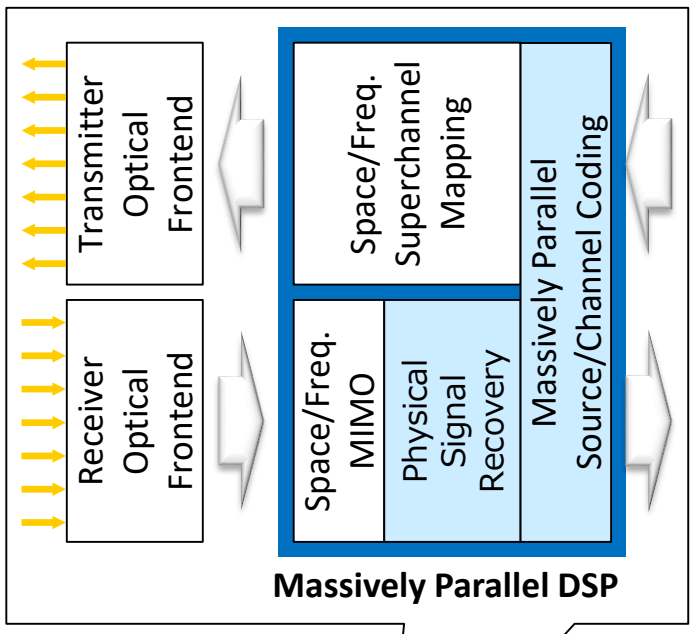
“Massively Parallel and Sliced Optical Network (MAPLE)”

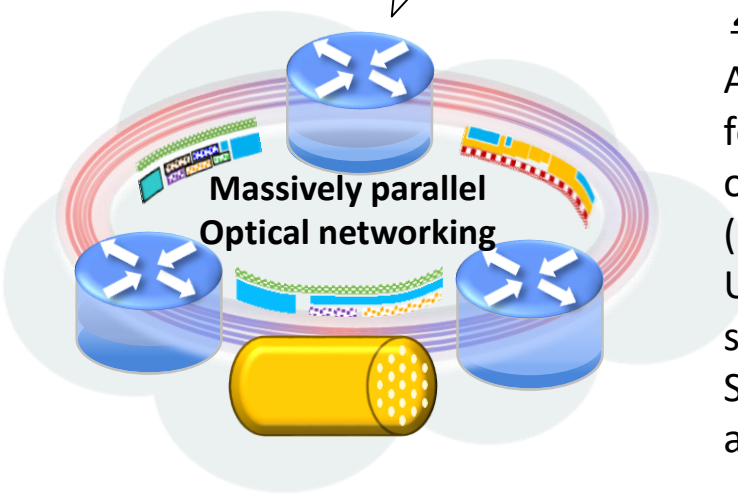
the Commissioned Research (#204) of NICT, Japan

MITSUBISHI ELECTRIC *Changes for the Better* · AIST · KDDI Research · KAGAWA UNIVERSITY · Keio University 1858 CALAMVS GLADIO FORTIOR

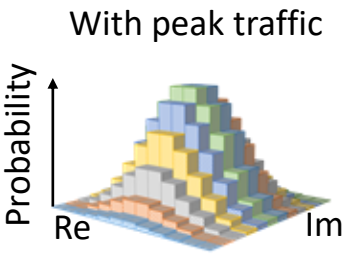
Aim: to establish a novel optical network supporting future large-scale/diverse traffic streams

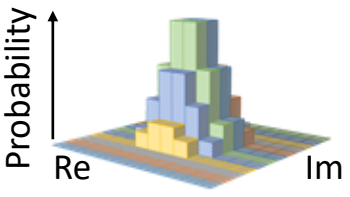
This work: to develop fundamental technologies with massively-parallel processing for low-consumption, open, and versatile optical transport





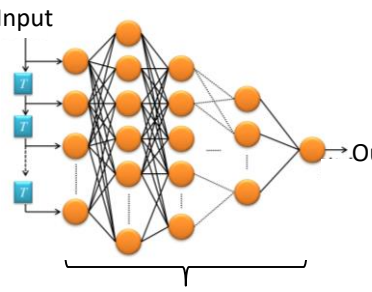
1. Massively Parallel Advanced DSP Technology

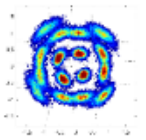




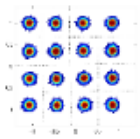
A: Signal recovery & adaptive control (Mitsubishi Electric)
Probabilistic shaping with real-time data compression
- Peak traffic: 10x
- Power efficiency: 25x

