

All-Photonics Network (APN) Common Infrastructure Technology

- ◆ Project: All-Photonics Network Common Infrastructure Technology
 - ~ Control Technologies and Equipment Configuration Technologies for Interconnection of All-Photonics Networks among Multiple Operators ~
- ◆ Project members: NTT, KDDI, Fujitsu, NEC, Rakuten Mobile
- ◆ Project duration: From December 2024 for up to 5 years.

Project overview

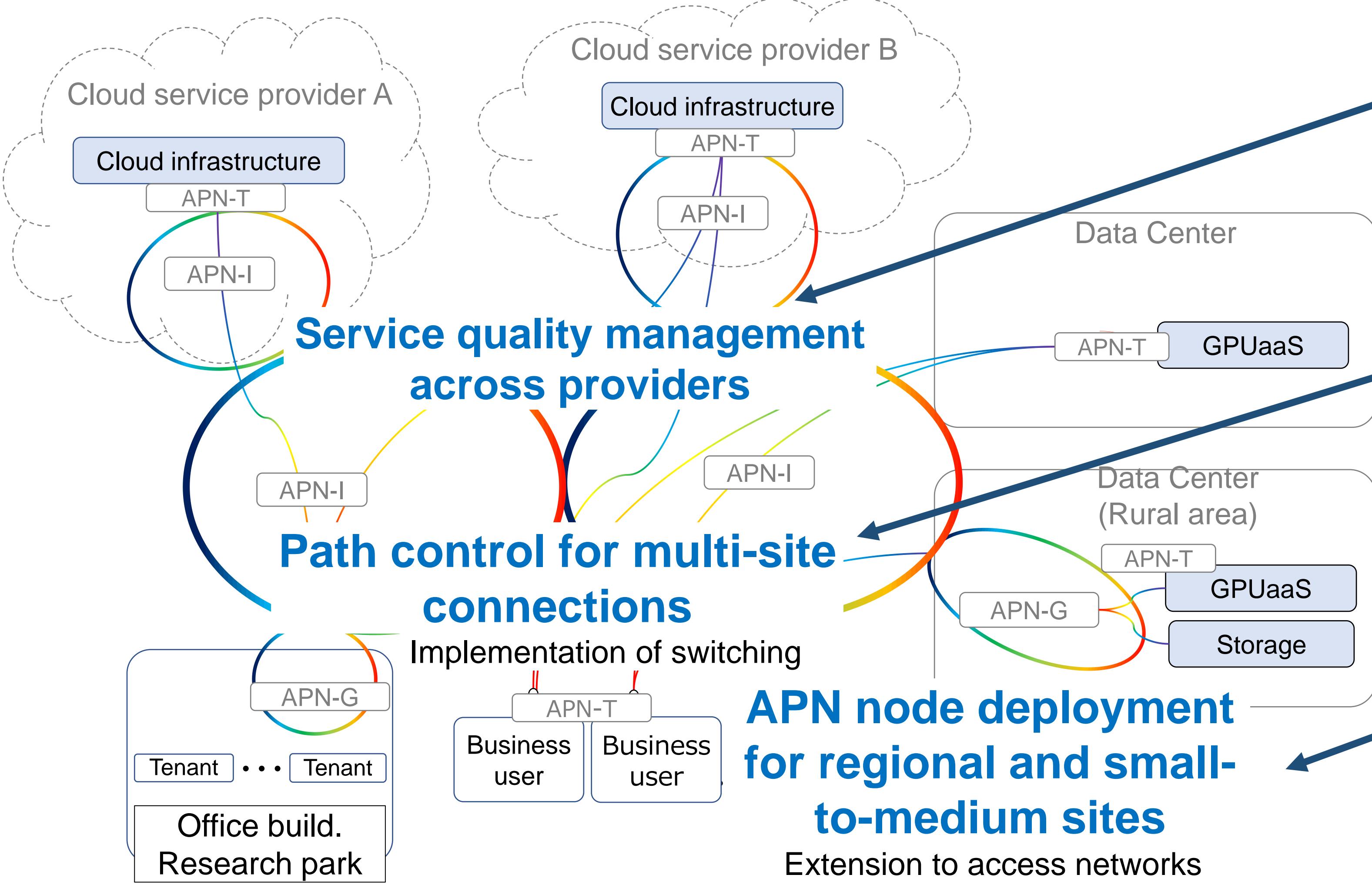
This research result was obtained from the commissioned research No. JPJ012368C09001 by NICT, Japan.

■ R&D Item 1. Formulation of the Overall Architecture for All-Photonics Networks

Develop an overall architecture for network interconnection spanning multiple operators.

Establish a comprehensive architecture that defines the required functions for all-photonics networks and optimal equipment configurations.

■ R&D Item 2. All-Photonics Network Common Infrastructure



(a) Photonic Network Federation

Enable cooperation among multiple operators' APNs to ensure fault tolerance and service quality.

→ Realize an APN network that traverses multiple operators.

