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TECHNICAL SPECIFICATION

SDN SBI Wireless Transport Profiles for Network Automation

Reference

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Keywords

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

Modal verbs terminology

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Executive summary

The aim of the present document is to provide a set of standardized, vendor-neutral attributes that can be uniformly interpreted across different implementations for network automation in the wireless transport domain. The present document defines a standard, common, and interoperable hardware inventory profile for microwave wireless backhaul within SDN-based transport networks. It specifies how microwave Network Elements shall represent and expose hardware inventory information using YANG data models, aligned with relevant IETF specifications, and exchanged via NETCONF between SDN Controllers and microwave equipment. Service-layer, performance, and control-plane aspects are referenced where necessary to support accurate and interoperable inventory representation.

The modelling approach profiles and uses IETF YANG modules, specifying the implementation guidelines to reflect real-world microwave configurations and operational deployment scenarios. The inventory framework covers simple 1+0 topologies, protected and capacity-oriented 1+1 and 2+0 solutions, heterogeneous multi-band combinations (microwave + E-band), XPIC-based architectures, and advanced multi-carrier or band and carrier aggregation configurations. It also accounts for practical variations in Indoor Unit (IDU) and Outdoor Unit (ODU) design, such as modular vs fixed IDUs, Ethernet vs IF-based ODU connectivity, and single vs dual RF ODUs, etc.

Validation activities associated with the present document are integrated into the ETSI SDN Plugtests Programme. Participating vendors implement the -YANG model profiles on their Network Elements and expose inventory information toward a multi-vendor SDN Controller for functional and interoperability testing. Plugtests-based feedback ensures model accuracy, consistency, and practical applicability in real deployment environments.

Strategically, the present document establishes a foundational inventory layer required for open, programmable, and disaggregated SDN transport architectures, in alignment with the framework defined in ETSI GR mWT 025 [i.2]. By eliminating proprietary dependencies at the Southbound Interface and enabling standardized, structured inventory data, the work in the present document supports large-scale automation, zero-touch provisioning, digital twin construction, and AI-assisted network operation. The resulting standardized inventory framework provides long-term benefits across operators, vendors, integrators, and the wider research and standardization community by reducing integration complexity, enhancing interoperability, and supporting future innovation in automation and autonomous networking.

Introduction

Microwave wireless backhaul networks constitute a critical part of modern transport infrastructures. Their integration into open SDN architectures has historically been constrained by the lack of standard, common, and interoperable -models. As a consequence, SDN Controllers have been required to interpret vendor-specific and inconsistent data structures, leading to increased integration effort, reduced automation potential, and limited portability of SDN applications.

The present document addresses this limitation by defining standard, common hardware inventory profiles for the SDN Southbound Interface, expressed through YANG models aligned with relevant IETF specifications. These profiles are tailored to real microwave configurations and operational deployment scenarios. The objective is to ensure that the microwave domain may be represented in a uniform, vendor-neutral, and interoperable manner within open, programmable, multi-vendor SDN transport networks.

1 Scope

The present document specifies the principles, objectives, and technical framework, which addresses the definition of standardized hardware inventory models for microwave wireless backhaul at the SDN Southbound Interface. It focuses on the modelling of hardware inventory information for microwave Network Elements as exchanged between a microwave SDN Controller and microwave Network Elements by means of standard, common YANG data model profiles exposed over NETCONF. Service-layer abstractions, performance management, and control-plane behaviour are present in the present document, when required to support accurate and interoperable hardware inventory representation.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document.

[1] IETF RFC 8348 (March 2018): "A YANG Data Model for Hardware Management".

[2] IETF RFC 8561 (June 2019): "A YANG Data Model for Microwave Radio Link"

[3] IETF RFC 8343 (March 2018): "A YANG Data Model for Interface Management".

[4] IETF RFC 7950 (August 2016): "The YANG 1.1 Data Modeling Language".

[5] IETF RFC 6241 (June 2011): "Network Configuration Protocol (NETCONF)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] ETSI GR mWT 016 (V.1.1.1): "Applications and use cases of Software Defined Networking (SDN) as related to microwave and millimetre wave transmission".

[i.2] ETSI GR mWT 025 (V1.1.1): "Wireless Backhaul Network and Services Automation: SDN SBI YANG models".

[i.3] ETSI CTI 5th mWT SDN Plugtests Report V1.0 (2025-12).

[i.4] ETSI 5th mWT SDN Test Plan V1.0 (2025-12).

[i.5] ETSI GR mWT 025 (V1.1.1): "Wireless Backhaul Network and Services Automation: SDN SBI YANG models".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Band & Carrier Aggregation (BCA): typically referring to aggregating carriers in uniform or non-uniform bands

NOTE: In the present document, it is referring to aggregating Eband with traditional MW band.

Fixed (compact) IDU: IDU represented as a chassis, but with a predefined and fixed set of physical ports without modular containerization

full-outdoor: single, outdoor unit in which the modem, network interfaces, and radio unit are integrated within the same physical hardware

Modular IDU: IDU of modular design and may include one or more containers hosting pluggable functional boards

split-type (or split-mount) architecture: this configuration follows an architecture where the outdoor unit (MW ODU) is physically separated from the Indoor Unit (IDU)

NOTE: There are two principal connectivity variants used in current microwave systems: Ethernet-based IDU-ODU connectivity and IF-based IDU-ODU connectivity.

YANG model profile: standardized, vendor-neutral set of attributes, constraints and modelling guidelines applied to existing IETF YANG modules to ensure interoperable implementation across multiple vendors

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AI	Artificial Intelligence
BCA	Band and Carrier Aggregation
ETH	ETHernet
FW	FirmWare
HW	HardWare
ID	IDentity
IDU	Indoor Unit
IEEE™	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IF	Intermediate Frequency
IP	Internet Protocol
LLDP	Link Layer Discovery Protocol
MODEM	MOdulator/DEModulator
MW	MicroWave
mWT	millimetre-Wave Transmission
NE	Network Element
NETCONF	NETwork CONFiguration protocol
NMS	Network Management System
ODU	OutDoor Unit
PTP	Precision Time Protocol
RF	Radio Frequency
RFC	Request For Comment
RO	Read-Only
RSL	Received Signal Level
RW	Re-Write

SBI	SouthBound Interface
SDN	Software Defined Networking
SFP	Small Form-factor Pluggable
SNMP	Simple Network Management Protocol
SW	SoftWare
XPIC	Cross-Polarization Interference Cancelling
YANG	Yet Another Next Generation

4 Objectives

The objectives of this new Profile are as follows:

- The new Profile shall define a standard, common, and interoperable YANG-based representation of microwave hardware inventory suitable for use in open SDN environments.
- The new Profile shall specify a minimum and sufficient set of inventory parameters required for consistent multi-vendor interpretation of microwave hardware.
- The new Profile shall reuse and profile relevant IETF YANG models and shall extend them where necessary to accurately represent real microwave network configurations.
- The new Profile should provide a controller-consumable representation that enables automated discovery, inventory synchronization, and lifecycle management of microwave Network Elements.
- The new Profile should establish a stable inventory foundation that enables zero-touch provisioning, software-defined networking, and AI-assisted network operation.

5 Alignment with ETSI Standards, IETF Models, and Plugtests Activities

The work specified in the present document is aligned with ETSI GR mWT 016 [i.1] as related to microwave and millimetre wave transmission" and ETSI GR mWT 025 [i.2], which define the SDN applicability framework for wireless transport networks. The present document extends this framework by introducing standard, common YANG-based inventory model profiles required to enable practical and scalable interoperability at the SDN Southbound Interface.

At the data modelling level, the new Profile shall be based on the use of relevant IETF YANG data models, including the hardware, interface, and microwave radio link models defined in IETF RFC 8348 [1], IETF RFC 8561 [2], and IETF RFC 8343 [3]. This use shall ensure alignment with global YANG modelling practices, compatibility with existing SDN controller ecosystems, and long-term sustainability of the resulting models. The reused IETF models shall be adapted and refined through explicit microwave-specific profiling rules to reflect the characteristics of microwave transport hardware and real deployment scenarios.

The activity shall be tightly coupled with the ETSI SDN Plugtests™ Programme. The architectural principles and multi-vendor environments validated across the ETSI mWT SDN Plugtests activities to date have been used as input to the development of the present document. In particular, the methodologies, test scenarios, and multi-vendor configurations documented in the 5th ETSI mWT SDN Plugtests report [i.3] have been used as a concrete validation reference. In addition, the ETSI SDN Plugtests environment shall continue to be used to validate the YANG model profiles defined in the present document in real multi-vendor SDN control scenarios and to refine the models based on implementation feedback.