B: Optical transmission/ reception processing (AIST)
Machine learning to cope with nonlinear Shannon limit
- Reach: 160%x





After nonlinear degradation



After compensation

1A: Efficient coding for massive data

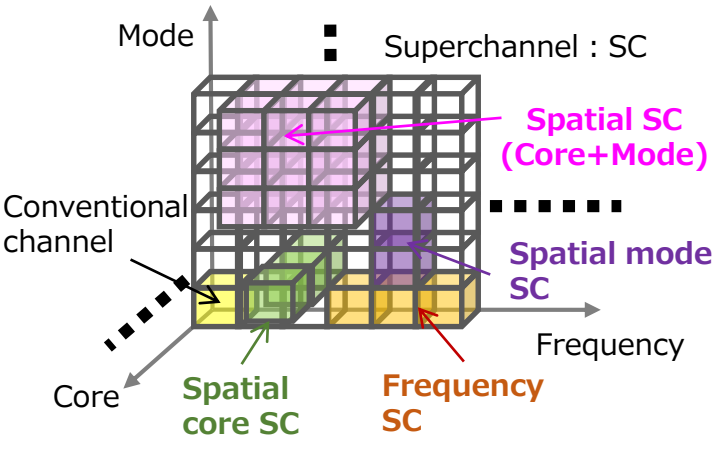
1B: Reach extension by signal compensation

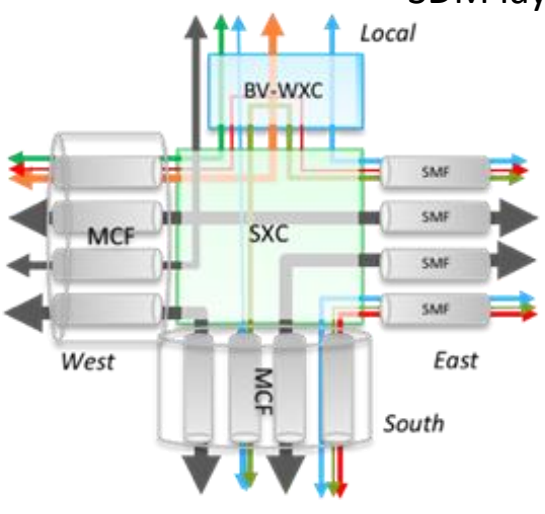
2. Massively Parallel Optical Networking Technology

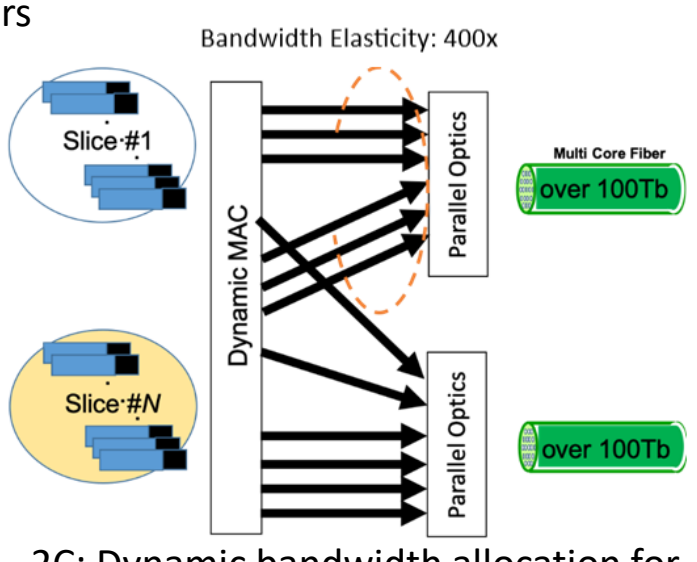
A: Design and control for massively sliced optical networks (KDDI Research)
Up to 1000 optical slices (80,000) by SDM/WDM channels and open control

B: Massively parallelized optical node and network architectures (Kagawa Univ.)
Enhancing bandwidth-elasticity up to 100 times by introducing hierarchical WDM and SDM layers

C: Dynamic MAC (Keio Univ.)
Media access control
- Parallelism: 1000
- B/W Elasticity: 100x







