

29-10-2024

Orchestration, Automation and Virtualisation Terminology Version 3.0

Grant Agreement No.: 101100680
Work Package: WP6
Task Item: Task 4
Nature of Document: White Paper
Dissemination Level: PU (Public)
Document ID: GN5-1-24-79G78F
Authors: Iacovos Ioannou (CYNET), Susanne Naegele Jackson (FAU/DFN), Daniel Lete (HEAnet), Kostas Stamos (GRNET), Hamzeh Khalili (RedIRIS/i2CAT), Martin Dunmore (Jisc), Maria Isabel Gandia (RedIRIS/CSUC), Ivana Golub (PSNC), Tim Chown (Jisc)

Abstract

This document provides a list of terms and abbreviations in the context of Orchestration, Automation and Virtualisation. Definitions are provided based on standardisation documents wherever possible; some have also been extended to reflect the understanding of the terms as used by a large number of NRENs in the GÉANT community. As of version 1.1, the document has also been adopted by the GNA-G Network Automation working group as their reference terminology.



Co-funded by
the European Union

© GÉANT Association on behalf of the GN5-1 project. The research leading to these results has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101100680 (GN5-1).

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

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Executive Summary

It first became evident during discussions at the GN4-3¹ Future Services Strategy Workshop which took place in Amsterdam on 09 May 2009, that different usages and understandings existed for various terms in the context of Orchestration, Automation and Virtualisation (OAV). To address this, a Focus Group (FG) on terminology was established within the *Network Services Evolution and Development* task (Task 2) of the *Network Technologies and Services Development* work package (WP6) in GN4-3 to provide definitions and a common understanding of these terms and facilitate better collaborative discussions within the GÉANT National Research and Education Network (NREN) community and globally.

The Focus Group was established with a six-month time frame to conduct an initial investigation. This involved compiling a list of key OAV terms and acronyms, accompanied by brief definitions. When possible, these definitions drew on documents from recognised standardisation bodies. In cases where such references were not available, the Focus Group developed definitions based on internal discussions and feedback from the GN4-3 WP6 T2 consensus-building team. After the end of the Focus Group, the list remains subject to updates as needed. The latest list of terms and abbreviations, updated under GN5-1² WP6 Task 4, is included in this document (v3.0) and can also be found on WP6's public OAV wiki [\[Wiki\]](#).

The original version of this document was shared with the Network Automation working group of the Global Network Advancement Group (GNA-G) [\[GNA-G\]](#). Subsequent versions (to date, version 1.1, version 2.0, and the current version 3.0) have been amended in collaboration with that WG and adopted by them as their terminology document of reference. This latest version includes machine-learning terminology related to OAV.

This joint work aims to further promote the potential for international collaboration on OAV beyond the GÉANT community.

¹ <https://geant.org/projects/a-european-success-story/>

² <https://geant.org/gn5-1/>

1 Introduction

Orchestration, automation, and virtualisation have become key enablers for service providers to facilitate faster, agile, more efficient, and cost-effective service development, deployment, and provisioning. Adopting OAV principles allows organisations to better utilise their resources, including physical and virtual hardware and software, to facilitate their digital transformation process.

The GÉANT and NREN community has been on this path for several years. Organisations are at various stages in their journeys but for most, the motivation for their efforts stems from an internal focus—prioritising improvements within their own areas of operation. Therefore, today, most of the work known so far is single-domain and domain-specific.

This document aims to achieve a common language across all GÉANT Project³ deliverables and to serve as a terminology of reference for use by the GÉANT and NREN community. Where necessary, detailed descriptions providing background for concise formal definitions are given.

The original version of this document was shared with the Network Automation working group of the Global Network Advancement Group (GNA-G). Subsequent versions (to date, version 1.1, version 2.0, and the current version 3.0) have been amended in collaboration with that WG and adopted by them as their terminology document of reference. This latest version includes machine-learning terminology related to OAV.

The updated list of OAV terms along with their definitions can be found in section 2 of this document, while the list of abbreviations is provided in section 3. A list of key terminology documents from which the definitions for the listed terms were drawn is included in the Terminology Documents section under References.

³ <https://geant.org/projects/>

2 Term Definitions

The following list of terms aims to serve as a reference for use by the GÉANT and NREN community in the area of OAV. The term definitions have where possible been drawn from terminology documents issued by standardisation bodies. The remaining terms and definitions have been identified and agreed upon internally by the WP6, in collaboration with the Network Automation WG of the GNA-G (key documents, and/or those cited more than once, are listed individually under [Terminology Documents](#)):

OAV Term	Definition and Reference(s) or Source
AIOps	<p>AIOps is (the usage of) Artificial Intelligence for IT Operations. It combines big data and machine learning to automate IT operations processes, including event correlation, anomaly detection, causality determination, and, for networking, predictive analytics, root cause analysis, and real-time automation of repetitive tasks.</p> <p>Reference(s) or Source: https://www.gartner.com/en/information-technology/glossary/aiops-artificial-intelligence-operations</p>
Adaptive Machine Learning	<p>Adaptive machine learning builds on traditional machine learning to create a more advanced solution to real-time environments with variable data. As its name suggests, adaptive machine learning can adapt to rapidly changing data sets, making it more applicable to real-world situations.</p> <p>Reference(s) or Source: https://www.encora.com/insights/machine-learning-what-is-adaptive-ml</p>
Adversarial AI/ML	<p>A practice concerned with the design of ML algorithms that can resist security challenges, the study of the capabilities of attackers, and the understanding of attack consequences.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgaMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OHtF0t4xlscuogNZ3hRZAaDQuv_K/pubhtml NIST(Reznik,_Leon)</p>
AI Accuracy	<p>Closeness of computations or estimates to the exact or true values that the statistics were intended to measure.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (Updated August4, 2024)” https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgaMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OHtF0t4xlscuogNZ3hRZAaDQuv_K/pubhtml</p>

