



GROUP REPORT

Zero-touch network and Service Management (ZSM); Landscape

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Zero touch network and Service Management (ZSM).

Modal verbs terminology

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1 Scope

The present document develops a landscape report for Zero-Touch Network and Service Management. It identifies and includes information about activities in other bodies (such as Standards Developing Organizations, Open Source Communities, and Industry Associations) that are relevant to the work in ISG ZSM.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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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 not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI GS ZSM 007: "Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM".
- [i.2] ETSI GS ZSM 001: "Zero-touch network and Service Management (ZSM); Requirements based on documented scenarios".
- [i.3] ETSI GR NFV 001 (V1.2.1): "Network Functions Virtualisation (NFV); Use Cases".
- [i.4] ETSI GS NFV 004 (V1.1.1): "Network Functions Virtualisation (NFV); Virtualisation Requirements".
- [i.5] ETSI GS NFV 002 (V1.2.1): "Network Functions Virtualisation (NFV); Architectural Framework".
- [i.6] ETSI GS NFV-MAN 001 (V1.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration".
- [i.7] ETSI GS NFV-IFA 013 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".
- [i.8] ETSI GS NFV-IFA 014 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Network Service Templates Specification".
- [i.9] ETSI GS NFV-IFA 011 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; VNF Descriptor and Packaging Specification".
- [i.10] ETSI GR NFV-IFA 023 (V3.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration; Report on Policy Management in Mano; Release 3".
- [i.11] ETSI GR NFV-IFA 015 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on NFV Information Model".
- [i.12] ETSI GR NFV-IFA 024 (V2.1.1): "Network Function Virtualisation (NFV) Release 2; Information Modeling; Report on External Touchpoints related to NFV Information Model".

- [i.13] ETSI GS NFV-IFA 027 (V2.4.1): "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Performance Measurements Specification".
- [i.14] ETSI GR NFV-IFA 021 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on management of NFV-MANO and automated deployment of EM and other OSS functions".
- [i.15] ETSI GS NFV-IFA 031 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Requirements and interfaces specification for management of NFV-MANO".
- [i.16] ETSI GR NFV-IFA 022 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on Management and Connectivity for Multi-Site Services".
- [i.17] ETSI GS NFV-SOL 004 (V2.5.1): "Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; VNF Package specification".
- [i.18] ETSI GS NFV-SOL 005 (V2.4.1): "Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point".
- [i.19] ETSI GR NFV-IFA 028: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on architecture options to support multiple administrative domains".
- [i.20] ETSI GS NFV-IFA 030: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Multiple Administrative Domain Aspect Interfaces Specification".
- [i.21] ETSI GS NFV-IFA 032: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Interface and Information Model Specification for Multi-Site Connectivity Services".
- [i.22] ETSI GS MEC 002 (V2.1.1): "Multi-access Edge Computing (MEC); Phase 2: Use Cases and Requirements".
- [i.23] ETSI GS MEC 003 (V2.1.1): "Multi-access Edge Computing (MEC); Framework and Reference Architecture".
- [i.24] ETSI GS MEC 010-1 (V1.1.1): "Mobile Edge Computing (MEC); Mobile Edge Management; Part 1: System, host and platform management".
- [i.25] ETSI GS MEC 010-2 (V2.1.1): "Multi-access Edge Computing (MEC); MEC Management; Part 2: Application lifecycle, rules and requirements management".
- [i.26] ETSI GS MEC 012 (V1.1.1): "Mobile Edge Computing (MEC); Radio Network Information API".
- [i.27] ETSI GS MEC 013 (V1.1.1): "Mobile Edge Computing (MEC); Location API".
- [i.28] ETSI GS MEC 014 (V1.1.1): "Mobile Edge Computing (MEC); UE Identity API".
- [i.29] ETSI GS MEC 015 (V1.1.1): "Mobile Edge Computing (MEC); Bandwidth Management API".
- [i.30] ETSI GS MEC 028 (V2.0.1): "Multi-access Edge Computing (MEC); WLAN Information API".
- [i.31] ETSI GS MEC 029 (V2.1.1): "Multi-access Edge Computing (MEC); Fixed Access Information API".
- [i.32] ETSI GS MEC 030 (V2.0.6): "Multi-access Edge Computing (MEC); V2X Information Service API".
- [i.33] ETSI GR ENI 001 (V1.1.1): "Experiential Networked Intelligence (ENI); ENI use cases".
- [i.34] ETSI GS ENI 002 (V2.1.1): "Experiential Networked Intelligence (ENI); ENI requirements".
- [i.35] ETSI GS ENI 005 (V1.1.1): "Experiential Networked Intelligence (ENI); System Architecture".
- [i.36] TM Forum Frameworx™, <https://www.tmforum.org/frameworx-homepage/>.

