



PoC Reference of Multi-domain IOWN Networking

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1. Introduction

1.1. Purpose

The rapid expansion of Artificial Intelligence (AI) is accelerating the demand for data centers as AI infrastructure. Since data centers require huge construction sites and power supplies, it is expected that data centers will be geographically distributed for sustainable infrastructure. This trend drives the growing traffic of AI training and inference between data centers, which requires high-speed and low-latency connectivity across geographically distributed locations. Open All-Photonic Network (APN) provides such high-performance connectivity services that go far beyond the capabilities of today's network infrastructure [1]. However, the service coverage of a single Open APN operator is inherently limited; as a result, providing optical connectivity services across geographically distributed sites requires coordination and interconnection among multiple operators. Multi-domain IOWN Networking aims to realize such interconnection of multiple Open APN domains operated by different organizations [2]. The purpose of this PoC is to establish the technical and operational basis for multi-domain interoperability to support the emerging demand of geographically distributed AI infrastructure.

1.2. Objectives

The multi-domain interoperability should be developed step-by-step due to the limitation of open/standardized interfaces currently available in the market. The roadmap of the multi-domain interoperability test is shown in Table 1. This table presents the expected step-by-step approach for reaching the final goal (Step 3), including the Feature, Management and Control plane (M/C-plane) Interface, User plane (U-plane) Interface, and Equipment Implementing BG for each step in the roadmap. The objective of this PoC is to achieve the multi-domain interoperability in on-demand path provisioning according to the features and interfaces described in Step 0 and Step 1. Furthermore, this PoC aims to evaluate inter-domain interfaces and APIs based on Table 1 in order to identify gaps and requirements for future standardization activities.

Table 1: Roadmap of Multi-domain Interoperability Test

	Step 0 (OEO)	Step 1 (OOO)	Step 2 (OOO)	Step 3 (OOO)
Feature	<ul style="list-style-type: none"> On-demand Path Provisioning 	<ul style="list-style-type: none"> On-demand Path Provisioning 	<ul style="list-style-type: none"> On-demand Path Provisioning Automated Fault Recovery 	<ul style="list-style-type: none"> On-demand Path Provisioning Automated Fault Recovery
M/C-plane Interface	<ul style="list-style-type: none"> MCEW.APN.WX[2]: Non-standardized interface BCN.APN.WX[2]: T-API BCS.APN.WX[2]: No specific limitation 	<ul style="list-style-type: none"> MCEW.APN.WX: Non-standardized interface BCN.APN.WX: T-API BCS.APN.WX: OpenROADM 	<ul style="list-style-type: none"> MCEW.APN.WX: Non-standardized interface BCN.APN.WX: T-API BCS.APN.WX: OpenROADM 	<ul style="list-style-type: none"> MCEW.APN.WX: Standardized interface BCN.APN.WX: T-API BCS.APN.WX: OpenROADM
U-plane Interface	<ul style="list-style-type: none"> U_{bb}[2]: No specific limitation 	<ul style="list-style-type: none"> U_{bb}: OpenROADM <ul style="list-style-type: none"> 100G, 200G, or 400G 	<ul style="list-style-type: none"> U_{bb}: OpenROADM <ul style="list-style-type: none"> 100G, 200G, 400G, or 800G 	<ul style="list-style-type: none"> U_{bb}: OpenROADM <ul style="list-style-type: none"> 100G, 200G, 400G, or 800G
Equipment Implementing BG	<ul style="list-style-type: none"> Switch, Router Multi-vendor 	<ul style="list-style-type: none"> APN-G, APN-I (OpenROADM-compliant) Single-vendor or Multi-vendor 	<ul style="list-style-type: none"> APN-G, APN-I (OpenROADM-compliant) Single-vendor or Multi-vendor 	<ul style="list-style-type: none"> APN-G, APN-I (OpenROADM-compliant) Multi-vendor

1.3. Scope

The scope of this PoC includes:

- Verification of the basic functions of the Multi-domain Orchestrators, Border Gateway Controllers (BG-Cs), and Border Gateways (BGs) defined in [2] for on-demand path provisioning including:
 - Exchange of necessary optical parameters between Multi-domain Orchestrators for path design

- Deploy optical paths across domains by the coordination of Multi-domain Orchestrators and BG-Cs via API
- Verification of interoperability for the M/C-plane and U-plane interfaces for on-demand path provisioning

To ensure a focused PoC, the following items are considered out of scope:

- Interoperability testing between APN-T equipment from different vendors
- Verification of the functions for fully automated fault recovery.