2A: Enhanced slicing and easier operation

2B: Hierarchical optical cross-connect

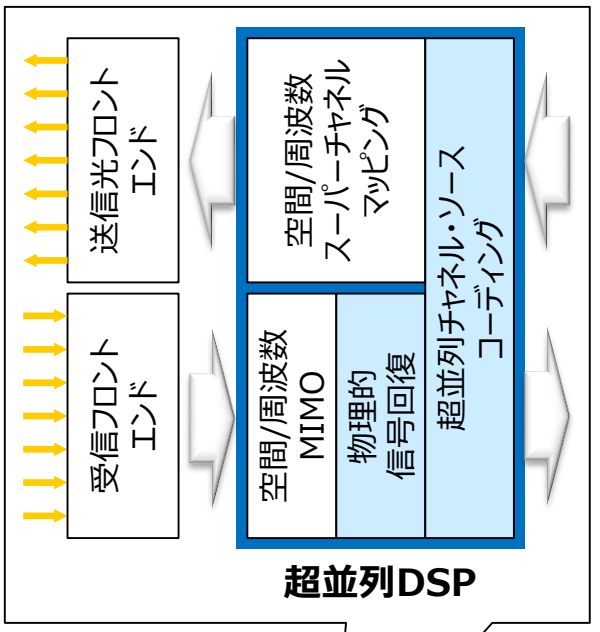
2C: Dynamic bandwidth allocation for parallelized elastic networking

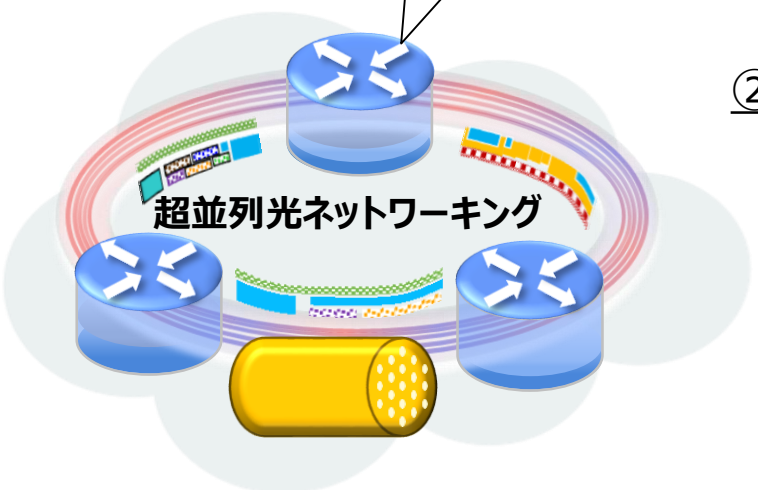
NICT委託研究課題204
『超並列型光ネットワーク基盤技術の研究開発』

[副題]大容量データを省電力・オープン・伸縮自在に収容する超並列処理光技術

MITSUBISHI ELECTRIC Changes for the Better　産総研　KDDI KDDI Research　香川大学 KAGAWA UNIVERSITY　Keio University 1858 CALAMVS GLADIO FORTIOR

先行/並走する委託研究にて開発される空間多重光ファイバ・中継技術および空間多重分離技術と、本課題が取り扱う、大容量データを省電力・オープン・伸縮自在に収容する超並列処理光技術により、将来の大規模・多様な通信需要を支える新たな光ネットワークを実現する。

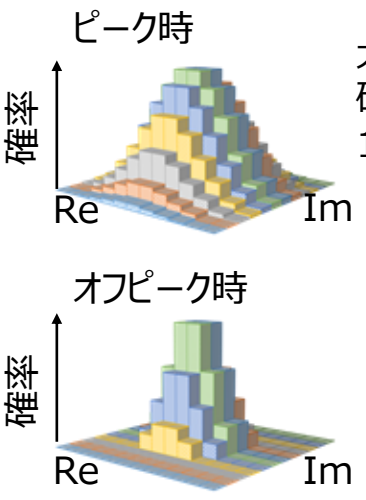




①超並列DSP高度化基盤技術

A：信号復元復号・適応制御技術 (三菱電機)