6 Technical Approach

The technical approach adopted in the present document follows the ETSI mWT SDN architectural framework and is based on the use of standard, YANG data model profiles derived from relevant IETF specifications, specified using YANG version 1.1 as defined in IETF RFC 7950 [4].

The IETF-originated YANG models have been refined and complemented, with microwave-specific usage profiles defined to represent real hardware configurations. The resulting models remain globally aligned with IETF modelling practices while providing operational accuracy for microwave transport equipment.

The YANG model profiles provide a shared, machine-readable, and extensible abstraction of microwave Network Elements and are exposed via an open NETCONF interface between the microwave SDN Controller and the microwave Network Elements according to IETF RFC 6241 [5]. This ensures that inventory information is exchanged in a consistent, non-proprietary, and fully interoperable manner across vendors.

The modelling approach follows a minimum-parameter philosophy. Only those attributes strictly required to achieve interoperability at the Southbound Interface are included, ensuring lightweight and practical implementations while providing a stable foundation for future automation, orchestration, and network intelligence functions.

7 Plugtests Integration and Validation Status

The validation of the standard, YANG-based inventory model profiles derived from IETF specifications was carried out within the ETSI SDN Plugtests Programme. As part of the ETSI 5th mWT SDN Test Plan V1.0 [i.4], participating vendors implemented the YANG model profiles in their microwave Network Elements and exposed inventory information via NETCONF toward a multi-vendor SDN Controller environment.

The Plugtests campaign successfully demonstrated uniform hardware discovery based on common models, consistent inventory interpretation across different vendors, and interoperable SDN Controller behaviour using standardized inventory data. The Plugtests framework therefore served as a critical maturity accelerator for the YANG model profiles defined in the present document, providing practical implementation feedback and confirming their applicability in real multi-vendor SDN control scenarios.

8 Industry Relevance and Impact

Industry relevance and impact are summarized in the following points:

- Multi-Vendor Interoperability: The absence of common YANG-based inventory models has historically forced SDN Controllers to rely on vendor-specific adapters and proprietary data representations. By defining a standard, common set of YANG models based on IETF specifications and specialized for microwave backhaul, the present document shall enable true multi-vendor interoperability at the Southbound Interface. Microwave Network Elements from different vendors shall be discoverable, identifiable, and manageable using the same data structures and semantic interpretation.

- Open and Disaggregated Network Architectures: The introduction of common IETF-aligned YANG inventory models shall eliminate proprietary dependencies at the Southbound Interface and shall enable microwave backhaul to be integrated into open and disaggregated SDN transport architectures. This shall directly support the architectural framework defined in ETSI GR mWT 025 [i.2].

- Automation and Zero-Touch Operations: Automation, zero-touch provisioning, and closed-loop control depend on reliable, structured, and standardized inventory data. The common IETF-based YANG models defined under the present document shall provide this essential data layer and shall enable large-scale, AI-assisted network operations.

- Real-World Applicability: The YANG model profiles shall be explicitly derived from real microwave configurations and deployment scenarios observed in operational networks. This shall ensure direct applicability to commercial products without excessive abstraction.

- Validation Through Plugtests: Systematic multi-vendor validation within the ETSI SDN Plugtests Programme shall continuously verify the correctness, completeness, and interoperability of the YANG model profiles. This shall strengthen industry confidence and readiness for commercial deployment.

- AI and Autonomous Networks: Common, standardized, IETF-aligned YANG-based inventory model profiles shall provide the trusted ground truth required for digital twins, predictive maintenance, AI-based fault correlation, and autonomous optimization of microwave networks.

- Industry Ecosystem Benefits: The introduction of standard, common YANG inventory model profiles based on IETF specifications and tailored for microwave backhaul shall deliver long-term benefits across the full ecosystem. Operators shall gain reduced integration complexity, faster SDN adoption, and increased vendor flexibility. Vendors shall benefit from a globally aligned implementation target and reduced proprietary interface burden. System integrators shall experience reduced customization effort and improved predictability. The research and standardization community shall benefit from a stable baseline for future automation and AI-driven innovation.

- Strategic Importance: By establishing standard, common IETF-aligned YANG-based hardware inventory models at the SDN Southbound Interface, the present document shall create a foundational pillar for the long-term evolution of microwave wireless backhaul networks toward open, programmable, automated, and ultimately autonomous operation. It shall ensure that the microwave domain evolves in full alignment with cross-domain SDN control frameworks and global IETF data modelling practices, while preserving multi-vendor interoperability and long-term operational efficiency.

9 Description of MW Hardware Configurations

Figure 1 illustrates two fundamental microwave hardware deployment configurations that serve as baseline reference cases for the inventory profiling activity.

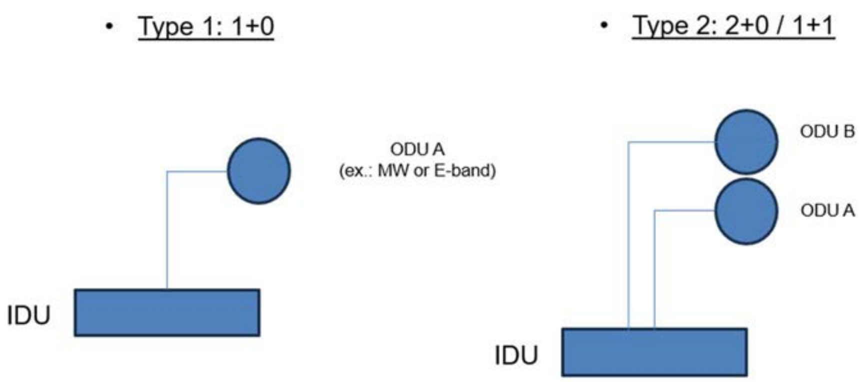

Figure 1: Type 1 1+0 & Type 2 2+0/1+1 configuration

The first configuration, referred to as Type 1: 1+0, represents the simplest microwave deployment scenario. In this configuration, a single Indoor Unit (IDU) is connected to one Outdoor Unit (ODU), which may operate either in the traditional microwave band or in the E-band. This topology supports a single radio carrier with no protection or redundancy. Due to its simplicity, this configuration is commonly used in straightforward point-to-point links where high availability through protection mechanisms is not a primary requirement.

The second configuration is referred to as Type 2 and covers both 2+0 and 1+1 variants. In this case, a single IDU is connected to two ODUs, denoted as ODU A and ODU B. In the 2+0 variant, the two ODUs typically operate in parallel to provide increased capacity through carrier aggregation. In the 1+1 variant, the two ODUs provide protection redundancy, where one ODU acts as the active unit and the second as a standby unit to ensure high availability. This configuration reflects typical commercial deployments where either capacity scaling or link protection is required.

Together, these two configuration types define the basic building blocks for the subsequent modelling and profiling of more complex microwave hardware topologies.

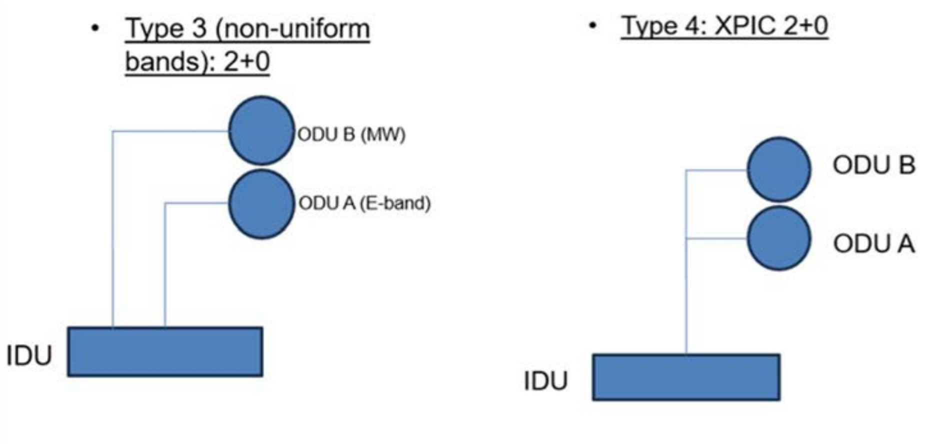

Figure 2: Type 3 2+0 non-uniform bands & Type 4 2+0 XPIC configuration

Figure 2 extends the baseline microwave hardware configurations by introducing more advanced and specialized deployment scenarios that are relevant for modern high-capacity and heterogeneous-band microwave networks.