2. Reference Cases

This section describes the scenarios to be evaluated by PoCs. The PoC environment should contain at least two domains operated by different organizations as is shown in the following figures (Operator 1, Operator 2). In these figures, Operator 1 uses Vendor A devices while Operator 2 is using Vendor B ones. However, vendor selection of each operator is not limited to one depicted in the figures. One option is the case where Operator 1 implements multiple vendors' equipment, and another option is the case where Operator 1 and Operator 2 adopt the same vendor.

2.1. OEO Interconnection

In this scenario, a BG of each domain is interconnected to a BG of another domain with electrical conversion: Optical–Electrical–Optical (OEO) interconnection. Optical signals are converted at one of the three layers, OTN (BG Type E1), Ethernet (BG Type E2), or IP (BG Type E3) defined in [2]. Figure 1 presents the example topology of this case.

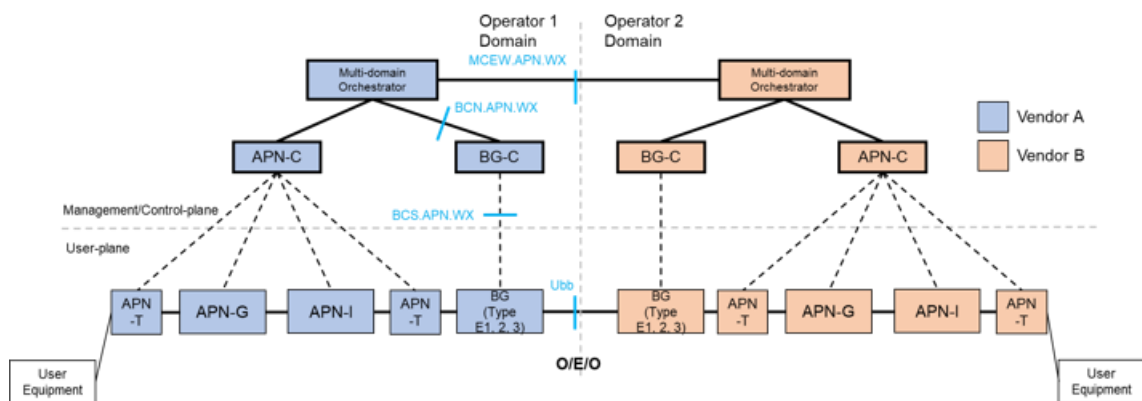


Figure 1: Example OEO Topology

- Minimum number of devices in one domain
 - Multi-domain Orchestrator: 1
 - BG-C: 1
 - This can be implemented in the same physical device with APN-C.
 - BG (Type E1/E2/E3): 1
 - One of these three Types should be used in both domains.
 - APN-C: 1
 - APN-T: 2

2.2. OOO Basic Interconnection

This scenario involves all-optical interconnection using BGs (BG Type O) with basic functionalities defined in [2]. Optical paths are established between an end-point in one domain and an end-point in another domain without electrical conversion: Optical–Optical–Optical (OOO) interconnection. Figure 2 shows the example topology of this case.

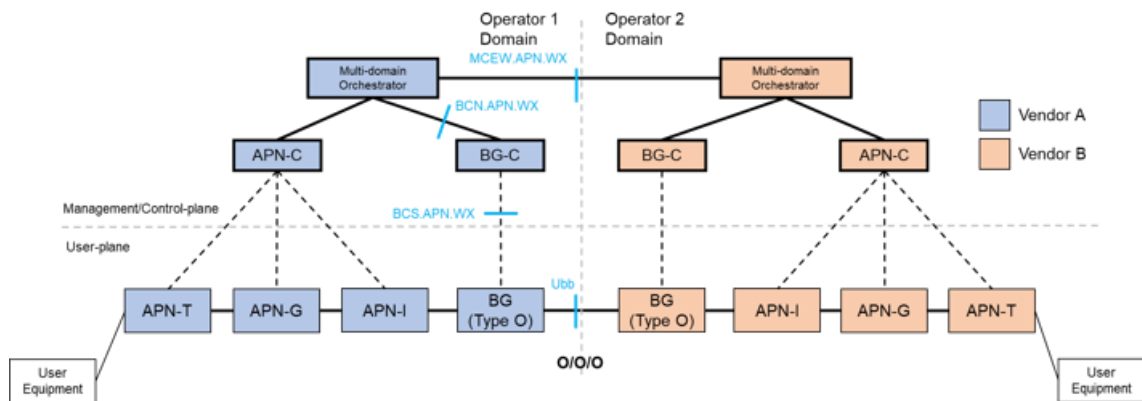


Figure 2: Example Basic OOO Topology

- Minimum number of devices in one domain
 - Multi-domain Orchestrator: 1
 - BG-C: 1
 - BG (Type O): 1
 - APN-C: 1
 - APN-T: 1

2.3. OOO Interconnection with Spectrum Monitoring

This reference case extends the OOO basic interconnection by equipping the BGs with Spectrum Monitoring (SM). SM provides per-slot measurement of receive and transmit power and channel occupancy at the inter-domain boundary: BG. It checks compliance with configured Power Spectral Density (PSD) and total-power envelopes and reports deviations to BG-C as events. When combined with Amplified Spontaneous Emission (ASE) noise placeholders, SM helps keep the boundary in a full-load condition during activations, deactivations, and faults. This improves fault isolation and recovery and supports stable C+L band coexistence at the inter-domain boundary. Figure 3 shows an example topology in which each domain provides one OOO path between APN-I nodes via BGs that include SM functions.