(b) Subchannel Circuit eXchange

Achieve communication according to user demands through logical circuit multiplexing layers over optical paths.

→ Enable simultaneous use and flexible switching among multiple user clouds and data centers.

(c) Distributed ROADM

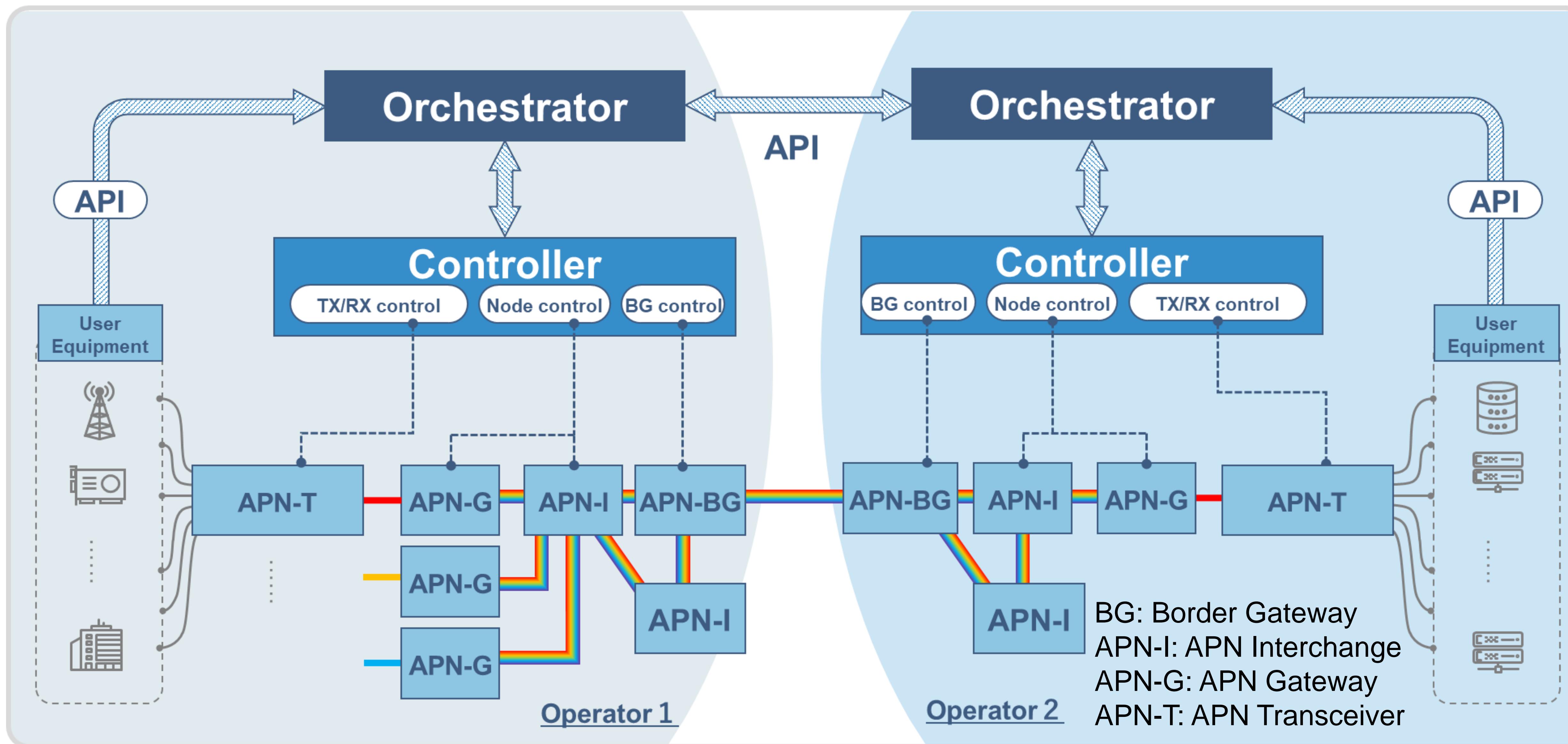
Develop APN nodes deployable to regional data centers and small- to medium-sized sites by applying high-density implementation and low power consumption technologies.

→ Expand APN user base by reducing equipment footprint.

Photonic Network Federation Technology

→ Technology for interworking and interconnection across multiple APNs

Architecture overview



- Ensures reliable and stable interconnection among diverse APNs.
- Enables cross-operator collaboration for fast communication failure recovery.
- Supports both all-optical and L1–L3 O/E/O connections between different APN domains.

Part of the research and development outcomes was incorporated into an IOWN GF document and published as the ***Functional Architecture for Multi-domain IOWN Networking*** in March 2025.

Please refer to the separate poster for an overview of the Multi-domain IOWN networking document.