The first configuration shown is referred to as Type 3: non-uniform bands 2+0. In this configuration, a single Indoor Unit (IDU) is connected to two Outdoor Units operating in different frequency bands. One ODU operates in the traditional microwave band, while the second ODU operates in the E-band. Both ODUs are used simultaneously to provide a combined 2+0 capacity configuration, where traffic is distributed across two carriers with dissimilar radio characteristics. This configuration is increasingly used in modern deployments to combine the high availability of traditional microwave with the very high capacity offered by E-band spectrum, resulting in a hybrid multi-band transport solution.

The second configuration is referred to as Type 4: XPIC 2+0. In this case, a single IDU is connected to two ODUs that operate on the same frequency channel using dual polarization and Cross-Polarization Interference Cancellation (XPIC) technology. Both ODUs are active simultaneously and provide a doubled capacity while occupying the same channel bandwidth. This configuration is widely used in spectrum-constrained environments where maximizing spectral efficiency is critical, as it enables a true 2+0 capacity gain without requiring additional frequency resources.

These two configuration types represent important modelling cases for the inventory profiles, as they introduce the need to capture heterogeneous band aggregation, dual-polarization operation, and advanced radio relationship attributes within the common YANG-based hardware inventory framework.

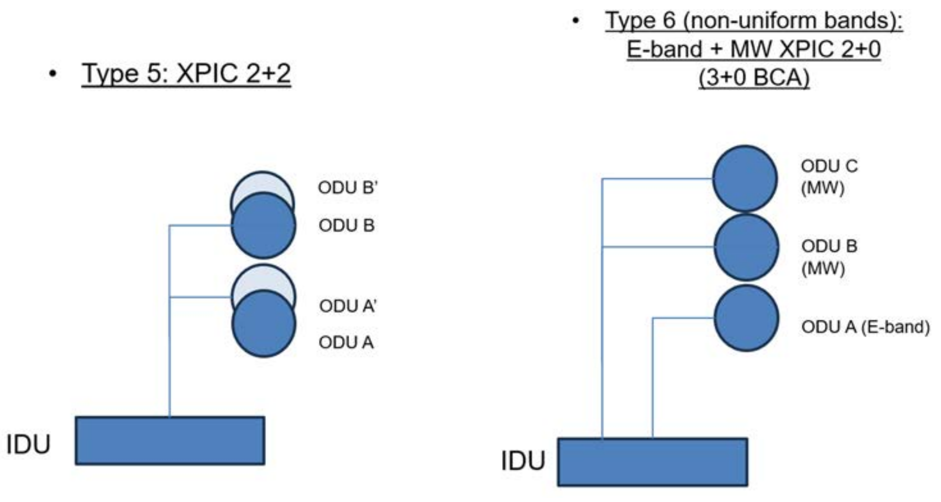

Figure 3: Type 5 2+2 XPIC & Type 6 3+0 BCA (E-band + MW 2+0 XPIC) configuration

Figure 3 presents the most advanced and complex microwave hardware deployment scenarios considered within the scope of the inventory profiling activity. These configurations combine multiple ODUs, advanced polarization techniques, and multi-band aggregation, and therefore represent the upper end of modelling complexity.

The first configuration shown is referred to as Type 5: XPIC 2+2. In this configuration, a single Indoor Unit (IDU) is connected to four Outdoor Units, organized as two XPIC pairs. The first pair consists of ODU A and ODU A', and the second pair consists of ODU B and ODU B′. Each pair operates on the same frequency channel using dual polarization with Cross-Polarization Interference Cancellation (XPIC), enabling a 2+0 capacity per pair. When combined, the overall system provides a 2+2 configuration, delivering very high aggregate capacity through the simultaneous operation of two XPIC links. This configuration is typically used in ultra-high-capacity backbone scenarios where both spectrum efficiency and throughput maximization are required.

The second configuration is referred to as Type 6: non-uniform bands E-band plus microwave XPIC 2+0 evolving to 3+0 through Band and Carrier Aggregation (BCA). In this case, a single IDU is connected to three ODUs operating across heterogeneous frequency bands. One ODU operates in the E-band, while two additional ODUs operate in the traditional microwave band with XPIC. The microwave XPIC pair provides a 2+0 configuration, and when combined with the single E-band carrier, the overall system effectively delivers a 3+0 aggregated capacity. This configuration reflects modern hybrid transport deployments where E-band is used as a very high-capacity overlay on top of a protected and spectrally efficient traditional microwave link.

These two configuration types represent the most demanding use cases for the inventory profiles, as they require the accurate modelling of multiple ODUs, XPIC relationships, heterogeneous frequency bands, and carrier aggregation mechanisms within a single, consistent, and vendor-neutral YANG-based inventory representation.

10 Modelling Considerations and Clarifications

10.0 Introduction

This clause documents the modelling considerations, interpretations, and agreements reached during the profiling activities of the present document. The objective of this clause is to ensure consistent understanding and application of the standardized YANG-based inventory model profiles across different microwave equipment architectures and connectivity variants.

10.1 Modular versus Fixed IDU Modelling

Microwave Indoor Units (IDUs) are implemented either as modular systems or as fixed (compact) systems. In the case of modular implementations, the IDU consists of a chassis hosting multiple containers, where each container may include one or more functional modules. These modules provide Ethernet interfaces, IF interfaces, power distribution, or may host additional container structures. In the case of fixed/compact implementations, the IDU is also represented as a chassis, but with a predefined and fixed set of physical ports without modular containerization.

It is agreed that the inventory profile shall support both modelling approaches. The profile shall therefore include one modelling variant for modular IDUs and one modelling variant for fixed IDUs, ensuring that both deployment types are represented consistently within the common YANG framework.

10.2 Dual RF ODU Identification

In the case of dual RF Outdoor Units (ODUs), the current understanding is that the dual RF ODU is identified and recognized by the SDN Controller upon the initial connection of the first carrier. No fundamental modelling differences have been identified between single RF and dual RF ODU configurations at the inventory level.

This approach is agreed and shall be supported by the inventory profile without introducing additional structural differentiation.

10.3 Ethernet versus IF Connectivity Between IDU and ODU

Two distinct connectivity cases exist between the IDU and the ODU. In the case of Ethernet-based connectivity, the ODU, whether it operates in the traditional microwave or E-band frequency band, is treated as a separate chassis. In the case of IF-based connectivity, the ODU, typically used for traditional microwave RF, is treated as a child module of the IF modem, which itself is part of the IDU chassis.

It is agreed that the inventory profile shall support both connectivity cases. The profile shall therefore include one modelling variant for Ethernet-based IDU-ODU interconnection and a separate modelling variant for IF-based cabling between the IDU and the ODU.

10.4 Current Interpretation on Modelling Differences

For certain intermediate configurations currently under discussion (e.g. is Type 2 (2+0/1+1 config) different from Type 4 (2+0 XPIC config) from modelling point of view?), the present view is that no material modelling difference is observed at inventory level. This position is agreed for the time being and shall remain valid unless further differentiation becomes necessary through additional implementation feedback.

10.5 Full-Outdoor Radio

A full outdoor radio is a single, outdoor unit in which the modem, network interfaces, and radio unit are integrated within the same physical hardware. The modelling approach is identical regardless of whether the radio operates in the Microwave (MW) or E-band frequency ranges.

Compared to a split-type architecture, the full outdoor radio is modelled as a single chassis, containing modem and ethernet interfaces. In most cases, full outdoor radios are non-modular, compact devices, with integrated and not field-replaceable modules. However, modular implementations may also exist.

10.6 Treatment of BCA configurations

This topic is currently also addressed within IETF activities and remains a pending action item originating from the published ETSI GR mWT 025 [i.2], clause 5.1.4, related to gap analysis in standard models.

Two alternative modelling interpretations are under consideration. In the first case, when all ODUs are connected via Ethernet cabling, no functional difference is observed compared to millimetre-wave ODU connectivity, and the IDU together with all associated ODUs may be bundled and represented as a single network element in a single stack. In the second case, when traditional microwave ODUs are connected via IF cabling, the E-band ODU is treated as a separate chassis and network element.

11 Hardware Inventory Modelling Profiles

11.0 Introduction

The present document defines specific hardware profiles which follow the structure of IETF RFC 8348 [1].

The inventory modelling approach follows the hierarchical hardware classification defined in IETF specifications for network element representation. In this hierarchy, a *chassis* represents the primary physical enclosure of networking equipment and serves as the top-level container for most physical components. Within a chassis, *containers* are used to represent physical locations or slots capable of hosting removable components, while *modules* represent self-contained functional sub-systems that may be installed within such containers or, when non-removable, directly within another physical component. *Ports* represent the physical or logical interfaces used to transmit or receive network traffic.