OAV Term	Definition and Reference(s) or Source
	(https://nvlpubs.nist.gov/nistpubs/ai/NIST.AI.100-3.pdf)
AI Agent	<p>An artificial intelligence (AI) agent is a software program that can interact with its environment, collect data, and use the data to perform self-determined tasks to meet predetermined goals. Unlike traditional automation agents, which follow static, predefined rules, AI agents can learn from their environment, adapt their behaviour, and make autonomous decisions based on real-time data, making them more flexible and capable of handling dynamic situations.</p> <p>Reference(s) or Source: https://aws.amazon.com/what-is/ai-agents/</p>
AI as a Service	<p>Artificial Intelligence as a Service (AIaaS) is a cloud-based service offering artificial intelligence (AI) outsourcing. AIaaS enables individuals and businesses to experiment with AI, and even take AI to production for large-scale use cases.</p> <p>Reference(s) or Source: https://www.run.ai/guides/machine-learning-in-the-cloud/ai-as-a-service</p>
AI Deployment Flexibility	<p>Flexibility to deploy the same system in multiple scenarios without any modifications to the AI models. It goes hand in hand with generalisability.</p> <p>Reference(s) or Source: https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf</p>
AI Policy Enforcer	<p>AI functionality to implement a recommended policy.</p> <p>Reference(s) or Source: https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf</p>
AI-powered Virtual Agent (AIVA)	<p>An AI-powered Virtual Agent is an animated virtual character, more complex than a chatbot, that makes use of technologies like machine learning and natural language processing (NLP). This allows it to actively participate in a conversation, acting more like a human.</p> <p>Reference(s) or Source: https://www.ringcentral.com/virtual-agent.html; “TM Forum AI Fundamentals” course [TMF AIF]; TM Forum “AI and its pivotal role in transforming operations” report and webinar [TMF AI]</p>
Analytics Logical Function	<p>A logical function in NWDAF, which performs inference, derives analytics information (i.e. derived statistics and/or predictions based on Analytics Consumer Request) and exposes analytics service.</p> <p>Reference(s) or Source: https://www.tech-invite.com/3m23/toc/tinv-3gpp-23-288_c.html</p>

OAV Term	Definition and Reference(s) or Source
Application Programming Interface (API)	<p>An API is a set of commands, functions, protocols, and objects that programmers can use to create software or interact with an external system. Data can be shared through an application programming interface.</p> <p>Reference(s) or Source: Based on https://techterms.com/definition/api and https://searchapparchitecture.techtarget.com/definition/application-program-interface-API</p>
Architecture component	<p>An architecture component is a nontrivial, nearly independent, and replaceable part of a system that fulfils a clear function in the context of a well-defined architecture.</p> <p>Reference(s) or Source: TM Forum Reference Document, <i>TMF071 ODA Terminology</i>, Release 19.0.1, October 2019 [TMF071]</p>
Architecture principles	<p>Architecture principles define the underlying general rules and guidelines for the use and deployment of all IT resources and assets across an organisation. They reflect a level of consensus among the various elements of the enterprise or organisations and form the basis for making future IT decisions.</p> <p>Reference(s) or Source: https://pubs.opengroup.org/architecture/togaf8-doc/arch/chap29.html</p>
Artificial General Intelligence	<p>Human-like intelligence, which can be applied widely as opposed to narrow AI, which can only be applied to one particular problem or task. Also called 'strong' AI as opposed to 'weak' AI.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgAMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1Kkm7OhtF0t4xlscuogNZ3hRZAaDQuv_K/pubhtml) NIST (AI_Ethics_Mark_Coeckelbergh)</p>
Artificial intelligence	<p>Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. It is the system’s ability to correctly interpret external data, to learn from such data, and to use that learning to achieve specific goals and tasks through flexible adaptation.</p> <p>Reference(s) or Source: based on https://www.britannica.com/technology/artificial-intelligence; and Kaplan, A., & Haenlein, M. “Siri, Siri, in my hand: Who’s the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence”. <i>Business Horizons</i>. 2019; 62:15–25 (https://www.sciencedirect.com/science/article/abs/pii/S0007681318301393)</p>