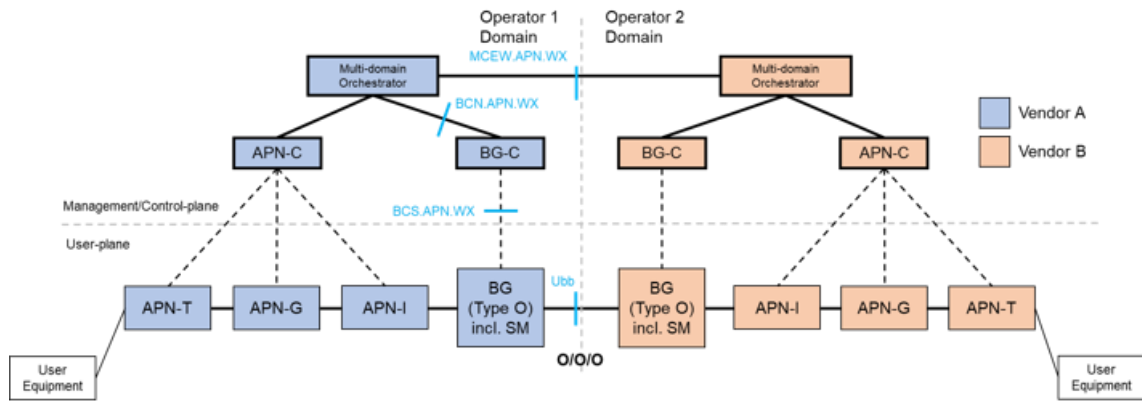


Figure 3: Example OOO with SM Topology

The minimum setup for this reference case uses the same device set as the OOO basic interconnection, with the additional requirement that the BG is Type O with SM capability:

- Multi-domain Orchestrator: 1
- BG-C: 1
- BG (Type O including SM): 1
- APN-C: 1
- APN-T: 1

This reference case is required to realize end-to-end OOO interconnection between two independently operated Open APN domains using BGs of Type O that include SM. A Multi-domain Orchestrator coordinates with each domain's APN-C and BG-C in the M/C-plane, while the U-plane remains strictly optical without OEO conversion. SM at the BG boundary provides per-slot and per-channel visibility and enforcement of spectrum-use policies. Optionally, ASE placeholders may be inserted at the boundary over the configured band or channel range associated with a reserved spectrum portion in order to maintain power balance during service activation, de-activation, and fault conditions. This reference case inherits the general multi-domain properties, such as end-to-end OOO connectivity and operator autonomy, from the OOO basic case.

2.4. OOO Interconnection with Wavelength Conversion

This scenario extends the OOO basic interconnection by explicitly introducing Wavelength Conversion (WC) functionality in the BGs. Note that WC is an optional function of BGs as defined in [2]. As described in [1], there are several technology options for WC, which includes inter-band WC and intra-band WC. Also note that there is no limitation for implementing WC in this PoC, mainly depending on assumed use cases and/or expected benefits. Such WC allows flexible allocation of wavelength bands/channels across domains considering available resources, improving interoperability in heterogeneous environments. Figure 4 shows the example topology where BGs support WC.

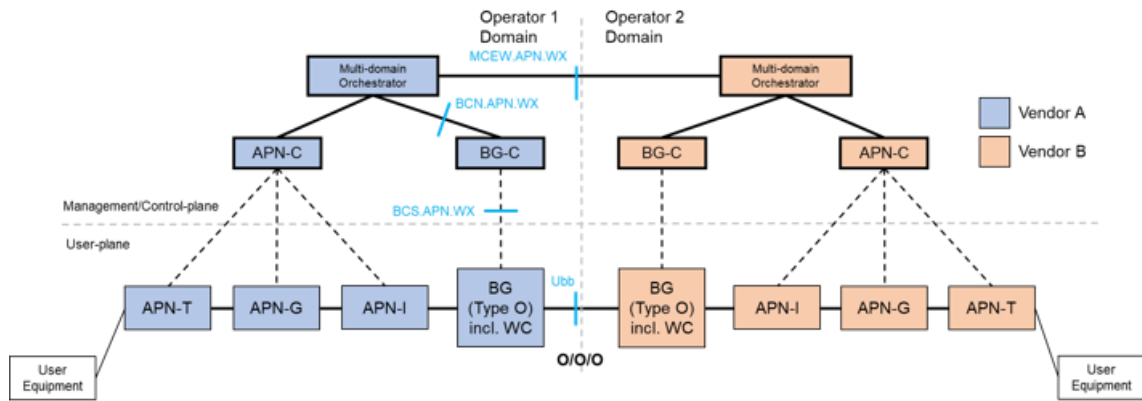


Figure 4: Example OOO with WC Topology

Just as Section 2.2 and Section 2.3, the minimum setup per domain for this reference case is as follows:

