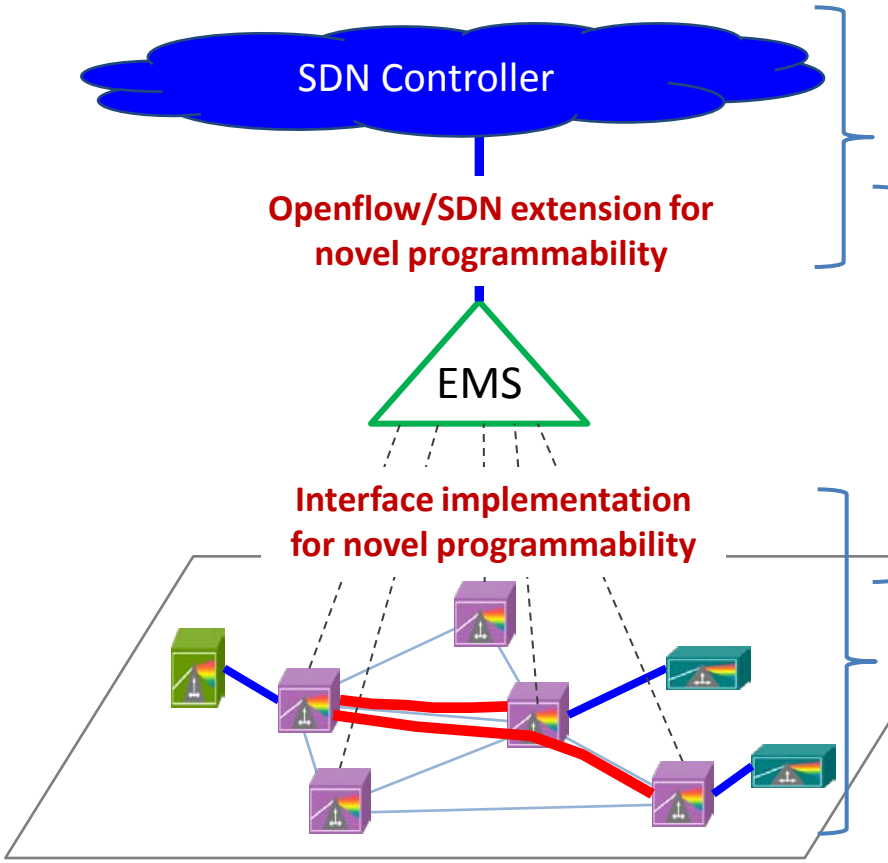
	DTU	UOS	COR	NTT	FUJ
Network control of programmable function				●	
Interworking functions for programmable control			●		
Design and verification of programmable function				●	
Design and system verification of SDM systems	●		●	●	
Detail design and fabrication of multicore fibre					●
Design and fabrication of multicore fibre amplifiers		●			
Testbed verification	●	●	●	●	●

Working package structure



WP3 Programmable optical hardware

Verification and establishment of a control scheme for optical transport programmability beyond 400 Gb/s



Programmability utilization design for scalable network provisioning

Scalable control of carrier network with an optimum degree of programmability NTT

Interworking between SDN and Physical Layer

Abstraction of information from programmable elements and the fiber links and implementation of intermediate layer Coriant