OAV Term	Definition and Reference(s) or Source
Automated root cause analysis	<p>Automated RCA is the process of using automation to investigate incident root causes in real time using AI/ML.</p> <p>Reference(s) or Source: https://www.bigpanda.io/blog/why-automated-root-cause-analysis-matters/</p>
Automated service provisioning	<p>Automated service provisioning is the ability to deploy an information technology or telecommunications service by using predefined procedures that are carried out electronically without requiring human intervention.</p> <p>Reference(s) or Source: multiple sources including US government documents, e.g. “Financial Services and General Government Appropriations for 2016”, p. 201 (https://books.google.de/books?id=h4SVIm3XaUsC&printsec=frontcover&hl=de&source=gbs_ge_summary_r&cad=0#v=onepage&q=201&f=false)</p>
Automation	<p>Processing tasks in a repeatable manner to yield the same result every time without human intervention.</p> <p>Reference(s) or Source: internal definition</p>
Autonomy (autonomous AI system)	<p>AI-enabled Autonomy is the capability of machines (either platforms or computer software) to operate independent of direct human intervention, but within constraints, to achieve a goal or solve a problem.</p> <p>Reference(s) or Source: https://www.baesystems.com/en-us/definition/what-is-ai-enabled-autonomy</p>
Auto-scaling support	<p>Autoscale allows you to automatically scale your applications or resources based on demand.</p> <p>Reference(s) or Source: https://learn.microsoft.com/en-us/azure/azure-monitor/autoscale/autoscale-get-started</p>
Bias	<p>A systematic error that occurs in the machine learning model itself due to incorrect assumptions in the ML process. Technically, bias is the error between average model prediction and the ground truth. Unwanted bias may place privileged groups at systematic advantage and unprivileged groups at systematic disadvantage.</p> <p>Reference(s) or Source: https://www.bmc.com/blogs/bias-variance-machine-learning/</p>
Bidirectional Encoder Representations	<p>Bidirectional Encoder Representations from Transformers (BERT) is a deep learning strategy for natural language processing (NLP) that helps artificial intelligence (AI) programs understand the context of ambiguous words in text.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: https://www.techopedia.com/definition/34116/bidirectional-encoder-representations-from-transformers-bert
Big data	Big data reflects extremely large or complex datasets that may be analysed computationally, rather than by traditional data-processing application software, to reveal patterns, trends and associations, especially relating to human behaviours and interactions. Reference(s) or Source: https://link.springer.com/article/10.1057/s41272-019-00191-9 ; https://en.wikipedia.org/wiki/Big_data
Big data-driven networking	A type of future network framework that collects big data from networks and applications, and generates big data intelligence based on that data; it then provides big data intelligence to facilitate smarter and autonomous network management, operation, control, optimisation and security, etc. Reference(s) or Source: ITU Recommendation Y.3652 “Big data driven networking – requirements” (06/20) (https://www.itu.int/rec/T-REC-Y.3652-202006-I/en)
Blockchain	A blockchain is an expanding list of cryptographically signed, irrevocable transactional records shared by all participants in a network. Reference(s) or Source: TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071]
Cgroups (control groups)	Cgroups are Linux kernel mechanisms to restrict and measure resource allocations to each process group. You can use cgroups to allocate resources such as CPU time, network, and memory. Reference(s) or Source: Bharadwaj, R. “Comprehending Processes, Address Space, and Threads: Namespaces and cgroups”, in Mastering Linux Kernel Development, Packt, October 2017 [Bharadwaj]
Chatbot/Bot	A computer program that simulates and processes human conversation (either written or spoken), allowing humans to interact with digital devices, systems and platforms as if they were communicating with a real person. Reference(s) or Source: https://www.oracle.com/chatbots/what-is-a-chatbot/
ChatGPT	A software that allows a user to ask it questions using conversational, or natural, language. It is a language model developed by OpenAI, and is based on the GPT (Generative Pre-training Transformer) architecture, which is a type of neural network designed for natural language processing tasks. Reference(s) or Source: https://www.britannica.com/technology/ChatGPT

OAV Term	Definition and Reference(s) or Source
Classification, classifier	<p>A classifier is the algorithm itself—the rules used by machines to classify data. A classification model, on the other hand, is the end result of your classifier's machine learning. The model is trained using the classifier, so that the model, ultimately, classifies your data.</p> <p>Reference(s) or Source: https://monkeylearn.com/blog/what-is-a-classifier/</p>
Closed-loop processes	<p>An automatic control system in which an operation, process, or mechanism is regulated by feedback.</p> <p>Reference(s) or Source: https://www.merriam-webster.com/dictionary/closed%20loop</p>
Cloud native application	<p>A cloud native application (CNA) refers to a type of computer software that natively utilises services and infrastructure provided by cloud computing providers.</p> <p>Reference(s) or Source: from TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071]</p>
Component	<p>A component is a functionally independent part of any system. It performs some function and may require some input or produce some output.</p> <p>Reference(s) or Source: https://www.techopedia.com/definition/3217/component</p>
Composite service	<p>A composite service is an assembly of one or more elements into an end-to-end service. It may be recursive, i.e. a composite service may become a component of yet another service.</p> <p>Reference(s) or Source: based on TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071] and “TM Forum Technical Report, TR274 Digital Services Reference Architecture Guide”, R17.5 Reference R02</p>
Container	<p>A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.</p> <p>Reference(s) or Source: https://www.docker.com/resources/what-container/</p>
Control plane	<p>The control plane is responsible for processing a number of different control protocols that may affect the forwarding table, depending on the configuration and type of network device. These control protocols are jointly responsible for managing the active topology of the network.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: Göransson, P., & Black, C., “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2014
Conversational agents/conversational AI (chatbots)	<p>A conversational agent is any dialogue system that conducts natural language processing (NLP) and responds automatically using human language. Conversational agents represent the practical implementation of computational linguistics, and are usually deployed as chatbots and virtual or AI assistants.</p> <p>Reference(s) or Source: https://www.dashbot.io/blog/conversational-agent</p>
Conversational AI	<p>Conversational AI (or conversational artificial intelligence), refers to technologies that enable machines to understand, process, and respond to human language naturally. These include chatbots and virtual assistants which can perform tasks or provide information based on voice or text inputs.</p> <p>Reference(s) or Source: https://boost.ai/blog/what-is-conversational-ai/</p>
Convolutional neural network (CNN)	<p>A convolutional neural network (CNN) is a type of artificial neural network used primarily for image recognition and processing. Due to its ability to recognize patterns in images, a CNN is a powerful tool but requires millions of labelled data points for training.</p> <p>Reference(s) or Source: https://www.arm.com/glossary/convolutional-neural-network</p>
Cortex XSOAR	<p>A platform for security orchestration, automation, and response (SOAR), enhanced with ChatGPT for user-friendly incident analysis and response.</p> <p>Reference(s) or Source: https://www.paloaltonetworks.com/blog/security-operations/using-chatgpt-in-cortex-xsoar/</p>
Cortex XSOAR Playbook	<p>A set of automated workflows in Cortex XSOAR, designed to handle security incidents efficiently.</p> <p>Reference(s) or Source: https://www.paloaltonetworks.com/blog/security-operations/using-chatgpt-in-cortex-xsoar/</p>
Cross-domain data services	<p>Data services that are delivered across multiple administrative, information or technological domains that allow data sharing among authorised consumers in different domains.</p> <p>Reference(s) or Source: internal definition based on ETSI GS ZSM 007 V1.1.1 (2019-08), “Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM” [ETSI ZSM 007]</p>