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Overview of Multi-domain IOWN Networking

◆ Background and Purpose:

- Open All-Photonics Network (APN) provides high-quality and energy-efficient optical networking
- Multi-domain IOWN Networking interconnects APNs operated by multiple organizations (carriers, data centers, campuses, etc.) to build a wider, flexible, and reliable network.
- Key challenges:
 - Exchange information for path design and fault recovery while keeping infrastructure details confidential
 - Monitoring optical signal quality and blocking unauthorized signals

◆ Key Features and Scenarios:

- On-demand Path Provisioning: Dynamically design and set up optical paths across domains
- Automated Fault Recovery: Detect failures and switch to redundant paths automatically
- Example scenarios: Carrier-to-carrier, data center–carrier–campus, multi-carrier backup

High-level Architecture

Source: Functional Architecture for Multi-domain IOWN Networking

Multi-domain Orchestrator
Design and management for network domain

APN/BG Controller
Design and management for network equipment

BG: Border Gateway

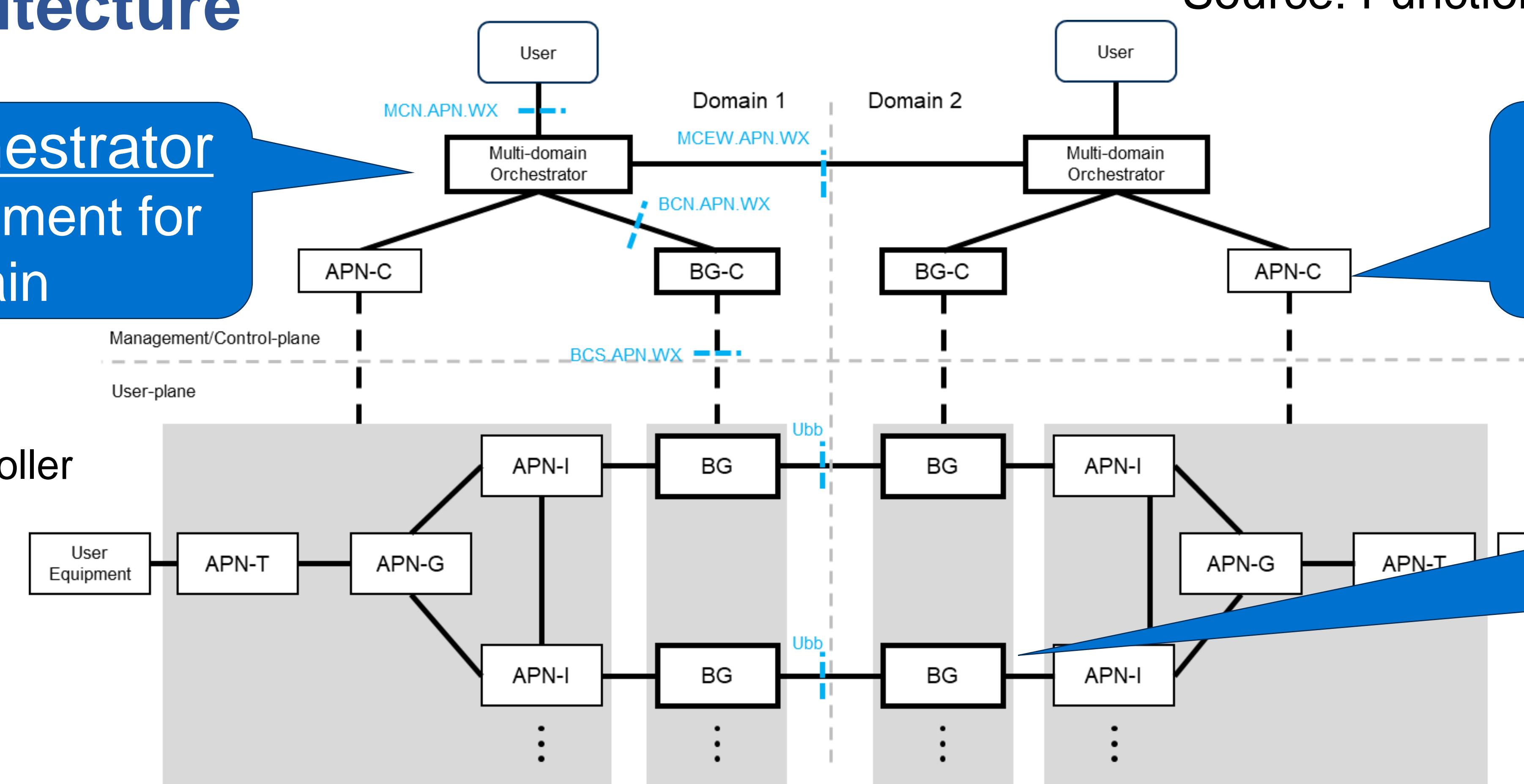
BG-C: Border Gateway Controller

APN-I: APN Interchange

APN-G: APN Gateway

APN-T: APN Transceiver

APN-C: APN Controller



Border Gateway

- Interconnection options
 - All-optical connection
 - OEO connection

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