- [i.37] TM Forum Open Digital Architecture, <https://www.tmforum.org/collaboration/open-digital-architecture-oda-project/>.
- [i.38] TM Forum Open APIs, <https://www.tmforum.org/open-apis/>.
- [i.39] TM Forum Catalyst Program, <https://www.tmforum.org/collaboration/catalyst-program/catalyst-program-benefits/>.
- [i.40] LF ONAP External APIs Framework Project, <https://wiki.onap.org/display/DW/External+API+Framework+Project>.
- [i.41] TMF Open Digital Lab project, <https://www.tmforum.org/open-digital-lab/>.
- [i.42] Open API Map portal, <https://projects.tmforum.org/wiki/display/API/Open+API+Table?ga=2.120461313.863093364.1543419979-18401513.1531316873>.
- [i.43] TM Forum IG1166: "ODA Architecture Vision R18.0.0".
- NOTE: Available at <https://www.tmforum.org/resources/exploratory-report/ig1166-oda-architecture-vision-r18-0-0/>.
- [i.44] TM Forum IG1167: "ODA Functional Architecture R19.0.1".
- NOTE: Available at <https://www.tmforum.org/resources/standard/ig1167-oda-functional-architecture-r19-0-0/>.
- [i.45] TM Forum GB998: "Open Digital Architecture (ODA) Concepts & Principles R19.0.1".
- NOTE: Available at <https://www.tmforum.org/resources/reference/gb998-open-digital-architecture-oda-concepts-principles-r19-0-0/>.
- [i.46] TM Forum GB921: "Business Process Framework (eTOM) Suite Release 18.5".
- NOTE: Available at <https://www.tmforum.org/resources/suite/gb921-business-process-framework-etom-suite-release-18-5/>.
- [i.47] TM Forum GB922: "Standards Addenda for Information Framework R18.5".
- NOTE: Available at <https://www.tmforum.org/resources/suite/gb922-standards-addenda-information-framework-r18-5/>.
- [i.48] TM Forum IG1171: "ODA Component Definition R19.0.1".
- NOTE: Available at <https://www.tmforum.org/resources/exploratory-report/ig1171-oda-component-definition-r19-0-0/>.
- [i.49] TM Forum TMF071: "ODA Terminology R19.0.1".
- NOTE: Available at <https://www.tmforum.org/resources/reference/tmf071-oda-terminology-r19-0-0/>.
- [i.50] TM Forum TMF633: "Service Catalog API REST Specification R18.5.1".
- NOTE: Available at <https://www.tmforum.org/resources/specification/tmf633-service-catalog-api-rest-specification-r18-5-0/>.
- [i.51] TM Forum TMF641: "Service Ordering API REST Specification R18.5.1".
- NOTE: Available at <https://www.tmforum.org/resources/specification/tmf641-service-ordering-api-rest-specification-r18-5-0/>.
- [i.52] TM Forum TMF652: "Resource Ordering Management API REST Specification R16.5.1".
- NOTE: Available at <https://www.tmforum.org/resources/specification/tmf652-resource-ordering-management-api-rest-specification-r16-5-1/>.
- [i.53] TM Forum TMF640: "Service Activation and Configuration API REST Specification R18.5.1".

NOTE: Available at <https://www.tmforum.org/resources/specification/tmf640-service-activation-and-configuration-api-rest-specification-r18-5-0/>.

[i.54] TM Forum TMF638: "Service Inventory API REST Specification R18.5.1".

NOTE: Available at <https://www.tmforum.org/resources/specification/tmf638-service-inventory-api-rest-specification-r18-5-0/>.

[i.55] TM Forum TR262: "Management Platform Blueprint and Application to Hybrid Infrastructure R17.5.1".

NOTE: Available at <https://www.tmforum.org/resources/technical-report/tr262-management-platform-blueprint-and-application-to-hybrid-infrastructure-r17-5-0/>.

[i.56] TM Forum TR229A: "User Stories for Hybrid Infrastructure Platform R17.0.1".

NOTE 1: Available at <https://www.tmforum.org/resources/technical-report/tr229a-user-stories-for-hybrid-infrastructure-platform-r17-0-1/>.

NOTE 2: A list of all public TM Forum documents (currently over 500) can be found here - https://www.tmforum.org/resources/?filter_security=2597.

NOTE 3: All "member only" TM Forum documents are available for formal Liaison.