OAV Term	Definition and Reference(s) or Source
Customer Facing Services (CFS)	<p>A logical capability that is packaged as part of a product offering by service providers to their customers, which is directly purchased, leased, visible to and/or otherwise directly usable by those customers. The logical functionality can be derived from underlying network or information technology (i.e., a dedicated contact number or tailored web-based access to operational support for a specific customer) or may be delivered or supplied by staff or contractors employed by the service provider (i.e., dedicated service team or help desk for a specific customer).</p> <p>Reference(s) or Source: https://www.itu.int/rec/T-REC-E.480-200609-I</p>
Data Centre Interconnect (DCI)	<p>A segment of the networking market that focuses on the technology used to link two or more data centres so the facilities can share resources.</p> <p>Reference(s) or Source: https://searchnetworking.techtarget.com/definition/data-center-interconnect</p>
Data Governance	<p>Data governance is the process of managing the availability, usability, integrity, and security of the data in enterprise systems, based on internal data standards and policies that also control data usage. It ensures that data is consistent, trustworthy, and doesn't get misused, facilitating effective decision-making. It also means setting internal standards – data policies – that apply to how data is gathered, stored, processed, and disposed of. It governs who can access what kinds of data and what kinds of data are under governance.</p> <p>Reference(s) or Source: https://cloud.google.com/learn/what-is-data-governance</p>
Data ingestion	<p>Data ingestion is the process of transporting data from one or more sources to a target site, system or platform for further processing and analysis. This data can originate from a range of sources, including data lakes, IoT devices, on-premises databases, and SaaS apps, and end up in different target environments, such as cloud data warehouses or data marts.</p> <p>Reference(s) or Source: https://www.striim.com/what-is-data-ingestion-and-why-this-technology-matters/</p>
Data lake	<p>A storage repository that holds a vast amount of raw data in its native format, primarily in files or objects storage without hierarchical dimensions, until it is needed for analytics applications.</p> <p>Reference(s) or Source: https://www.techtarget.com/searchdatamanagement/definition/data-lake</p>

OAV Term	Definition and Reference(s) or Source
Data model	<p>A data model (or datamodel) is an abstract model that organises elements of data and standardises how they relate to one another.</p> <p>Reference(s) or Source: https://en.wikipedia.org/wiki/Data_model</p>
Data plane	<p>The data plane (sometimes known as the user plane, forwarding plane, carrier plane or bearer plane) is the part of a network device that carries user traffic from one interface to another.</p> <p>Reference(s) or Source: https://searchnetworking.techtarget.com/definition/data-plane-DP</p>
Data Poisoning	<p>Data Poisoning is an adversarial attack that tries to manipulate the training dataset in order to control the prediction behaviour of a trained model such that the model will label malicious examples into desired classes (e.g., labelling spam e-mails as safe).</p> <p>Reference(s) or Source: https://paperswithcode.com/task/data-poisoning</p>
Data Quality	<p>Data quality measures how well a dataset meets criteria for accuracy, completeness, validity, consistency, uniqueness, timeliness, and fitness for purpose, and it is critical to all data governance initiatives within an organization.</p> <p>Reference(s) or Source: https://www.ibm.com/topics/data-quality</p>
Decision management engine	<p>A decision management engine is a customisable solution that represents the logic, often in the form of a rules flow or decision tree, that can be operationalised to automate a decision. [...] A decision management engine articulates how smaller decisions branch off to bigger and more complex decisions and ultimately end with a final outcome. This logic can be codified, documented, and often executed in an automated fashion.</p> <p>Reference(s) or Source: https://www.fico.com/en/glossary/decision-engine</p>
Decoupling	<p>An approach (in electronics, software, etc.) where the constituent components of a system can be produced, sourced and interchanged independently of the other.</p> <p>Reference(s) or Source: internal definition based on TM Forum Reference Document, "TMF071 ODA Terminology", Release 19.0.1, October 2019 [TMF071] and The Open Group Architecture Framework (TOGAF) Standard Version 9.2, Reference R16 (https://publications.opengroup.org/c182?_ga=2.206822355.1575818371.1673347919-434069978.1673347918)</p>
Deep learning	<p>Deep learning is an iterative approach to artificial intelligence (AI) that stacks machine learning algorithms in a hierarchy of increasing complexity</p>