RJ45 Ethernet interfaces are modelled as *ports* of the *module* or *chassis*, as they are permanently integrated and not field replaceable. SFP cages are modelled as *containers* capable of hosting pluggable transceiver components (*modules)* with Ethernet *ports*. In IF-based connectivity systems, IF modem interfaces are modelled as *containers* representing pluggable/activatable functions within the modem *modules* of the IDU.

In addition, a *stack* is used to represent a logical super-container that groups multiple chassis entities into a single aggregated structure. A stack represents a logical grouping of multiple chassis and is modelled at a level above individual chassis, rather than as a physical component contained within a chassis.

The profile defines two alternative inventory modelling approaches for the MW RF ODU. In one approach, the MW RF ODU is modelled as a separate chassis, while in the other it is modelled as a child module of the modem, forming part of the IDU chassis inventory scope.

More specifically:

1) The MW RF ODU is modelled as a separate chassis, typically associated with deployments using Ethernet-based IDU-ODU connectivity.

2) The MW RF ODU is modelled within the IDU chassis inventory scope, typically associated with deployments using IF-based IDU-ODU connectivity. For inventory modelling purposes, the ODU is represented as a module and modelled as a child component of the IDU, more specifically as a child component of the IF container within the IDU.

Furthermore, a distinction is made between modular and fixed (compact, non-modular) Indoor Unit (IDU) architectures, reflecting the different inventory modelling approaches required for each case:

- In the case of a modular IDU, the IDU is modelled as a chassis comprising multiple containers, each of which may host one or more modules. Each module may expose Ethernet (electrical or optical) ports or may itself include additional containers, reflecting the modular and hierarchical nature of the hardware.

- In the case of a fixed (compact, non-modular) IDU, the IDU is also modelled as a chassis, but with a fixed set of physical ports. The RJ45 Ethernet ports are modelled as fixed ports of the chassis, as they are permanently integrated and not field replaceable. SFP cages are modelled as containers capable of hosting pluggable transceiver components. IF modem ports are modelled as containers representing pluggable/activatable modem functions within the IDU. As a result, unlike the modular IDU mode, this representation does not include container slots since no removable board-level containers are present.

11.1 Split-mount IDU-ODU connectivity, modular IDU, 1+0 configuration

11.1.0 Introduction

The below examples, illustrate two representative split-mount implementations of a 1+0 single-carrier microwave configuration in modular Indoor Unit (IDU) architectures. This configuration follows a split-type architecture, where the Outdoor Unit (MW ODU) is physically separated from the Indoor Unit (IDU). The IDU is of modular design and may include one or more containers hosting pluggable functional boards.

The examples highlight the two principal connectivity variants used in current microwave systems: Ethernet-based IDU-ODU connectivity and IF-based IDU-ODU connectivity. Together, the two examples illustrate how modular IDU architectures may support two different but widely deployed connectivity configurations, each requiring consistent representation in the common YANG-based inventory model profiles. The figures also highlight the underlying modelling abstractions used throughout the present document (stack, chassis, container, module, and port), which ensure a uniform and extensible description of microwave hardware across vendors and implementations according to IETF recommendations.

11.1.1 ODU as a separate chassis

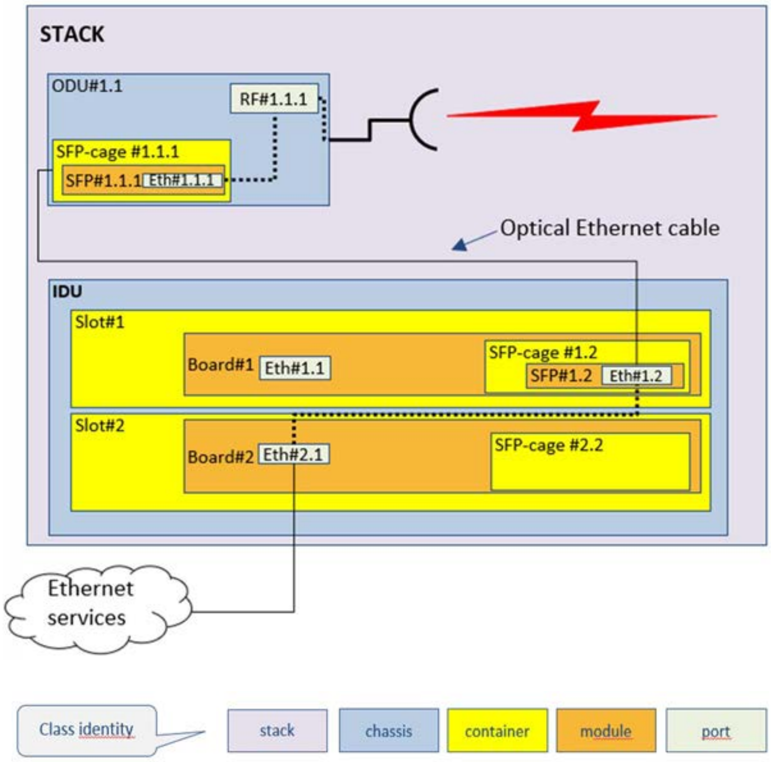

Figure 4: Split-mount (modular) IDU-ODU Connectivity ethernet - 1+0 Configuration

Figure 4 illustrates a split-mount implementation of a 1+0 microwave configuration with modular Indoor Unit (IDU). In the considered configuration, the interconnection between the IDU and the ODU is provided via an Ethernet interface. For inventory modelling purposes, the MW ODU is represented as a separate chassis with its own inventory scope.

The ODU is connected to the IDU through an optical or electrical Ethernet cable. The ODU is treated as an independent chassis with its own class identity and is modelled as a separate network component in the inventory. The IDU contains multiple containers and modules, such as SFP cages, modem boards, and Ethernet boards, which expose their ports directly to the SDN Controller. The ODU is represented as a peer chassis, connected via the Ethernet interface.

In this configuration, the ODU and IDU chassis are logically grouped using a *stack*, acting as a super-container that aggregates multiple chassis entities into a single logical inventory grouping, while each physical unit remains a distinct chassis component within the stack.

11.1.2 ODU as a module and child component of the indoor

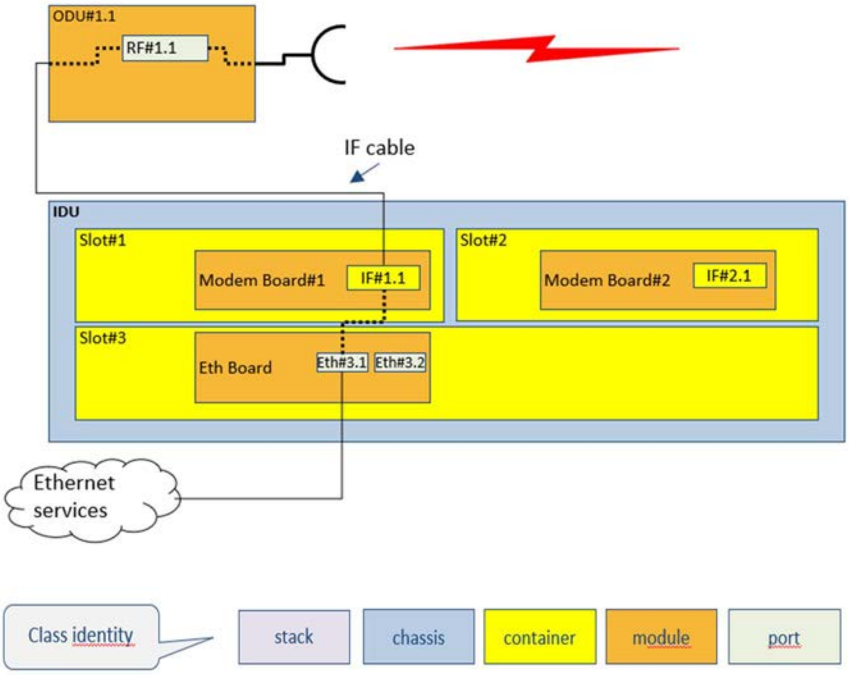

Figure 5: Split-mount (modular) IDU-ODU Connectivity IF - 1+0 Configuration

This configuration follows a split-type architecture with IF cable connectivity between the Indoor Unit (IDU) and the Microwave Outdoor Unit (MW ODU). The IDU is again of modular design and may comprise one or more containers hosting pluggable functional boards. In the considered configuration, the interconnection between the IDU and the MW ODU is provided via an IF cable interface. For inventory modelling purposes, the MW ODU is represented as a module and modelled as a child component of the IDU, more specifically as a child component of the IF board container within the modem board, and therefore within the same chassis and inventory scope.