[i.57] MEF 55: "Lifecycle Service Orchestration (LSO): Reference Architecture and Framework", March 2016.

NOTE: Available at http://dev.mef.net/Assets/Technical_Specifications/PDF/MEF_55.pdf.

[i.58] MEF 55.0.1: "Amendment to MEF 55 - Operational Threads", October 2017.

NOTE: Available at <http://www.mef.net/resources/technical-specifications/download?id=99&fileid=file1>.

[i.59] 3GPP TR 23.791 (V16.1.0): "Study of Enablers for Network Automation for 5G (Release 16)".

[i.60] ETSI TS 123 501 (V15.4.0): "5G; System Architecture for the 5G System (3GPP TS 23.501 version 15.4.0 Release 15)".

[i.61] ETSI TS 123 503 (V15.4.0): "5G; Policy and Charging Control Framework for the 5G System; Stage 2 (3GPP TS 23.503 version 15.4.0 Release 15)".

[i.62] 3GPP TR 23.742 (V1.1.0): "Study on Enhancements to the Service-Based Architecture (Release 16)".

[i.63] 3GPP TS 28.521 (V15.0.1): "Performance Management (PM) for mobile networks that include virtualized network functions".

[i.64] ETSI TS 128 550 (V15.0.0): "5G; Management and orchestration; Performance assurance (3GPP TS 28.550 version 15.0.0 Release 15)".

[i.65] 3GPP TS 28.552 (V16.0.0): "Management and orchestration; 5G performance measurements (Release 16)".

[i.66] ETSI TS 128 554 (V15.1.0): "5G; Management and orchestration; 5G end to end Key Performance Indicators (KPI) (3GPP TS 28.554 version 15.1.0 Release 15)".

[i.67] ETSI TS 128 515 (V15.0.0): "LTE; Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Requirements (3GPP TS 28.515 version 15.0.0 Release 15)".

[i.68] ETSI TS 128 516 (V15.0.0): "LTE; Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Procedures (3GPP TS 28.516 version 15.0.0 Release 15)".

[i.69] ETSI TS 128 517 (V15.0.0): "LTE; Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Stage 2 (3GPP TS 28.517 version 15.0.0 Release 15)".

- [i.70] ETSI TS 128 518 (V15.0.0): "LTE; Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Stage 3 (3GPP TS 28.518 version 15.0.0 Release 15)".
- [i.71] ETSI TS 128 545 (V15.1.0): "5G; Management and orchestration; Fault Supervision (FS) (3GPP TS 28.545 version 15.1.0 Release 15)".
- [i.72] ETSI TS 128 510 (V15.0.0): "LTE; Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Requirements (3GPP TS 28.510 version 15.0.0 Release 15)".
- [i.73] ETSI TS 128 511 (V15.0.0): "LTE; Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Procedures (3GPP TS 28.511 version 15.0.0 Release 15)".
- [i.74] ETSI TS 128 512 (V15.0.0): "LTE; Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Stage 2 (3GPP TS 28.512 version 15.0.0 Release 15)".
- [i.75] ETSI TS 128 513 (V15.0.0): "LTE; Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Stage 3 (3GPP TS 28.513 version 15.0.0 Release 15)".
- [i.76] 3GPP TS 28.311: "Policy management for Network Function Virtualization (NFV) based mobile networks".
- [i.77] 3GPP TR 32.871 (V15.0.0): "Study on policy management for mobile networks based on Network Function Virtualization (NFV) scenarios (Release 15)"
- [i.78] 3GPP TR 28.812 (V0.1.0): "Telecommunication management; Study on scenarios for Intent driven management services for mobile networks (Release 16)".
- [i.79] 3GPP TR 28.861 (V0.1.0): "Telecommunication management; Study on the Self-Organizing Networks (SON) for 5G networks (Release 16)".
- [i.80] ETSI TS 128 530 (V15.1.0): "5G; Management and orchestration; Concepts, use cases and requirements (3GPP TS 28.530 version 15.1.0 Release 15)".
- [i.81] 3GPP TS 28.531 (V16.0.0) (2018-12): "Management and orchestration; Provisioning; (Release 16)".
- [i.82] ETSI TS 128 532 (V15.1.0): "5G; Management and orchestration; Generic management services (3GPP TS 28.532 version 15.1.0 Release 15)".
- [i.83] ETSI TS 128 533 (V15.0.0): "5G; Management and orchestration; Architecture framework (3GPP TS 28.533 version 15.0.0 Release 15)".
- [i.84] ETSI TS 128 540 (V15.1.0): "5G; Management and orchestration; 5G Network Resource Model (NRM); Stage 1 (3GPP TS 28.540 version 15.1.0 Release 15)".
- [i.85] ETSI TS 128 541 (V15.1.0): "5G; Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3 (3GPP TS 28.541 version 15.1.0 Release 15)".
- [i.86] 3GPP TR 28.801 (V15.1.0): "Telecommunication management; Study on management and orchestration of network slicing for next generation network (Release 15)".
- [i.87] CORD®: <https://www.opennetworking.org/cord/>.
- [i.88] R-CORD: <https://www.opennetworking.org/r-cord/>.
- [i.89] M-CORD: <https://www.opennetworking.org/m-cord/>.
- [i.90] E-CORD: <https://www.opennetworking.org/e-cord/>.