OAV Term	Definition and Reference(s) or Source
	<p>and abstraction. Each deep learning level is created with knowledge gained from the preceding layer of the hierarchy.</p> <p>Reference(s) or Source: https://www.techopedia.com/definition/30325/deep-learning</p>
Domain	<p>A collection of network infrastructure components under the administrative control of the same organisation.</p> <p>Reference(s) or Source: internal definition based on Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.110 (06/98); “Series Y: Global Information Infrastructure – General: Global Information Infrastructure principles and framework architecture” [ITU-T Y.110].</p>
Dynamic Function Placement (DPS)	<p>The act of dynamically placing network functions. This is done by deploying intelligent algorithms to optimally orchestrate differentiated services across multiple sites and clouds based on diverse intents and dynamic environments' policy constraints.</p> <p>Reference(s) or Source: https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf</p>
Edge Computing	<p>Edge computing refers to a distributed computing paradigm that brings computation and data storage closer to the location where it is needed to improve response times and save bandwidth. Instead of relying on a centralised cloud data centre, edge computing performs these processes at or near the physical location of the user or data source.</p> <p>Reference(s) or Source: https://www.ibm.com/cloud/what-is-edge-computing</p>
Evasion attacks	<p>Evasion attacks (a.k.a. adversarial examples) consist of carefully perturbing the input samples at test time to have them misclassified.</p> <p>Reference(s) or Source: https://secml.readthedocs.io/en/stable/tutorials/03-Evasion.html</p>
Expert system	<p>An expert system uses artificial intelligence (AI) technologies to simulate the judgement and behaviour of a human expert based on “knowledge” programmed into it by humans, and only following predetermined rules.</p> <p>Reference(s) or Source: https://www.techtarget.com/searchenterpriseai/definition/expert-system and TM Forum “AI Fundamentals” course [TMF_AIF]</p>
Extract, Transform, Load (ETL)	<p>The data processing technique that engineers use to extract data from different sources, transform the data into a usable and trusted resource, and load that data into the systems end users can access and use downstream to solve business problems.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: https://databricks.com/glossary/extract-transform-load
Federated Learning	<p>A learning model that addresses the problem of data governance and privacy by training algorithms collaboratively without transferring the data to another location.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgMrdfF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OHTf0t4xlscukoNz3hRZAaDQuv_K/pubhtml), NIST(Public_Health_and_Informatics_MIE_2021)</p>
Federated orchestration	<p>Service orchestration, performed by multiple autonomous management domains, to effectively allow services to span across several providers.</p> <p>Reference(s) or Source: internal definition based on https://e-archivo.uc3m.es/rest/api/core/bitstreams/9c33fd42-6611-4a50-b12b-67c79a3661fc/content, ETSI GS ZSM 007 V1.1.1 (2019-08); “Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM” [ETSI ZSM 007]; and https://www.researchgate.net/publication/318473608_Orchestration_of_Network_Services_across_multiple_operators_The_5G_Exchange_prototype</p>
Foundation model	<p>An AI model that is trained on broad data at scale, is designed for generality of output, and can be adapted to a wide range of distinctive tasks.</p> <p>Reference(s) or Source: “Proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts” (https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/CJ40/DV/2023/05-11/ConsolidatedCA_IMCOLIBE_AI_ACT_EN.pdf)</p>
Functional block	<p>A self-contained unit in an overall system that performs a specific function or task.</p> <p>Reference(s) or Source: internal definition based on TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071]; and ETSI GS NFV-INF 007 V1.1.1 (2014-10), “Network Functions Virtualisation (NFV); Infrastructure; Methodology to describe Interfaces and Abstractions, Reference R08” (https://www.etsi.org/deliver/etsi_gs/NFV-INF/001_099/007/01.01.01_60/gs_NFV-INF007v010101p.pdf)</p>

OAV Term	Definition and Reference(s) or Source
Generative Adversarial Network (GAN)	<p>An approach to training AI models useful for applications like data synthesis, augmentation, and compression where two neural networks are trained in tandem: one is designed to be a generative network (the forger) and the other a discriminative network (the forgery detector). The objective is for each network to train and better itself off the other, reducing the need for big, labeled training data.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgMrdfF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1Km7OHtF0t4xlsckuogNZ3hRZAaDQuv_K/pubhtml), NIST(NSCAI)</p>
Generative AI	<p>Foundation models used in AI systems specifically intended to generate, with varying levels of autonomy, content such as complex text, images, audio, or video.</p> <p>Reference(s) or Source: “Proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts” https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/CJ40/DV/2023/05-11/ConsolidatedCA_IMCOLIBE_AI_ACT_EN.pdf), P. 42</p>
Generative Pre-trained Transformer	<p>GPT, or Generative Pre-trained Transformer, is a state-of-the-art language model developed by OpenAI. It uses deep learning techniques to generate natural language text, such as articles, stories, or even conversations, that closely resemble human-written text.</p> <p>Reference(s) or Source: https://encord.com/glossary/gpt-definition/</p>
Hierarchical orchestration	<p>Orchestration decomposed into one or more hierarchical interactions where parts of the service are delegated to a subordinate orchestrator.</p> <p>Reference(s) or Source: ETSI GS ZSM 007 V1.1.1 (2019-08), “Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM” [ETSI ZSM 007]</p>
Holistic Anomaly Detection (e.g., via multi-vector AI/ML-based behavioural analytics)	<p>Anomaly detection, or outlier detection, is the identification of observations, events or data points that deviate from what is usual, standard or expected, making them inconsistent with the rest of a data set. Holistic anomaly detection takes a comprehensive approach to anomaly detection using a variety of methods.</p> <p>Reference(s) or Source: https://www.ibm.com/topics/anomaly-detection</p>
Horizontal Scaling	<p>Horizontal scaling (or scaling out) means that you scale by adding more machines into your pool of resources.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: https://ibm.github.io/data-science-best-practices/scaling.html
Human-centric AI	<p>Human-Centered AI (HCAI) is an emerging discipline intent on creating AI systems that amplify and augment rather than displace human abilities. HCAI seeks to preserve human control in a way that ensures artificial intelligence meets our needs while also operating transparently, delivering equitable outcomes, and respecting privacy.</p> <p>Reference(s) or Source: https://research.ibm.com/blog/what-is-human-centered-ai</p>
Intelligent network	<p>An architectural concept for the support, maintenance, operation and provision of new services which is characterised by information processing, efficient management, control and use of network resources and standardised communication between physical resources, network functions and services.</p> <p>Reference(s) or Source: based on International Telegraph and Telephone Consultative Committee (CCITT) Recommendation I.312 / Q.1201 (10/92) "Principles of Intelligent Network Architecture" (https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-I.312-199210-!!PDF-E&type=items)</p>
Intent-based Networking	<p>A software-enabled automation process that uses high levels of intelligence, analytics, and orchestration to improve network operations and uptime.</p> <p>Reference(s) or Source: https://www.juniper.net/us/en/research-topics/what-is-intent-based-networking.html</p>
Intent-based policy / network	<p>Technology incorporating artificial intelligence (AI) and machine learning to automate administrative tasks across a network.</p> <p>Reference(s) or Source: based on TM Forum Reference Document, "TMF071 ODA Terminology", Release 19.0.1, October 2019 [TMF071]</p>
Internet of Things (IoT)	<p>The Internet of Things, or IoT, is a system of interrelated networking computing devices, mechanical and digital machines aimed at objects, animals or people and provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.</p> <p>Reference(s) or Source: based on https://en.wikipedia.org/wiki/Internet_of_things and https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT</p>
Kubernetes	<p>Kubernetes is an open-source platform used to automate the deployment, scaling, and management of containerized applications. It orchestrates</p>