11.2 Split-mount IDU-ODU connectivity, modular IDU, 2+0 configurations

11.2.0 Introduction

This architecture illustrates a split-mount microwave deployment implementing a 2+0 configuration, with a modular IDU which allows scalable deployment, where multiple pluggable boards can be hosted in the container slots. These examples, demonstrate how Ethernet-based or IF-based IDU-ODU connectivity can be used to model and manage 2+0 split-mount systems in a consistent and interoperable manner.

11.2.1 2+0 with single RF ODUs, separate eth boards, Ethernet connectivity

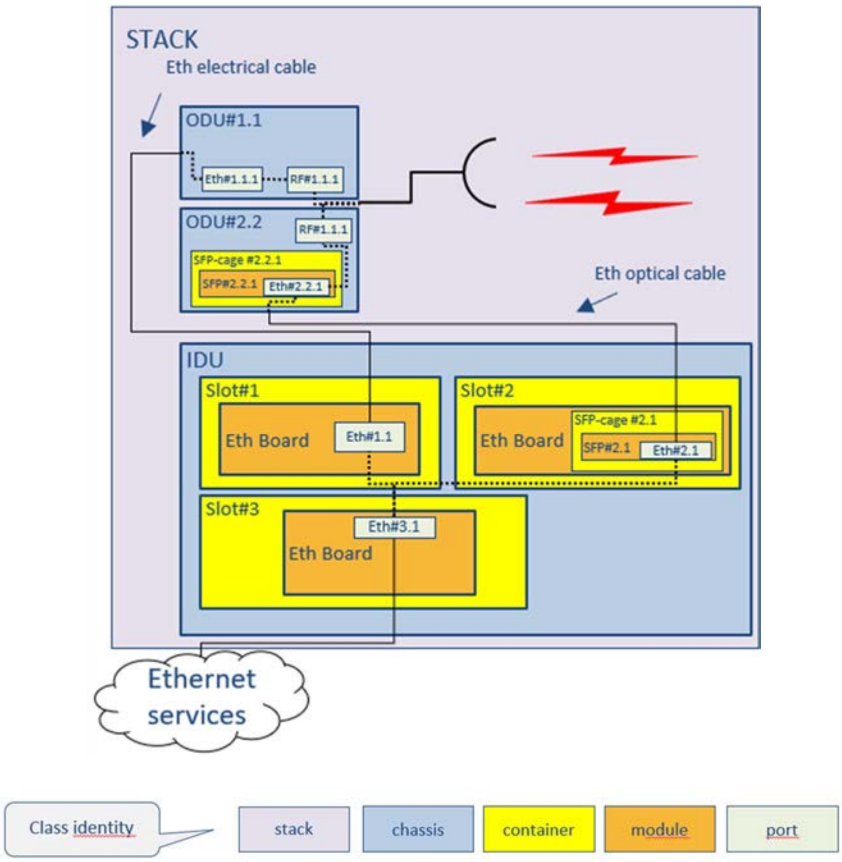

Figure 6: Split-mount 2+0 configuration using separate ODUs, Ethernet connectivity via different eth boards

Figure 6 illustrates a split-mount microwave deployment implementing a 2+0 configuration, where two independent radio paths are realized using two separate Outdoor Units (ODUs). The overall link capacity is increased through carrier aggregation mechanisms.

The IDU–ODU connections are realized using electrical Ethernet cabling or optical Ethernet cabling with pluggable units, depending on deployment requirements.

Within the IDU, multiple Ethernet boards installed in separate slots provide the connectivity to support the two parallel ODUs. This modular arrangement allows flexible scaling and clear separation of the two radio channels while maintaining a single indoor aggregation point.

The extra MW RF ODU is modelled as a separate chassis. All chassis are again bundled together via a stack.

11.2.2 2+0 with single RF ODUs, single eth board, Ethernet connectivity

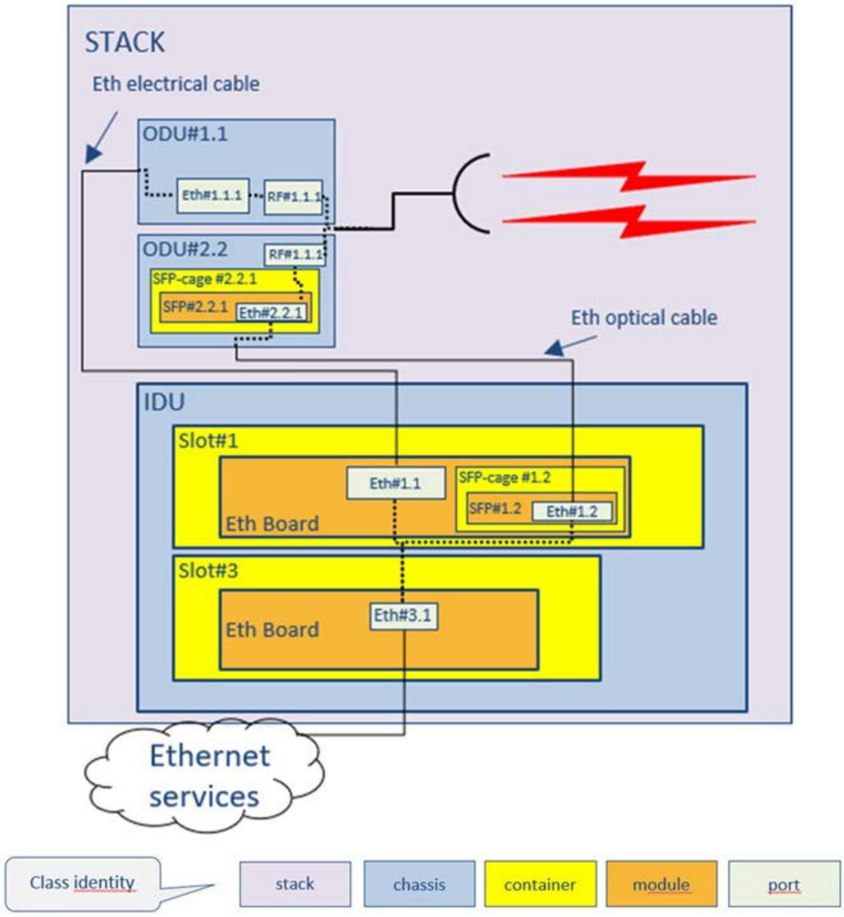

Figure 7: Split-mount 2+0 configuration using separate ODUs, Ethernet connectivity via single eth board

Figure 7 illustrates a split-mount microwave deployment in which a single RF Outdoor Unit (ODU) is connected to an Indoor Unit (IDU) using Ethernet-based connectivity. The ODU integrates one radio frequency chain and is responsible for the RF transmission towards the remote end of the microwave link.

Service traffic from the Ethernet network is aggregated on the IDU and forwarded through the same Ethernet board to the ODU. The ODU processes the Ethernet traffic and maps it onto the RF carriers for transmission. This configuration represents a compact and cost-efficient split-mount deployment.

This example highlights a split-mount topology where both RF ODUs Ethernet connectivity is centralized on a single Ethernet board, simplifying hardware layout while maintaining clear separation between indoor aggregation and outdoor radio functions. The IDU hosts a single Ethernet board that terminates both of the outdoor physical chassis. This Ethernet board may support electrical Ethernet ports as well as optical Ethernet interfaces via pluggable transceivers, enabling flexible choice of cabling between the IDU and the ODU.