Programmable functions of L0/L1

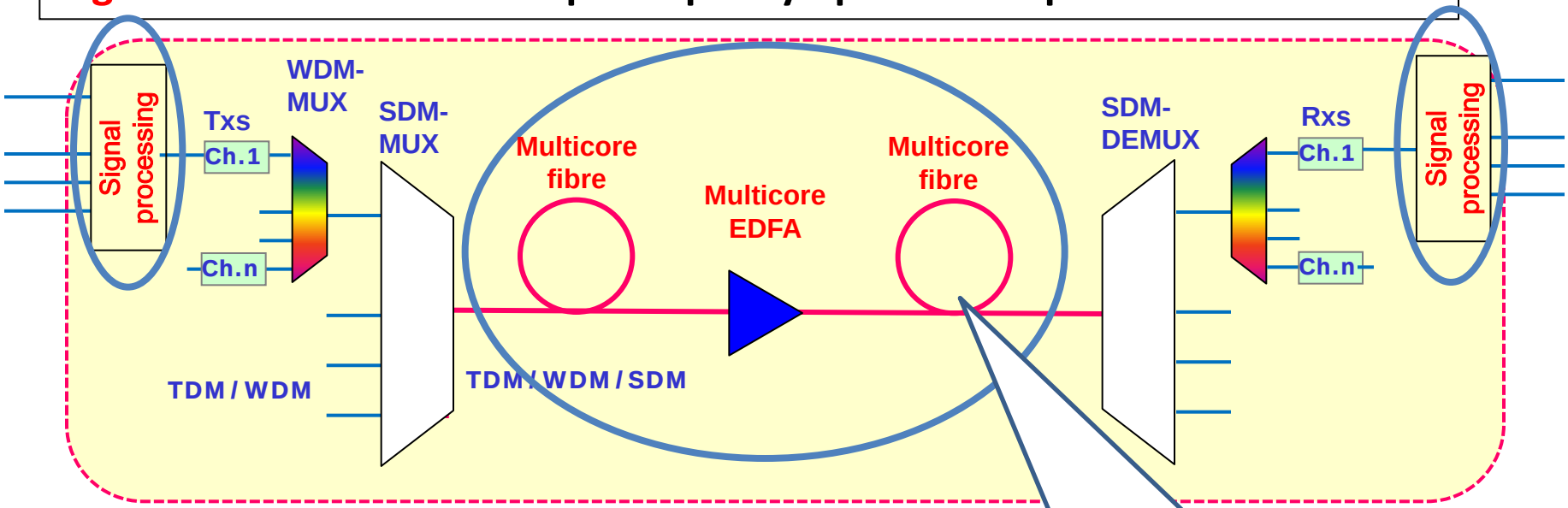
Develop and verify various flexible features of programmable optical hardware including carrier-number, modulation format etc. NTT

Coriant

WP4 Super capacity optical transport networks

Innovative R&D by NTT

Investigation and development of MCF-based SDM technologies with high core counts toward super-capacity optical transport networks