- Multi-domain Orchestrator: 1
- BG-C: 1
- BG (Type O with WC): 1
- APN-C: 1
- APN-T: 1

3. Desired Features

Three desired features are described in this section. Feature 1 is a mandatory feature to be tested since this feature is a fundamental one for realizing multi-domain interoperability. Features 2 and 3 are optional features that can be added on Feature 1 as advanced technology.

3.1. Feature 1: On-demand Path Provisioning

This feature will verify that inter-domain connectivity can be established on demand based on a user request. The following sub-features are expected to be tested.

- Interfaces
 - The Multi-domain Orchestrator should have a generic open and/or standardized east/westbound interface (MCEW.APN.WX) which coordinates with a Multi-domain Orchestrator in a different domain to set up a part of the requested connectivity service.
 - The BG-C should have a generic open and/or standardized northbound interface (BCN.APN.WX) which sends control requests for configuring BG devices.
- Functions of Multi-domain Orchestrator
 - The Multi-domain Orchestrator should have a network design function that provides a recommended domain-level network design based on the user request.
 - The Multi-domain Orchestrator should have a network control function that sends path provisioning requests to both own domain and other domains.
- Functions of BG-C
 - The BG-C should have a network control function that sends a device-level configuration request for path provisioning in own domain.
- Functions of BG
 - The BG (Type E1/E2/E3) should forward frames/packets across domains and drop unadmitted frames/packets according to policy.
 - The BG (Type O) should forward optical signals across domains and block abnormal signals. When the measured signals at the inter-domain boundary deviate from the agreed envelope, the BG blocks or attenuates abnormal signals.
 - The BG (Type O) should measure incoming and outgoing optical signals from and to neighbor BG.
 - The BG (Type E1/E2/E3/O) should support configuration via the BG-C and report required status, alarms, and performance metrics.

3.2. Feature 2: Spectrum Monitoring

This feature will verify that boundary spectrum telemetry is measured, exchanged, and enforced at inter-domain interfaces, and that optional ASE placeholders can be used to maintain full-load optical conditions during adds, drops, and faults. In addition to the basic on-demand OOO path provisioning defined in Feature 1, the PoC for testing this feature must successfully demonstrate the following mandatory sub-features related to SM, and should demonstrate the optional sub-features when the corresponding functions are used.

- **Mandatory SM Sub-features**
 - **SM-1: Boundary SM Telemetry**
BGs provide per-slot and per-channel measurements of Rx/Tx power and occupancy (live channel, ASE placeholder, empty) on the inter-domain ports and export this information to the M/C-plane.
 - **SM-2: Transient Handling and Lifecycle Visibility**
Controllers manage service adds and drops with controlled (non-hitless) transients and use SM events to report service lifecycle states (for example, IN-PROGRESS, COMPLETED, FAILED) for end-to-end visibility.
- **Optional SM Sub-features**
 - **SM-3: ASE Placeholder Behavior**
When ASE placeholders are used, BGs automatically insert and remove ASE at the boundary during activation, de-activation, loss-of-signal or low-power conditions, and recovery. ASE coverage (for example, C band, L band, or C+L band) is configured per PoC and may apply to the full reserved spectrum or to a subset of channels.
 - **SM-4: C+L Band Coexistence**
When both C band and L band are used, SM confirms C+L band coexistence and boundary compliance during L-band introduction and subsequent channel evolution.
- All SM functions should preserve the operator autonomy defined in [2]. Only boundary telemetry and summarized state are exchanged between domains; internal topology remains hidden.
- **Interfaces of the Multi-domain Orchestrator**
The Multi-domain Orchestrator should:
 - Support a generic open and/or standardized east/westbound interface (MCEW.APN.WX) to exchange boundary state summaries and SM events with a peer orchestrator in another domain.
 - Support a generic open and/or standardized northbound interface to BG-C (BCN.APN.WX) to subscribe to SM telemetry and events and to convey policy parameters such as PSD and total-power envelopes associated with a requested service.