11.2.3 2+0 with dual RF ODUs, single eth board, Ethernet connectivity

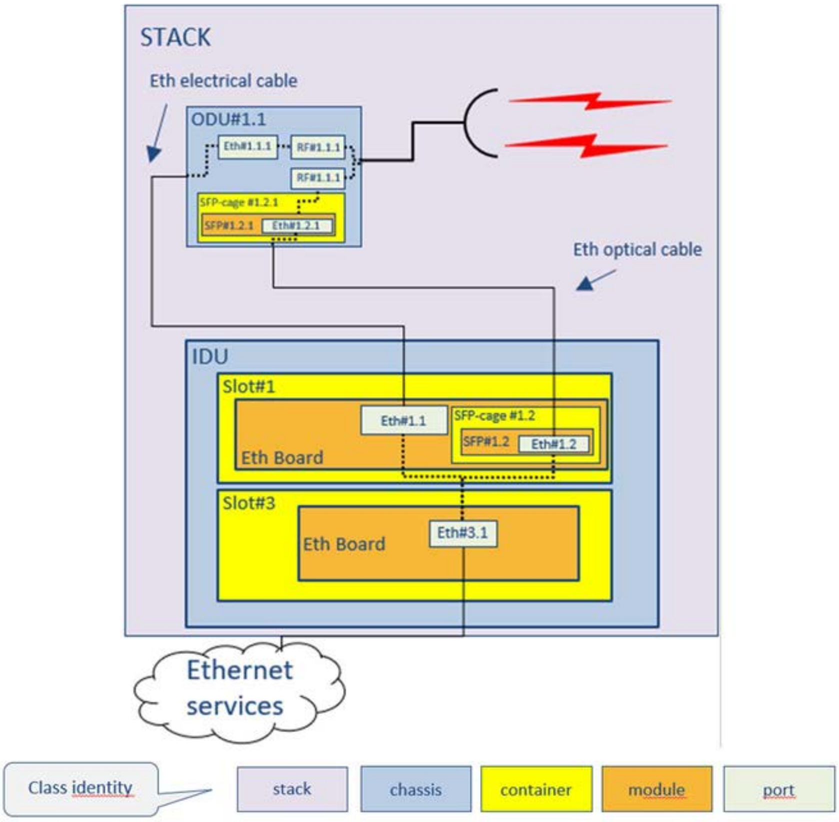

Figure 8: Split-mount 2+0 configuration using dual RF ODUs with Ethernet connectivity via a single Ethernet board

Figure 8 illustrates a split-mount microwave deployment in which a dual RF Outdoor Unit (ODU) is connected to an Indoor Unit (IDU) using Ethernet-based connectivity. The dual RF ODU supports two RF carriers, forming a 2+0 microwave configuration in a single outdoor box.

The IDU hosts a single Ethernet board that terminates both Ethernet interfaces towards the ODUs. This Ethernet board may support electrical Ethernet ports as well as optical Ethernet interfaces via pluggable transceivers, enabling flexible cabling options between the IDU and the ODU.

Service traffic from the Ethernet network is aggregated on the single Ethernet board within the IDU and forwarded over Ethernet towards the ODU. Within the ODU, the Ethernet traffic is mapped onto the corresponding RF carriers for transmission over the microwave link.

This configuration represents a compact and cost-efficient split-mount 2+0 deployment, where a single indoor Ethernet board and a dual-RF outdoor unit are used, simplifying the overall system hardware architecture. Compared to the previous example, the overall number of chassis are reduced to two, again modelled as a common stack.

11.2.4 2+0 with single RF ODUs, separate modem boards, IF connectivity

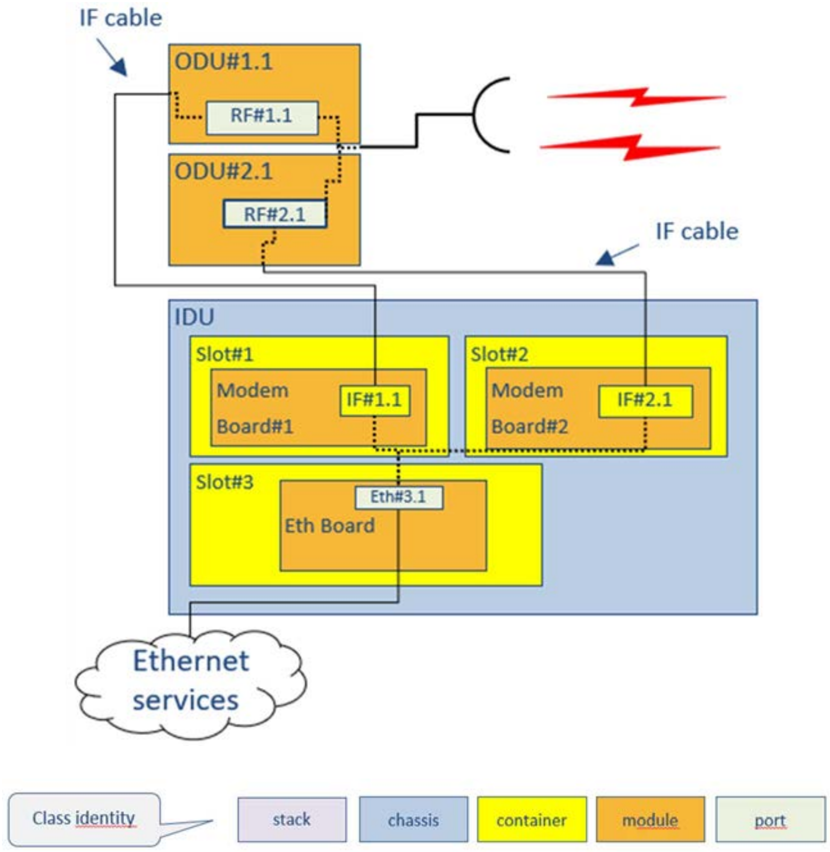

Figure 9: Split-mount 2+0 configuration using single IF modems and single RF ODUs

Figure 9 illustrates a split-mount microwave deployment in which the Indoor Unit (IDU) and Outdoor Units (ODUs) are interconnected using Intermediate Frequency (IF) cabling. The configuration supports a 2+0 microwave setup, where each RF carrier is served by a dedicated IF modem and a corresponding RF ODU.

The IDU is modular and hosts two separate modem boards, each occupying an individual slot. Each modem board provides an IF interface that is connected via an IF cable to a corresponding RF ODU. Each ODU integrates a single RF transmission path supporting one RF carrier.

Ethernet service traffic is terminated on a single Ethernet board within the IDU. The Ethernet board aggregates service-facing Ethernet traffic and forwards internally to the modem boards. Each modem processes the Ethernet traffic, performs modulation and framing functions, and outputs the corresponding IF signal towards its associated ODU.

11.2.5 2+0 with single RF ODUs, dual IF modem, IF connectivity

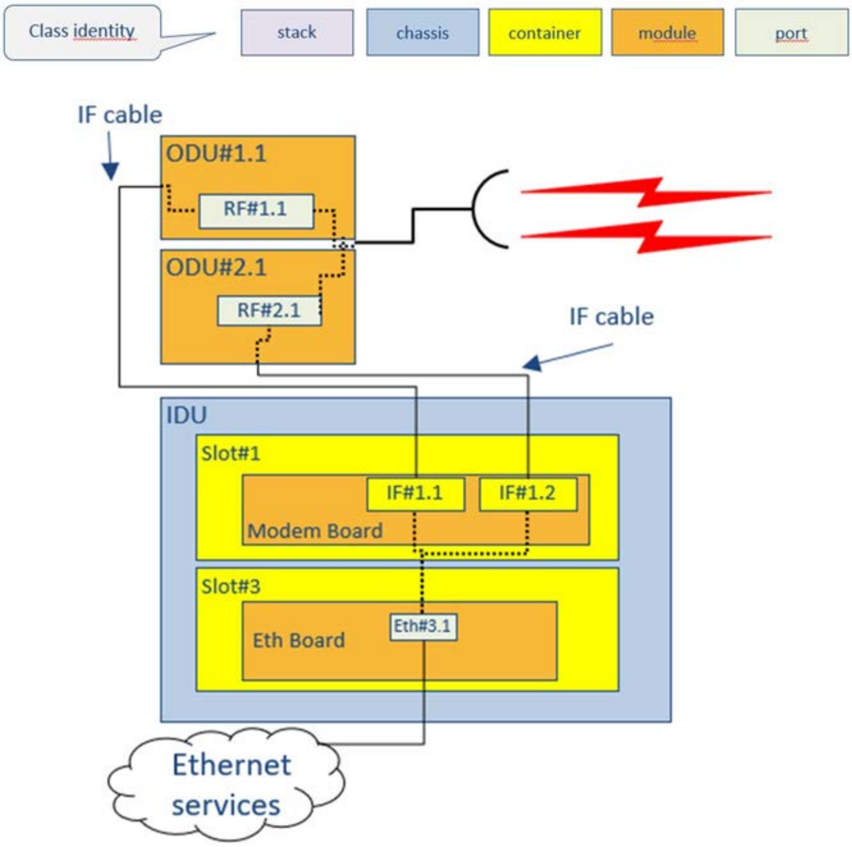

Figure 10: Split-mount 2+0 configuration using dual IF modem and single RF ODUs

Figure 10 illustrates a split-mount microwave deployment in which a modular Indoor Unit (IDU) is connected to a single RF Outdoor Unit (ODU) using Intermediate Frequency (IF) cabling. The configuration supports a 2+0 microwave setup by means of two IF modem instances housed on a single modem board within the IDU and two single RF outdoor units integrating two independent RF transmission paths.

The IDU hosts a modem board that provides two IF interfaces, each corresponding to a separate RF carrier. These IF interfaces are connected via IF cables to the single ODU.