OAV Term	Definition and Reference(s) or Source
	<p>computing, networking, and storage infrastructure on behalf of user workloads, providing a resilient environment for running distributed systems. Kubernetes allows for self-healing, scaling, and service discovery, making it a vital tool for managing containerized applications at scale.</p> <p>Reference(s) or Source: https://kubernetes.io/docs/concepts/overview/what-is-kubernetes/</p>
Language Model	<p>A machine-learning model designed to represent the language domain.</p> <p>Reference(s) or Source: https://www.deepset.ai/blog/what-is-a-language-model</p>
Large Language Model	<p>A class of language models that use deep-learning algorithms and are trained on extremely large textual datasets that can be multiple terabytes in size. LLMs can be classed into two types: generative or discriminatory. Generative LLMs are models that output text, such as the answer to a question or even writing an essay on a specific topic. They are typically unsupervised or semi-supervised learning models that predict what the response is for a given task. Discriminatory LLMs are supervised learning models that usually focus on classifying text, such as determining whether a text was made by a human or AI.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgMrdfF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1K7m7OhtF0t4xlscukoNz3hRZAaDQuv_K/pubhtml), NIST (AI_Assurance_2022)</p>
Machine learning (ML)	<p>Processes that enable computational systems to “understand” data and gain “knowledge” from it without necessarily being explicitly programmed. (Supervised machine learning and unsupervised machine learning are two examples of machine learning.)</p> <p>Reference(s) or Source: based on ETSI GR ENI 004 V2.1.1 (2019-10), “Experiential Networked Intelligence (ENI); Terminology for Main Concepts in ENI” https://www.etsi.org/deliver/etsi_gr/ENI/001_099/004/02.01.01_60/gr_eni004v020101p.pdf) and Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.3177 (02/2021) “Architectural framework for artificial intelligence-based network automation for resource and fault management in future networks including IMT-2020” (https://www.itu.int/rec/dologin_pub.asp?lang=s&id=T-REC-Y.3177-202102-!!!PDF-E&type=items)</p>
Management	<p>The processes for fulfilment, assurance, and billing of services, network functions, and resources in both physical and virtual infrastructure including compute, storage, and network resources.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: based on Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.3100 (09/2017); “Series Y: Global Information Infrastructure, Internet Protocol Aspects, Next-Generation Networks, Internet of Things and Smart Cities – Future networks: Terms and definitions for IMT-2020 network” [ITU-T Y.3100]
Management API	<p>A software interface that allows the performing of all management operations before, during and after the use of a service.</p> <p>Reference(s) or Source: based on TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071]</p>
Management domain	<p>A collection of physical or functional elements under the control of an entity (e.g. organisation, NREN) that provides the fulfilment, assurance, and billing of services, network functions, and resources in both physical and virtual infrastructures.</p> <p>Reference(s) or Source: internal definition based on Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.3100 (09/2017), “Series Y: Global Information Infrastructure, Internet Protocol Aspects, Next-Generation Networks, Internet of Things and Smart Cities – Future networks: Terms and definitions for IMT-2020 network” [ITU-T Y.3100] and Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.110 (06/98); “Series Y: Global Information Infrastructure – General: Global Information Infrastructure principles and framework architecture” [ITU-T Y.110]</p>
Maturity level	<p>A maturity level is a defined evolutionary plateau for organisational process improvement. Each maturity level matures an important subset of an organisation’s processes, preparing it to move to the next maturity level. The maturity levels are measured by the achievement of the specific and generic goals associated with each predefined set of process areas.</p> <p>Reference(s) or Source: https://www.megatronicstech.com/maturity-level-of-technology/</p>
Maturity model	<p>A maturity model is an instrument that evaluates the current position of certain capabilities of an organisation and provides indications of how it can transform to improve.</p> <p>Reference(s) or Source: based on https://www.bmc.com/blogs/digital-maturity-models/, https://link.springer.com/article/10.1007/s12599-009-0044-5 and the TM Forum “AI Fundamentals” course [TMF_AIF]</p>
Microservices	<p>An approach to software architecture that builds a large, complex application from multiple small components that each perform a single function, such as authentication, notification, or payment processing. Each microservice is a distinct unit within the software architecture, with its own code base, infrastructure, and database. The microservices work together,</p>