- *Multicore fibres*
- *Multicore EDFA*
- *Signal processing for SDM*

DTU

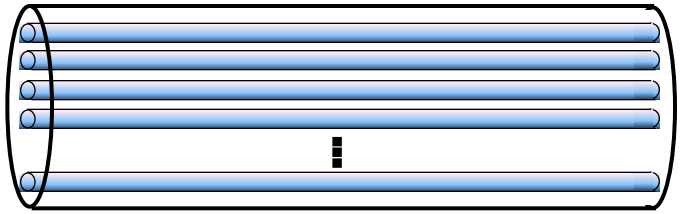
Fujikura

UNIVERSITY OF Southampton

NTT

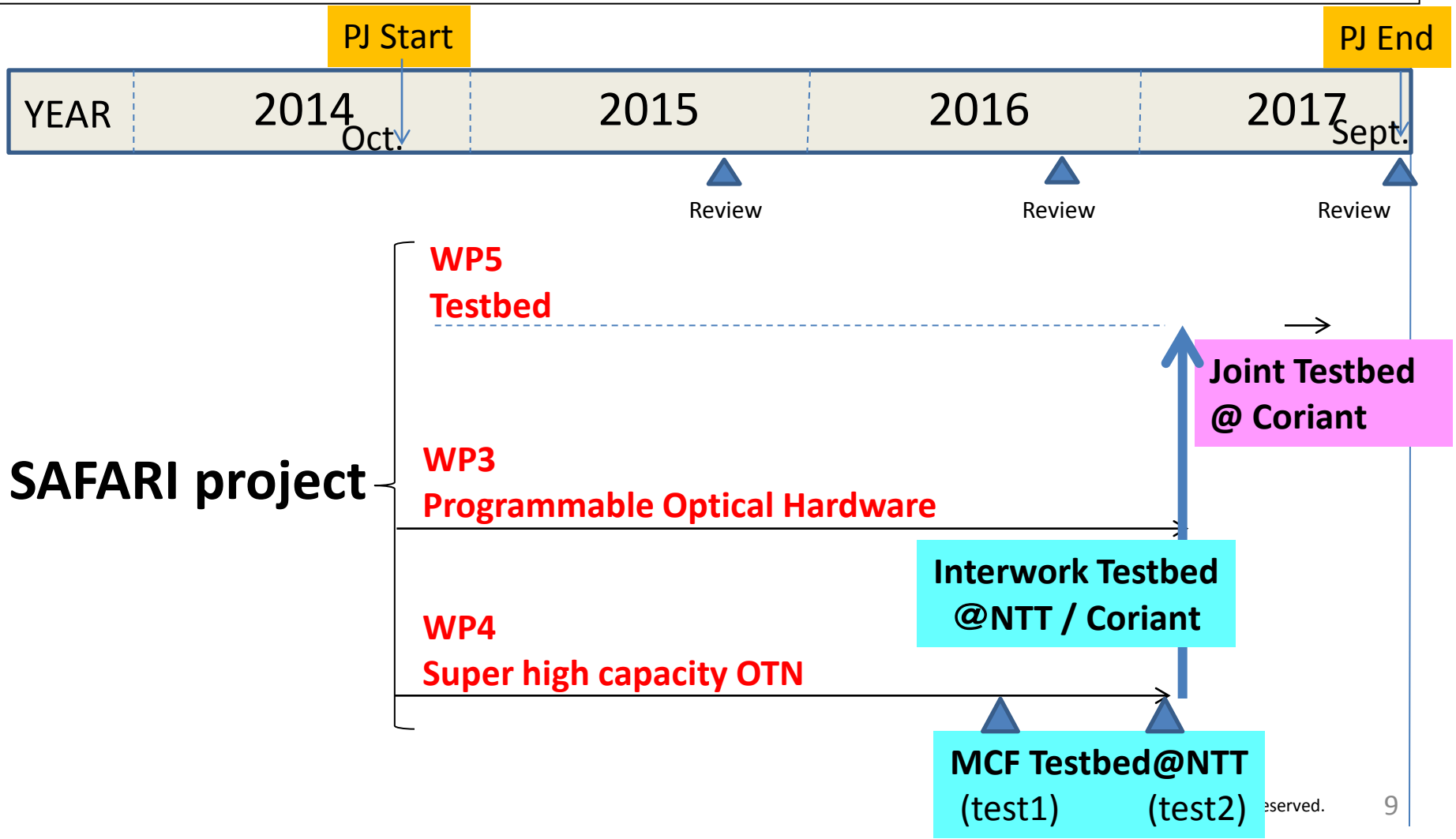
Coriant

Single-mode multicore fibre



WP5 Testbed

The core technologies for future scalable Optical Transport Network in WP3 and WP4 are combined to be tested in the testbed of WP5



Summary

Significance of EU-Japan R&D collaboration

Impact on society (commercialisation and standardisation)

- High speed digital signal processing technologies at more than 400G and SDN-based control technologies offering flexible functionality is the key for future OTN
- Capacity scaling of super channels is expected through various combinations of wavelength division and space division multiplexing for channel capacities beyond 400 Gbps