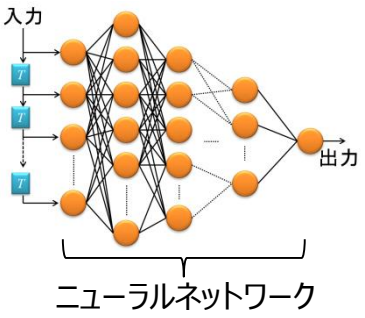
大容量データを自動圧縮・確率整形し、ピーク容量10倍、電力効率25倍

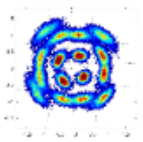


①A：大規模データの効率的なコーディング

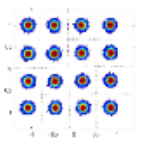
B：光送受信処理技術 (産総研)

機械学習に基づき非線形シャノン限界を克服、伝送距離を60%延伸





非線形波形劣化した信号のコンスタレーション波形



非線形波形劣化が補償された信号のコンスタレーション波形

①B：伝送品質劣化補償による距離延伸

②超並列光ネットワーキング基盤技術

A：超並列スライス設計制御技術 (KDDI総合研究所)

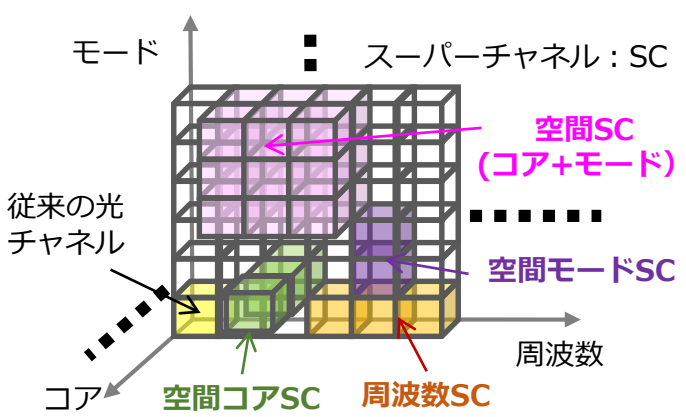
周波数×空間多重による信号並列度現行比1000倍とオープン制御

B：超並列光ノード・ネットワーク構成技術 (香川大学)

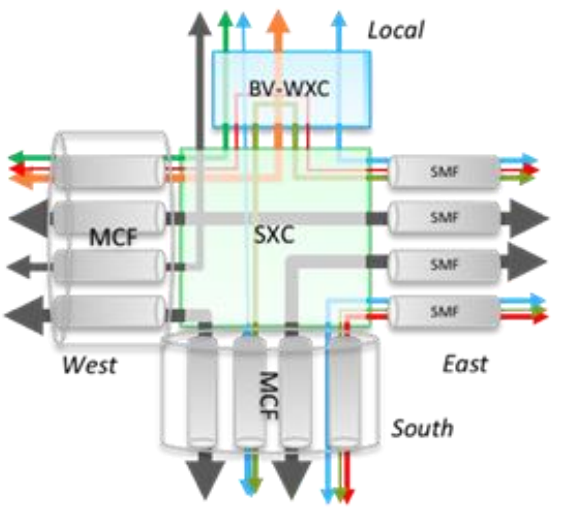
波長レイヤと空間レイヤの階層化により帯域伸縮度を100倍に

C：超並列ダイナミックMAC技術 (慶應大学)

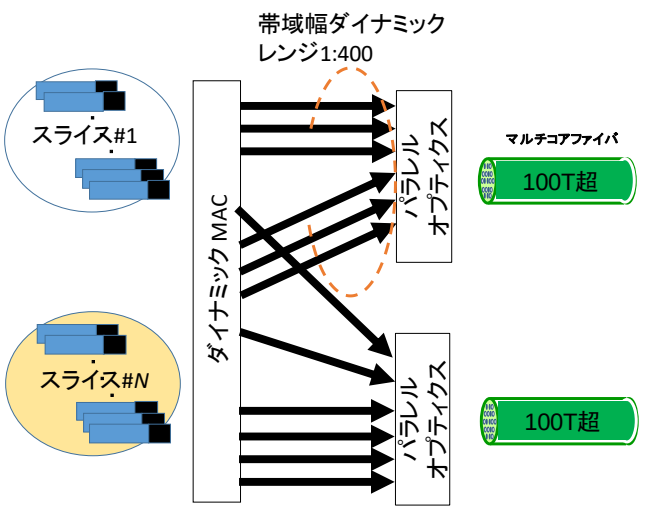
並列度1000倍と転送帯域伸縮度100倍をサポートするMAC



②A：スライス収容の高度化、運用容易化



②B：階層化光クロスコネクト



②C並列化・伸縮化を可能とする動的帯域割当