OAV Term	Definition and Reference(s) or Source
	<p>communicating through web APIs or messaging queues to respond to incoming events.</p> <p>Reference(s) or Source: https://www.nginx.com/learn/microservices/</p>
Modelling Abstractions	<p>Model abstraction is a way of simplifying an underlying conceptual model on which a simulation is based while maintaining the validity of the simulation results with respect to the question being addressed by the simulation.</p> <p>Reference(s) or Source: https://www.sciencedirect.com/book/9780123850850/model-based-engineering-for-complex-electronic-systems</p>
Natural Language Generation	<p>Natural language generation (NLG) is the use of artificial intelligence (AI) programming to produce written or spoken narratives from a data set.</p> <p>Reference(s) or Source: https://www.qualtrics.com/uk/experience-management/customer/natural-language-generation/?rid=ip&prevsite=en&newsite=uk&geo=RO&geomatch=uk</p>
Natural language processing (NLP)	<p>The ability of a machine to process, analyse, and mimic human language, either spoken or written.</p> <p>Reference(s) or Source: The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)" (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgaMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1Km7OHtF0t4xlscukoNz3hRZAaDQuv_K/pubhtml), NIST (NSCAI)</p>
Network automation	<p>The process of automating the configuration, management, testing, deployment, and operations of physical and virtual devices within a network.</p> <p>Reference(s) or Source:</p> <p>https://www.juniper.net/uk/en/products-services/what-is/network-automation/</p> <p>https://www.cisco.com/c/en/us/solutions/automation/network-automation.html</p> <p>https://www.netsync.com/practices/service-provider/network-automation/</p>
Network controller	<p>A functional block that centralises some or all of the control and management functionality of a network domain, and may provide an abstract view of its domain to other functional blocks via well-defined interfaces.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: ETSI GS NFV 003 V1.4.1 (2018-08), “Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV” [ETSI_NFV_003]
Network function (NF)	<p>A functional building block within a network infrastructure, which has well-defined external interfaces and functional behaviour.</p> <p>Reference(s) or Source: ETSI GS ZSM 007 V1.1.1 (2019-08), “Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM” [ETSI_ZSM_007]</p>
Network function disaggregation (NFD)	<p>Defines the evolution of switching and routing appliances from proprietary, closed hardware and software sourced from a single vendor, towards totally decoupled, open components which are combined to form a complete switching and routing device.</p> <p>Reference(s) or Source: https://drivenets.com/blog/network-disaggregation-101/</p>
Network intelligence level	<p>A three-level application of automation capabilities (i.e., full automated infrastructure management, data centre infrastructure management and traceable/intelligent patch cords), including those enabled by integrating artificial intelligence techniques in the network.</p> <p>Reference(s) or Source: Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.3173 (02/2020) “Series Y: Global Information Infrastructure, Internet Protocol Aspects, Next-Generation Networks, Internet of Things and Smart Cities – Future networks: Framework for evaluating intelligence levels of future networks including IMT-2020 network” (https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-Y.3173-202002-!!!PDF-E&type=items)</p>
Network namespaces	<p>A virtualisation mechanism (a virtualised networking stack) which provides abstraction and virtualisation of network protocol services and interfaces. Each network namespace has its own network device instances that can be configured with individual network addresses.</p> <p>Reference(s) or Source: internal definition based on Bharadwaj, R. “Comprehending Processes, Address Space, and Threads: Namespaces and cgroups”, in Mastering Linux Kernel Development, Packt, October 2017 [Bharadwaj]</p>
Network orchestration	<p>Network orchestration is the execution of the operational and functional processes involved in designing, creating, and delivering an end-to-end service. For example, it uses network automation to provide services through the use of applications that drive the network. An orchestrator functions to arrange and organise the various components involved in delivering a network service.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: internal definition based on https://www.ciena.com/insights/what-is/what-is-service-orchestration.html
Network resource	Physical or logical network component of hardware, software or data in the data, control or management planes within an organisation's infrastructure. Reference(s) or Source: internal definition
Network service	A collection of network functions with a well-specified behaviour (e.g. content delivery networks (CDNs) and IP multimedia subsystem (IMS)). Reference(s) or Source: internal definition based on Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation Y.3515 (07/2017), "Series Y: Global Information Infrastructure, Internet Protocol Aspects, Next-Generation Networks, Internet of Things and Smart Cities – Cloud Computing: Functional architecture of Network as a Service" (https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-Y.3515-201707-1!!PDF-E&type=items)
Network Service Meshes	A network service mesh is intended to support application-to-application and function-to-function communications in networks and scenarios through dynamic and automated virtual network services – to be allocated on-demand, based on application requirements. Additionally, a service mesh is a software layer that handles all communication between services in applications. This layer is composed of containerized microservices. Reference(s) or Source: https://aws.amazon.com/what-is/service-mesh/#:~:text=service%20mesh%20requirements%3F-,What%20is%20a%20service%20mesh%3F,the%20performance%20of%20the%20services
Network slice instance	A network slice instance is a set of network function instances and the required resources (e.g., compute, storage and networking resources) which form a deployed network slice. Reference(s) or Source: based on TM Forum Reference Document, "TMF071 ODA Terminology", Release 19.0.1, October 2019 [TMF071] and the 3rd Generation Partnership Project (3GPP) Technical Specification (TS) 23.501, System architecture for the 5G System (5GS) (https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3144)
Network slicing	A specific form of virtualisation that allows multiple logical networks to run on top of a shared physical network infrastructure. The intent of network slicing is to be able to partition the physical network at an end-to-end level to allow optimum grouping of traffic, isolation from other tenants, and configuring of resources at a micro level.