Technical feasibility

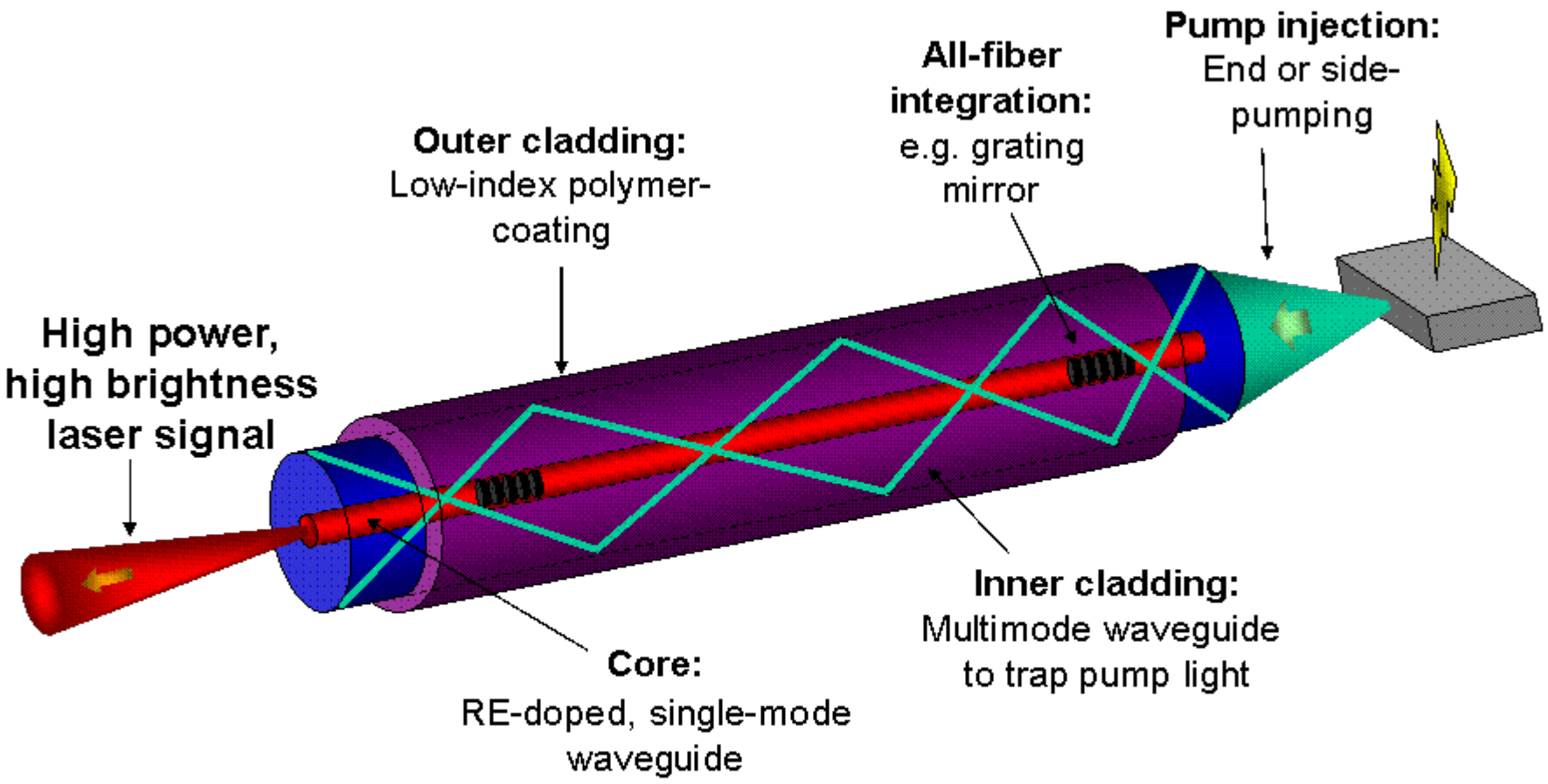
- EU team is a world leader in SDN-controlled transport layer systems
- Japan team is a world leader in real-time high-speed DSP-ASICs
- Japan team has world leading expertise in MCF transmission technology
- EU team has world leading expertise in SDM optical amplification technology

Advantages of EU-Japan collaboration

- Sharing technical roadmap on the evolution for managing flexibility in future scalable OTN
- Proposal of international standards for future interoperability through wide-scope open innovation based on the world leading technologies from the EU and Japan

Reference

Cladding Pumped Fibre Devices



Rare-earth-doped core converts multimode pump energy to high brightness, *diffraction-limited*, signal beam

UNIVERSITY OF Southampton