Ethernet service traffic is terminated on a single Ethernet board within the IDU. The Ethernet board aggregates service-facing Ethernet interfaces and forwards traffic internally to the modem boards. The modem board processes the Ethernet traffic, performs modulation and framing functions independently for each carrier, and outputs two distinct IF signals towards the ODU.

11.2.6 2+0 with dual RF ODUs, dual IF modem, IF connectivity

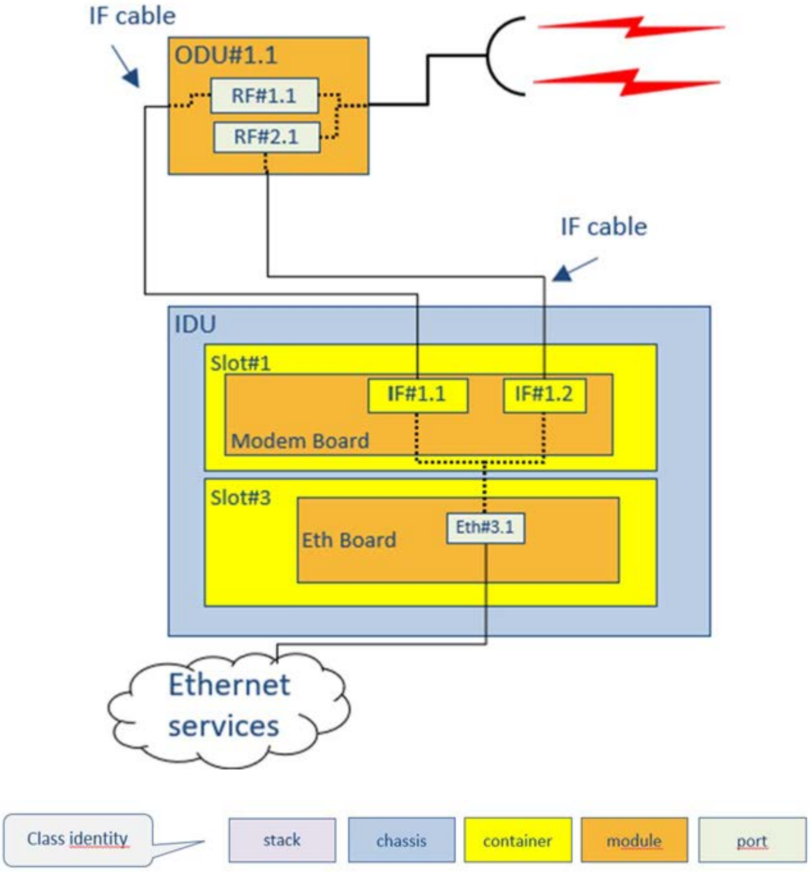

Figure 11: Split-mount 2+0 configuration using dual IF modem and dual RF ODU

Figure 11 illustrates a split-mount microwave deployment that supports a 2+0 microwave setup by means of two IF modem instances housed on a single modem board within the IDU and a single ODU integrating two independent RF transmission paths.

The IDU hosts a modem board that provides two independent IF interfaces, each corresponding to a separate IF modem instance. These IF interfaces are connected via IF cables to the dual RF ODU. The ODU integrates two RF transmission paths, each supporting one RF carrier, and performs RF up-conversion and transmission towards the remote end of the microwave link. This architecture reduces outdoor hardware footprint. In this case, the ODU is a child of both IF containers but for modelling purposes, the parent of the ODU is only the first IF container.

11.3 Split-mount IDU-ODU connectivity, fixed (compact) IDU, 1+0 configuration

11.3.0 Introduction

The below examples, illustrate two representative split-mount implementations of a 1+0 single-carrier microwave configuration in non-modular, compact Indoor Unit (IDU) architectures, with a predefined and fixed set of physical ports without modular containerization.

11.3.1 ODU as a separate chassis

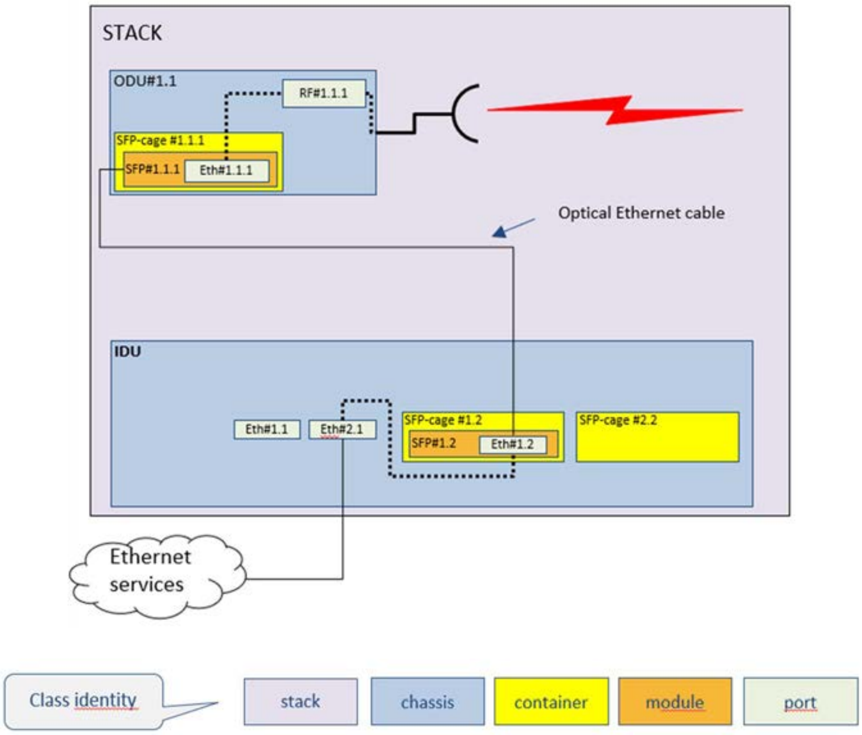

Figure 12: Split-mount (fixed/compact indoor) IDU-ODU Ethernet Connectivity - 1+0 Configuration

This configuration follows a split-type architecture but this time with a fixed (compact, non-modular) Indoor Unit (IDU), where the IDU is represented as a chassis with a fixed set of physical ports. The RJ45 Ethernet ports are modelled as fixed ports of the chassis, as they are permanently integrated and not field replaceable. SFP cages are modelled as containers capable of hosting pluggable transceiver components. IF/modem interfaces are modelled as containers representing pluggable/activatable modem functions within the IDU. Unlike the modular IDU representation, this configuration does not include container slots, as direct child components of the chassis, since no removable board-level containers are present. In this case, the interconnection between the IDU and the MW ODU is provided via an Ethernet interface. For inventory modelling purposes, the MW ODU is represented as a separate chassis with its own inventory scope.

11.3.2 ODU as a module and child component of the indoor

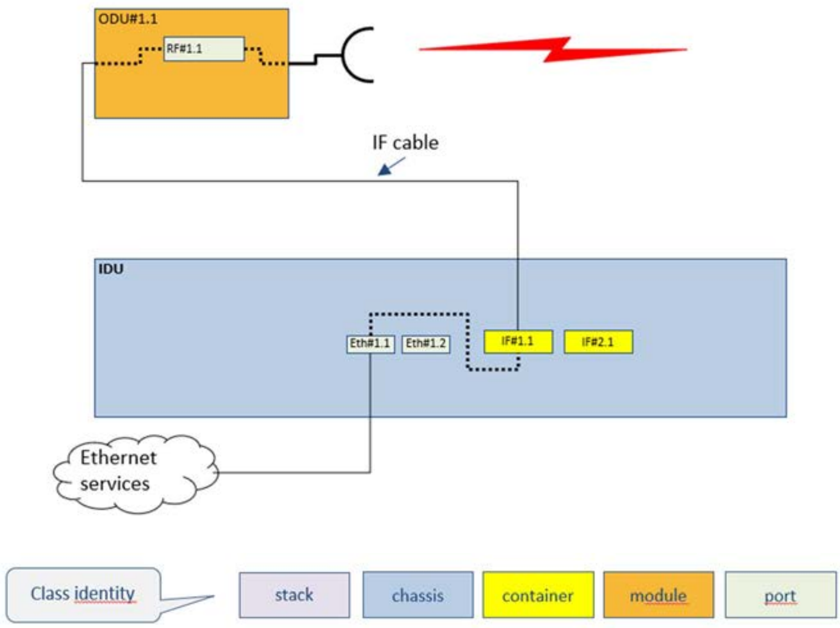

Figure 13: Split-mount (fixed/compact indoor) IDU-ODU IF Connectivity - 1+0 Configuration

This configuration follows a split-type architecture with a fixed (compact, non-modular) Indoor Unit (IDU), in which the interconnection between the IDU and the Microwave Outdoor Unit (MW ODU) is provided via an IF cable interface. For inventory modelling purposes, the MW ODU is represented as a module and modelled as a child component of the IDU, within the same chassis and inventory scope.