- Map boundary SM events and quality indicators to service lifecycle states for unified monitoring and reporting across domains.
- Interfaces and Functions of BG-C
BG-C should:
 - Expose configuration objects for the boundary power envelope (PSD and total power), allowed bands (C and/or L), and channel plan, and provide access to per-slot and per-channel power and occupancy reported by BGs.
 - Publish summarized boundary state (for example, channel, ASE, empty) northbound and raise alarms or notifications on policy deviations.
 - Support a common schema for SM telemetry and events so that items such as timestamp, interface identifier, spectral slot, measured Rx/Tx power, occupancy state, envelope identifier, quality metrics, and event severity are reported in a consistent format across PoCs. Threshold values and reporting intervals may be configured per PoC but should use this common schema.
- Functions of APN-C
APN-C should:
 - Consume boundary SM information to coordinate intra-domain adds, drops, and recovery actions, while keeping internal topology hidden from other domains.
 - Use the common telemetry and event schema to correlate boundary SM events with intra-domain operations and to support unified monitoring at the service level.
- Functions of BG (Type O with SM)
A BG of Type O with SM should:
 - Measure per-slot and per-channel Rx/Tx power on inter-domain ports in the configured band or bands (C, L, or C+L) and build a boundary occupancy map indicating live channels, ASE placeholders, and empty slots.
 - Evaluate received spectrum against the configured PSD and total-power envelopes and generate events and, if domain policy requires, block or attenuate abnormal signals.
 - Support automatic ASE insertion and removal at the boundary during activation, deactivation, loss-of-signal or low-power conditions, and recovery, and report these actions to BG-C and APN-C.
 - Confirm C+L band coexistence and boundary compliance when both bands are used, while preserving operator autonomy and privacy by exporting only boundary telemetry.

3.3. Feature 3: Wavelength Conversion

This feature will verify that wavelength(s) allocated to optical signal(s) can be changed to the desired one(s) when providing inter-domain connectivity. The following sub-features are expected to be tested.

- Interfaces and Functions of the Multi-domain Orchestrator
 - The Multi-domain Orchestrator should have a generic open and/or standardized east/westbound interface (MCEW.APN.WX) which coordinates with a Multi-domain Orchestrator in a different domain to set up a part of the requested connectivity service, in which WC functionality is utilized.
 - The Multi-domain Orchestrator should have a network design function that explicitly considers WC at the domain boundaries. Such a network design is executed based on the user request and operation policy of each organization.
- Interfaces and Functions of BG-C
 - BG-C should have a generic open and/or standardized southbound interface (BCS.APN.WX) which sends control requests for configuring BG (Type O with WC).
 - BG-C should have a WC control function that sends a WC configuration request to BGs in its own domain. Such a request may include information on input/output wavelength(s) and optical power.
- Functions of BG (Type O with WC)
 - The BG should convert (i.e., change) input wavelength(s) to the desired one(s) and forward optical signals across domains.
 - The BG should support WC configuration via the BG-C (e.g., relationship between input and output wavelength(s), output power).
 - The BG should report WC-related status, alarms, and monitored performance to BG-C.

4. Key Benchmarks

This section describes key benchmarks to be measured. Benchmark 1, 2, 3 map to Feature 1, 2, 3 respectively. According to the mandatory/optional description in Section 3, Benchmark 1 is mandatory, while Benchmark 2 and 3 are optional to be measured.

4.1. Benchmark 1: Provisioning Time

This benchmark maps to Feature 1 (On-demand Path Provisioning).

- Measure the time required for provisioning the requested optical path, i.e., between the time an orchestrator receives a path request and the time the requested path is deployed across domains.
- In addition, it is recommended to measure the breakdown of time required for each process per component (the orchestrator, controller, and transmission devices).
- Measurement method can be a timestamp recorded in the orchestrator and controller.
- The PoC report should describe both measured time and its measurement methods.

4.2. Benchmark 2: Spectrum Monitoring Telemetry and Policy Compliance

This benchmark maps to Feature 2 (Spectrum Monitoring) and is primarily applied to Reference Case 2.3 (OOO Interconnection with Spectrum Monitoring).

Measure and report the following items to validate that boundary SM is measured, exchanged, and enforced at the inter-domain interface, and that (when used) ASE placeholders support stable boundary operation during service adds/drops and fault conditions:

Benchmark 2.1: Telemetry Performance

- Granularity and coverage: Spectral granularity of reported data (per-slot vs per-channel, including slot width/channel grid used in the PoC) and monitored spectrum coverage (C, L, or C+L; full reserved spectrum vs subset).
- Reported fields: Per slot/channel fields reported (at minimum: timestamp, interface identifier, spectral slot/channel identifier, Rx power, Tx power, occupancy state such as live/ASE/empty; plus any quality indicators used in the PoC).
- Update interval and data volume: Reporting interval for SM telemetry and SM events (if different), and approximate telemetry volume (number of reported slots/channels, message frequency, estimated data size per report) to assess operational feasibility.
- End-to-end reporting latency: Time from measurement at the BG (or boundary measurement point) to availability at the BG-C (northbound visibility) and at the Multi-domain Orchestrator

(east/westbound summary exchange and/or northbound service visibility), ideally with a breakdown (BG → BG-C/APN-C → Orchestrator) when logs allow it.