[i.91] ONF TR-512: "CoreModel".

NOTE: Available at https://www.opennetworking.org/wp-content/uploads/2018/12/TR-512_v1.4_OnfCoreInfo.zip.

[i.92] ONF TR-514: "UM" L.

NOTE: Available at https://www.opennetworking.org/wp-content/uploads/2018/08/TR-514_UML_Modeling_Guidelines_v1.3-1-1.pdf.

[i.93] ONF TR-515: "Papyrus".

NOTE: Available at https://www.opennetworking.org/wp-content/uploads/2018/08/TR-515_Papyrus_Guidelines_v1.3-1-1.pdf.

[i.94] ONF TR-513: "CIM".

NOTE: Available at https://www.opennetworking.org/wp-content/uploads/2014/10/TR-513_CIM_Overview_1.2.pdf

[i.95] ONF TR-523: "Intent".

NOTE: Available at https://www.opennetworking.org/wp-content/uploads/2014/10/TR-523_Intent_Definition_Principles.pdf.

[i.96] FG-ML5G ToR.

NOTE: Available at https://www.itu.int/en/ITU-T/focusgroups/ml5g/Documents/FG-ML5G_ToRs.docx.

[i.97] ML5G-O-001 ToR.

NOTE: Available at <https://extranet.itu.int/sites/itu-t/focusgroups/ML5G/output/ML5G-O-001.docx?Web=1>.

[i.98] ML5G-O-002 ToR.

NOTE: Available at <https://extranet.itu.int/sites/itu-t/focusgroups/ML5G/output/ML5G-O-002.docx?Web=1>.

[i.99] ML5G-O-003 ToR.

NOTE: Available at <https://extranet.itu.int/sites/itu-t/focusgroups/ML5G/output/ML5G-O-003.docx?Web=1>.

[i.100] Use Cases for ML5G: "Use cases for Machine Learning for Future Networks including 5G".

[i.101] Recommendation ITU-T Y.3172: "Architectural framework for machine learning in future networks including IMT-2020".

NOTE: Available at <https://www.itu.int/rec/T-REC-Y.3172/en>.

[i.102] ANIMA WG, <https://datatracker.ietf.org/wg/anima/about/>.

[i.103] NETCONF WG, <https://datatracker.ietf.org/group/netconf/about/>.

[i.104] NETMOD WG, <https://datatracker.ietf.org/wg/netmod/about/>.

[i.105] OPSAWG WG, <https://datatracker.ietf.org/wg/opsawg/about/>.

[i.106] L2SM WG, <https://datatracker.ietf.org/wg/l2sm/about/>.

[i.107] ALTO WG, <https://datatracker.ietf.org/wg/alto/about/>.

[i.108] HOMENET WG (more remote but still relevant), <https://datatracker.ietf.org/wg/homenet/about/>.

[i.109] NMRG, <https://datatracker.ietf.org/rg/nmrg/about/>.

[i.110] draft-ietf-anima-reference-model-10: "A Reference Model for Autonomic Networking".

NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-anima-reference-model/>

- [i.111] draft-ietf-anima-autonomic-control-plane-18: "An Autonomic Control Plane (ACP)".
NOTE: Available at https://datatracker.ietf.org/doc/draft-ietf-anima-autonomic-control-plane/?include_text=1.
- [i.112] draft-ietf-anima-bootstrapping-keyinfra-17: "Bootstrapping Remote Secure Key Infrastructures (BRSKI)".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-anima-bootstrapping-keyinfra/>.
- [i.113] draft-ietf-anima-constrained-voucher-02: "Constrained Voucher Artifacts for Bootstrapping Protocols".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-anima-constrained-voucher/>.
- [i.114] draft-ietf-anima-grasp-15: "A Generic Autonomic Signaling Protocol (GRASP)".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-anima-grasp/>.
- [i.115] draft-ietf-anima-grasp-api: "Generic Autonomic Signaling Protocol Application Program Interface (GRASP API)".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-anima-grasp-api/>.
- [i.116] IETF RFC 6241: "NETCONF Protocol".
NOTE: Available at <https://www.rfc-editor.org/rfc/rfc6241.txt>.
- [i.117] IETF RFC 8040: "RESTCONF Protocol".
NOTE: Available at <https://www.rfc-editor.org/rfc/rfc8040.txt>.
- [i.118] draft-ietf-netconf-nmda-netconf-08: "NETCONF Extensions to Support the Network Management Datastore Architecture".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-nmda-netconf/>.
- [i.119] draft-ietf-netconf-nmda-restconf-05: "RESTCONF Extensions to Support the Network Management Datastore Architecture".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-nmda-restconf/>.
- [i.120] IETF RFC 8342: "Network Management Datastore Architecture (NMDA)".
NOTE: Available at <https://www.rfc-editor.org/info/rfc8342>.
- [i.121] draft-ietf-netconf-netconf-event-notifications-14: "Dynamic Subscription to YANG Events and Datastores over NETCONF".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-netconf-event-notifications/>.
- [i.122] draft-ietf-netconf-notification-capabilities-00: "Generic YANG-related System Capabilities and YANG-Push Notification Capabilities".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-notification-capabilities/>.
- [i.123] draft-ietf-netconf-notification-messages-04: "Notification Message Headers and Bundles".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-notification-messages/>.
- [i.124] draft-ietf-netconf-restconf-notif-10: "Dynamic Subscription to YANG Events and Datastores over RESTCONF".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-restconf-notif/>.
- [i.125] draft-ietf-netconf-subscribed-notifications-18: "Subscription to YANG Notifications".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netconf-subscribed-notifications/>.

- [i.126] IETF RFC 5277: "NETCONF Event Notifications".
NOTE: Available at <https://datatracker.ietf.org/doc/rfc5277/>.
- [i.127] IETF RFC 6470: "Network Configuration Protocol (NETCONF) Base Notifications".
NOTE: Available at <https://datatracker.ietf.org/doc/rfc6470/>.
- [i.128] draft-bryskin-netconf-automation-yang-02: "Generalized Network Control Automation YANG Model".
NOTE: Available at https://datatracker.ietf.org/doc/draft-bryskin-netconf-automation-yang/?include_text=1.
- [i.129] IETF RFC 7950: "The YANG 1.1 Data Modeling Language".
NOTE: Available at <http://www.rfc-editor.org/info/rfc7950>.
- [i.130] draft-ietf-netmod-syslog-model-26: "A YANG Data Model for Syslog Configuration".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-ietf-netmod-syslog-model/>.
- [i.131] IETF RFC 6020: "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)".
[i.132] IETF RFC 6244: "An Architecture for Network Management Using NETCONF and YANG".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc6244/](https://datatracker.ietf.org/doc/rfc6244).
- [i.133] IETF RFC 8343: "A YANG Data Model for Interface Management".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc8343/](https://datatracker.ietf.org/doc/rfc8343).
- [i.134] IETF RFC 7317: "A YANG Data Model for System Management".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc7317/](https://datatracker.ietf.org/doc/rfc7317).
- [i.135] IETF RFC 7407: "A YANG Data Model for SNMP Configuration".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc7407/](https://datatracker.ietf.org/doc/rfc7407).
- [i.136] draft-wwx-netmod-event-yang-00: "A YANG Data model for ECA Policy Management".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-wwx-netmod-event-yang/>.
- [i.137] draft-wu-netmod-base-notification-nmda-00: "NMDA Base Notification for Intent based configuration update".
NOTE: Available at <https://datatracker.ietf.org/doc/draft-wu-netmod-base-notification-nmda/>.
- [i.138] IETF RFC 7788: "Home Networking Control Protocol".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc7788/](https://datatracker.ietf.org/doc/rfc7788).
- [i.139] IETF RFC 7368: "IPv6 Home Networking Architecture Principles".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc7368/](https://datatracker.ietf.org/doc/rfc7368).
- [i.140] draft-ietf-homenet-simple-naming-03: "Homenet Naming and Service Discovery Architecture".
NOTE: Available at [https://datatracker.ietf.org/doc/draft-ietf-homenet-simple-naming/](https://datatracker.ietf.org/doc/draft-ietf-homenet-simple-naming).
- [i.141] IETF RFC 5345: "Simple Network Management Protocol (SNMP) Traffic Measurements and Trace Exchange Formats".
NOTE: Available at [https://datatracker.ietf.org/doc/rfc5345/](https://datatracker.ietf.org/doc/rfc5345).