11.4 BCA configuration

11.4.1 MW & Eband ODU as a separate chassis, Ethernet IDU ODU connectivity

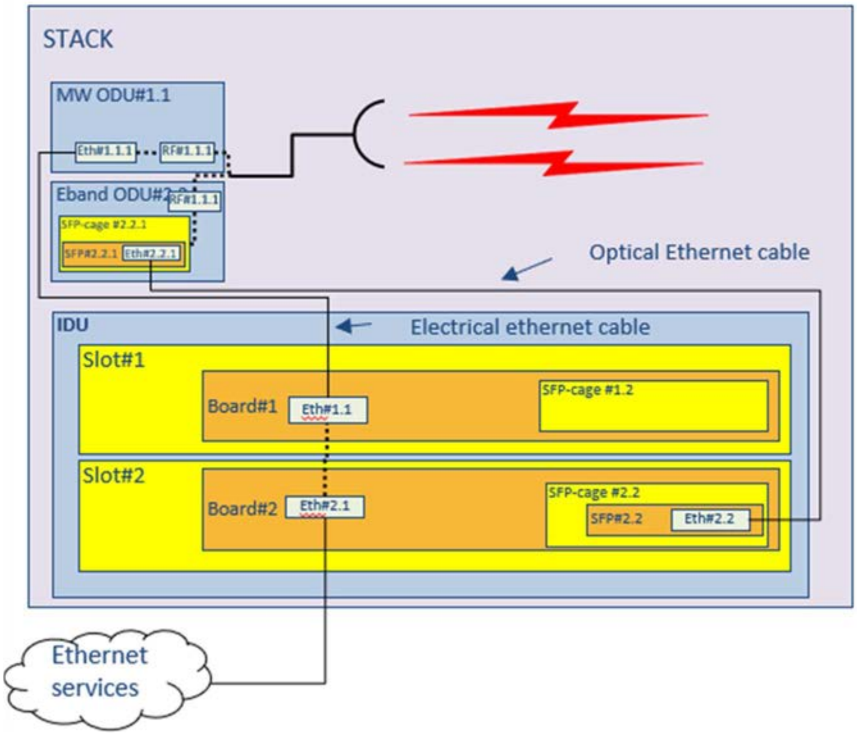

Figure 14: IDU-ODU Ethernet Connectivity, 2+0 BCA MW + Eband

In this interpretation, all ODUs are connected to the IDU via Ethernet cabling. The example takes into account a single multiband antenna, a single MW ODU and single Eband ODU for simplicity. From a functional and operational perspective, this configuration is similar to the one depicted in clause 11.2.1, since there is no distinction if the added ODU is in MW frequency band or Eband. As a result, the IDU together with all associated ODUs are bundled and represented as a single network element, modelled using a single stack that groups the involved chassis under a common logical entity. More carriers can be added via additional ethernet cable connectivity to MW or Eband ODUs.

11.4.2 MW ODU as a module & child component of the indoor, IF-based IDU-ODU connectivity

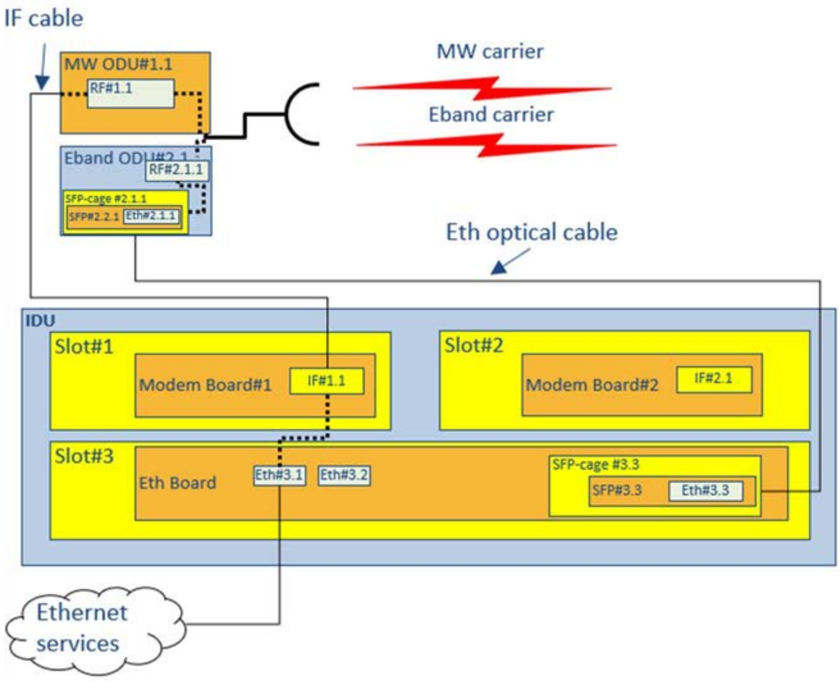

Figure 15: IDU-ODU IF Connectivity, 2+0 BCA MW + Eband

In this interpretation, the traditional microwave ODU is connected to the IDU via IF cabling and is treated again as a module of the indoor. The E-band ODU is connected to the IDU via ethernet cabling and is treated as a separate chassis and network element, with its own inventory scope, reflecting the different architectural and modelling characteristics associated with IF-based connectivity. The example takes into account a single multiband antenna, a single MW ODU and single Eband ODU for simplicity. More carriers can be added via additional IF cable connectivity to MW ODUs and ethernet cable connectivity to Eband ODUs.

Annex A (informative): Parameters used in the "5th mWT SDN Plugtests"

The list of parameters used from IETF RFC 8348 [1] during the 5th mWT SDN Plugtests for Hardware Management.

Parameter	Description	Required for test	Comment
+--rw name	NE name (component)	Yes	
+--rw class		Yes	
+--ro physical-index?	Model number, Chassis id (to correlate SNMP with NETCONF)	Out of scope	
+--ro description?	NE description (component)	Optional	
+--rw parent?		Yes	
+--rw parent-rel-pos?		Yes	
+--ro contains-child*		Yes	
+--ro hardware-rev?	HW version	At least one occurrence	not used for Container and port
+--ro firmware-rev?	FW version	Optional	Software on a specific chip
+--ro software-rev?	SW version	At least one occurrence	not used for Container and port
+--ro serial-num?	Serial number	Yes	not used for Container and port
+--ro mfg-name?	Manufacturer name	Optional	not used for Container and port
+--ro model-name?	Model version	Optional	not used for Container and port
+--rw alias?		Out of scope	
+--rw asset-id?		Out of scope	
+--ro is-fru?	Field replacable unit	Optional	not used for Container
+--ro mfg-date?		Optional	not used for Container
+--rw uri*		Out of scope	
+--ro uuid?	Hardware id	Out of scope	
+--rw state {hardware-state}?		Out of scope	
+--ro sensor-data {hardware-sensor}?		Out of scope	

Annex B (informative): Bibliography

- IEEE™ 802.3.2-2025: "IEEE Standard for Ethernet YANG Data Model Definitions".

NOTE: Additional resources: YANG Catalog.

- IEEE™ 802.1Qcp-2018: "IEEE Standard for Local and metropolitan area networks -- Bridges and Bridged Networks -- Amendment 30: YANG Data Model".

NOTE: Additional resources:
https://ieee802.org/1/files/public/YANGs/ieee802-dot1q-bridge.yang
ieee802.org/1/files/public/YANGs/ieee802-dot1q-pb.yang

- IEEE™ 802.1AB-2016: "IEEE Standard for Local and metropolitan area networks - Station and Media Access Control Connectivity Discovery".

NOTE: Additional resources:
https://www.yangcatalog.org/api/services/tree/ieee802-dot1ab-lldp@2022-03-15.yang.
ieee802.org/1/files/public/YANGs/ieee802-dot1ab-lldp.yang

- IETF RFC 8632 (September 2019): "A YANG Data Model for Alarm Management".
- IETF RFC 6020 (October 2010): "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)".
- IETF RFC 8575 (May 2019): "YANG Data Model for the Precision Time Protocol (PTP)".
- draft-ietf-netmod-intf-ext-yang: "Common Interface Extension YANG Data Models".
- IETF RFC 5277 (July 2008): "NETCONF Event Notifications".
- IETF RFC 7317 (March 2004): "A YANG Data Model for System Management".

History

Version	Date	Status
V1.1.1	February 2026	Publication