Benchmark 2.2: Policy Compliance and Deviation Detection

- Compliance of received spectrum against the configured PSD envelope and total-power envelope at the BG
- Detection time for deviations (time from deviation occurrence to event/notification raised at the BG-C and/or orchestrator)
- Description of deviation types validated (e.g., over-PSD, over total power, unexpected occupancy, out-of-band power)

Benchmark 2.3: (If applicable) Enforcement / Mitigation Responsiveness

- If the PoC implements blocking/attenuation or other enforcement actions at the boundary, measure:
 - Time from deviation detection to enforcement action
 - Resulting residual deviation (before/after)

Benchmark 2.4: (If applicable) ASE Placeholder Behavior and Stability

When ASE placeholders are used, measure:

- ASE insertion time and removal time under key lifecycle events (service activation, de-activation, loss-of-signal or low-power, recovery)
- Boundary power stability during transients (e.g., maximum total power excursion and duration; any PSD excursions) when adding/dropping services with ASE enabled

Benchmark 2.5: (If applicable) C+L Coexistence Validation

When both bands are used, measure:

- Ability to correctly report band occupancy and per-band compliance (C vs L)
- Any additional events/observations during L-band introduction and subsequent channel evolution

Measurement Method/Report

- Use timestamps recorded in BG/BG-C/APN-C/Multi-domain Orchestrator logs and event logs.
- When available, correlate with an independent reference (e.g., external spectrum measurement) to confirm correctness of occupancy and power reporting.
- The PoC report should describe both the measured values and the measurement method/configuration/framework (reporting interval, thresholds, envelopes, monitored band(s), channel plan, and APIs used in the PoC).

4.3. Benchmark 3: Wavelength Conversion Performance

This benchmark maps to Feature 3 (Wavelength Conversion) and is primarily applied to Reference Case 2.4 (OOO Interconnection with Wavelength Conversion).

Measure and report the following items to validate that wavelength conversion is operable at a domain boundary in the context of BG. The PoC report should describe measurement results as well as measurement methods.

Benchmark 3.1: Wavelength Conversion Capability

- Measure the wavelength of input/output to/from the BG (or wavelength converter itself) for verifying its conversion operation.
- Measurement method can be a tester (i.e., an optical spectrum analyzer), where optical power splitters are properly used.
- The PoC report should include measured center wavelength of input and output signal. Captured waveform data may also be included. In addition, it is recommended to confirm conversion accuracy, i.e., the difference in center wavelength (or frequency) between the setting value and measured one. It is also recommended to describe reasons if waveform distortions are observed.
- Note that it is recommended to report attributes of optical signal tested (such as modulation format and Baud rate).

Benchmark 3.2: Transmission Performance

- Measure the signal quality of optical path across multiple domains for verifying physical-layer feasibility of wavelength conversion in the BG context. In particular, signal quality should be compared between the case where wavelength conversion is applied and not applied.
- Performance metric can be bit error rate, Q-factor, or (optical) signal-to-noise ratio.
- Measurement method can be a monitoring function of APN-T or a signal analyzer.
- Note that it is recommended to report attributes of optical signal tested (such as modulation format and Baud rate).

Benchmark 3.3: (if applicable) Latency

- Measure the latency experienced by client data signal over inter-domain optical path for verifying the impact of wavelength conversion on inter-domain data communications. In particular, end-to-end latency should be compared between the case where wavelength conversion is applied and not applied.
- Measurement method can be a tester such as traffic generator connected to APN-T.

Benchmark 3.4: (if applicable) Jitter

- Measure the jitter experienced by client data signal over inter-domain optical path for verifying the impact of wavelength conversion on inter-domain data communications. In particular, end-to-end jitter should be compared between the case where wavelength conversion is applied and not applied.
- Measurement method can be a tester such as traffic generator connected to APN-T.

5. Considerations for Commercialization

5.1. Interoperability Test Configurations

For proving the commercial operability, this PoC validates the interoperability across a wide range of test configurations, covering as many practical combinations as feasible:

- Vendor Combination: For example, APN-BGs from N product suppliers are used in the PoC, it is recommended to test all the combinations out of N products.
- Span Loss or Distance of the OOO Interconnection Cable: e.g., <2km, 30km
- Channel Allocations: (a) Uniform 100GHz x 48, (b) Mixed 100GHz x 24 + 300GHz x 8 (where 300GHz channel carries 4x75GHz signals)
- Transceiver Mix: (a) Uniform all Digital Coherent Optics (DCO) (b) Mix of DCO and Intensity Modulation and Direct Detection (IMDD) (half and half)

5.2. Recommendations for API Standardization

One objective of this PoC is to identify the items to be standardized for future activity (e.g., API standardization in related standards developing organizations). Therefore, the following information is recommended to be described in the PoC report.

- APIs used for MCEW.APN.WX, BCN.APN.WX, and BCS.APN.WX
- Additional/modified parameters in these APIs should be explained if they are customized in the PoC
- API requirement list (e.g., necessary information, abstraction level) for these APIs
- Implementation models of BG and orchestrator/controller

Annexes

A. Supplementary Information on Spectrum Monitoring

Spectrum sharing is an advanced optical networking technology that enables multiple network operators or service domains to efficiently utilize the same physical fiber infrastructure simultaneously. By employing sophisticated spectrum monitoring, allocation, and management techniques, spectrum sharing dynamically optimizes spectral resources, maximizing utilization and flexibility. This approach addresses key challenges in fiber-optic networks, such as finite spectral resources and escalating demand for bandwidth, significantly reducing the need for costly new fiber installations. Through spectrum sharing, operators can deliver improved network efficiency, flexibility, and cost-effectiveness, essential for meeting evolving market conditions and growing bandwidth demands. ASE loading complements this by maintaining consistent optical power levels across the entire available spectrum, injecting controlled ASE noise into unused spectral regions. This approach creates stable and predictable network conditions from initial deployment, simplifies power management, mitigates adverse effects such as Stimulated Raman Scattering (SRS) and signal-to-noise ratio variations, and enhances precise boundary management between multiple operational domains. When combined, spectrum sharing and ASE loading deliver powerful synergies that enhance network performance, operational agility, and overall effectiveness. These technologies ensure seamless cross-domain coordination, rapid fault restoration, predictable system behaviors, and simplified link management. Together, they allow operators to build scalable, cost-effective, and resilient optical networks, fully optimized from day one and adaptable to evolving service demands and market dynamics. The SM function is designed to enable precise, real-time monitoring and management of optical spectrum resources within APNs. Its primary purpose is to ensure efficient, dynamic allocation and optimal usage of spectral capacity, especially in complex multi-domain and multi-vendor environments. By continuously tracking spectrum utilization and performance across network boundaries, the SM helps operators proactively manage spectrum availability, resolve conflicts, enhance interoperability, and maximize overall network efficiency. This capability is critical to effectively deploy spectrum-sharing technologies, simplify operational processes, and minimize service disruptions, ultimately ensuring high-quality network performance and facilitating seamless capacity expansion.

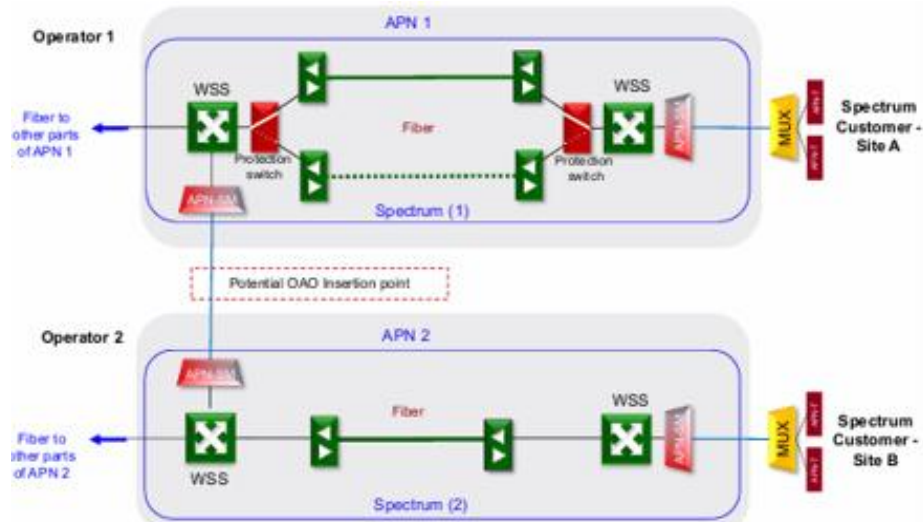


Figure 5: Multi-domain Shared Spectrum Enabling Multi-segment

B. Example Implementation Model

This annex describes example implementation models for Multi-domain IOWN Networking. These models are provided as an example to be described in the PoC report and do not restrict actual PoC implementations. Two representative models are described: the Separated model and the Converged model.

B.1. Separated Model

Figure 6 shows an example implementation of the Separated model in which the APN-C and the BG-C are deployed as separate physical components. In each domain, a Multi-domain Orchestrator, APN-C, and BG-C are independently deployed. APN-C controls APN-related components (APN-T, APN-G, APN-I), while BG-C controls BGs. This model enables clear functional separation and flexible deployment, and is suitable for PoC scenarios that require coexistence with existing systems or gradual introduction of multi-domain functions.

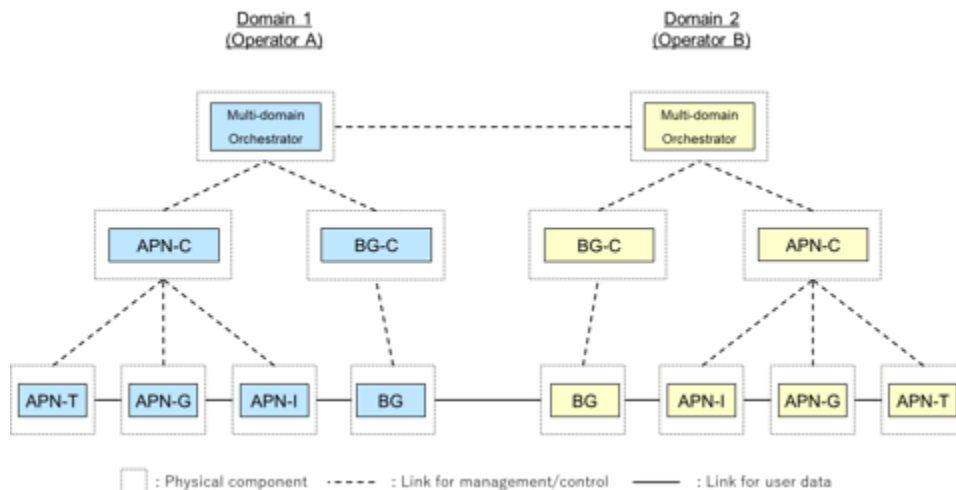


Figure 6: Separated Implementation Model

B.2. Converged Model

Figure 7 shows an example implementation of the Converged model in which APN-C and BG-C functions are integrated into a single physical controller. In this model, the converged controller provides unified control and management of APN components and BGs within a domain. The Converged model is suitable for PoC scenarios that evaluate simplified architectures and tighter coordination between APN and BG control.

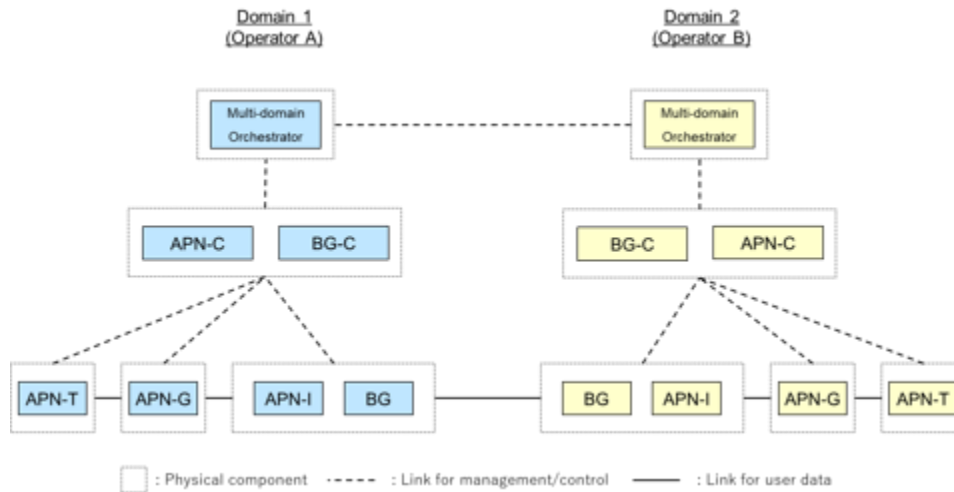


Figure 7: Converged Implementation Model

References

Reference	Description
[1]	Open All-Photonic Network Functional Architecture Version 3.0
[2]	Functional Architecture for Multi-domain IOWN Networking Version 1.0

Abbreviations and acronyms

AI	Artificial Intelligence
APN	All-Photonic Network
ASE	Amplified Spontaneous Emission
BG	Border Gateway
BG-C	Border Gateway Controller
DCO	Digital Coherent Optics
IMDD	Intensity Modulation and Direct Detection
M/C-plane	Management and Control plane
OEO	Optical–Electrical–Optical
OOO	Optical–Optical–Optical
PSD	Power Spectral Density
SM	Spectrum Monitoring
SRS	Stimulated Raman Scattering
U-plane	User plane
WC	Wavelength Conversion

History

Revision	Release Date	Summary of Changes
1	May 2026	Initial Release