OAV Term	Definition and Reference(s) or Source
	<p>Reference(s) or Source: https://www.idginsiderpro.com/article/3231244/what-is-the-difference-between-network-slicing-and-quality-of-service.html and https://www.samenacouncil.org/thought-leadership-read?id=151</p>
Neural Network	<p>Neural networks, also known as artificial neural networks (ANNs) or simulated neural networks (SNNs), are a subset of machine learning and are at the heart of deep learning algorithms. Their name and structure are inspired by the human brain, mimicking the way that biological neurons signal to one another. Artificial neural networks (ANNs) consist of multiple layers: an input layer, one or more hidden layers, and an output layer, all organised within a node structure. Each node, or artificial neuron, connects to another and has an associated weight and threshold. If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network.</p> <p>Reference(s) or Source: https://www.ibm.com/topics/neural-networks</p>
NFV	<p>Network function virtualisation (NFV) is a network architecture concept that uses virtualisation to classify entire classes of network node functions into building blocks that may connect or chain together to create communication services. More specifically, it is the deployment of software implementations of traditional network functions (e.g., load balancers, firewalls, office switches/routers) on virtualised infrastructure rather than on function-specific specialised hardware devices.</p> <p>Reference(s) or Source: based on Huang, D., & Wu, H., “Virtualization” in Mobile Cloud Computing: Foundations and Service Models, Morgan Kaufmann, 2018 (https://www.sciencedirect.com/topics/computer-science/network-function-virtualization)</p>
NFV-MANO	<p>Network function virtualisation management and orchestration (NFV-MANO) is a key element of the ETSI network function virtualisation (NFV) architecture. MANO is an architectural framework that coordinates network resources for cloud-based applications and the lifecycle management of virtual network functions (VNFs) and network services. As such, it is crucial for ensuring rapid, reliable NFV deployments at scale. MANO includes the following components: the NFV orchestrator (NFVO), the VNF manager (VNFM), and the virtual infrastructure manager (VIM).</p> <p>Reference(s) or Source: https://www.adva.com/en/products/technology/what-is-nfv-mano</p>
NFV-MANO architectural framework	<p>Network functions virtualisation management and orchestration (NFV-MANO) architectural framework is a collection of all functional blocks (including those in the NFV-MANO category and others that interwork with NFV-MANO), data repositories used by these functional blocks, and</p>

OAV Term	Definition and Reference(s) or Source
	<p>reference points and interfaces through which these functional blocks exchange information to manage and orchestrate NFV.</p> <p>Reference(s) or Source: ETSI GS NFV 003 V1.4.1 (2018-08), “Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV” [ETSI NFV 003]</p>
NFVO	<p>Network Functions Virtualisation Orchestrator (NFVO) is a functional block that manages the network service (NS) lifecycle and coordinates the management of NS lifecycle, VNF lifecycle (supported by the VNFM) and NFVI resources (supported by the VIM) to ensure an optimised allocation of the necessary resources and connectivity.</p> <p>Reference(s) or Source: ETSI GS NFV 003 V1.4.1 (2018-08), “Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV” [ETSI NFV 003]</p>
Omni-channel Capabilities	<p>Omnichannel capabilities is a term used in e-commerce and retail to describe if a business has the capabilities to implement a strategy that aims to provide a seamless shopping experience across all channels, including in-store, mobile, and online.</p> <p>Reference(s) or Source: https://www.techtarget.com/searchcustomerexperience/definition/omnichannel</p>
Open virtual network (OVN)	<p>An Open vSwitch-based software-defined networking (SDN) solution for supplying network services to instances.</p> <p>Reference(s) or Source: https://access.redhat.com/documentation/en-us/red_hat_openshift_platform/13/html/networking_with_open_virtual_network/open_virtual_network_ovn</p>
Open vSwitch (OVS)	<p>Open-source multilayer virtual switch that supports standard interfaces and protocols.</p> <p>Reference(s) or Source: based on https://www.openvswitch.org/</p>
OpenFlow protocol	<p>A protocol defined by the OpenFlow Switch Specification that allows separation of the network control plane by providing programmable access to the forwarding plane.</p> <p>Reference(s) or Source: internal definition based on the Open Networking Foundation’s OpenFlow Switch Specification (https://www.opennetworking.org/wp-content/uploads/2014/10/openflow-switch-v1.5.1.pdf) and https://www.opennetworking.org/sdn-definition/?nab=1</p>

OAV Term	Definition and Reference(s) or Source
OpenFlow (standard)	<p>An open standard that enables you to control traffic and run experimental protocols in an existing network by using a remote controller. The OpenFlow components consist of a controller, an OpenFlow or OpenFlow-enabled switch, and the OpenFlow protocol.</p> <p>Reference(s) or Source: https://www.juniper.net/documentation/en_US/junos/topics/concept/junos-sdn-openflow-support-overview.html</p>
OpenStack	<p>Open-source software for creating private and public clouds. OpenStack software can control large pools of compute, storage, and networking resources throughout a data centre, managed through a dashboard or via the OpenStack API.</p> <p>Reference(s) or Source: https://www.openstack.org/</p>
Operational domain	<p>Scope of management delineated by an administrative and technological boundary.</p> <p>Reference(s) or Source: based on TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071]</p>
Orchestration (ONAP)	<p>The arrangement, sequencing and automated implementation of tasks, rules and policies to coordinate logical and physical resources in order to meet a customer or on-demand request to create, modify or remove network or service resources.</p> <p>Reference(s) or Source: TM Forum Technical Specification, “TMF071 Terminology for Zero-touch Orchestration, Operations and Management, Release 17.0.1, November 2017, version 0.4.1” (https://www.tmforum.org/resources/specification/tmf071-terminology-for-zero-touch-orchestration-operations-and-management-r17-0-1/)</p>
Process automation	<p>Process automation refers to the usage of technology to automate complex processes. It typically has three functions: automating processes, centralising information, and reducing the requirement for input from people. It is designed to remove bottlenecks and reduce errors and data loss, all while increasing transparency, communication across departments, and processing speed.</p> <p>Reference(s) or Source: https://www.tibco.com/reference-center/what-is-process-automation</p>
Raw Model	<p>In the context of machine learning, a 'raw model' typically refers to a model that has been trained on data without much preprocessing or feature engineering. It is a basic model without any fine-tuning or optimisation.</p>

OAV Term	Definition and Reference(s) or Source
	<p>Reference(s) or Source: https://www.sciencedirect.com/science/article/pii/S0952197622003049</p>
Rectification Activation Function	<p>Rectification is the process of using a rectifier activation function (also referred to as a Rectified Linear Unit or ReLU): Rectified linear units, allow for faster and effective training of deep neural architectures on large and complex datasets compared to sigmoid function or similar activation functions.</p> <p>Reference(s) or Source: https://www.ml-science.com/rectifier-activation-function</p>
Recurrent Neural Network	<p>RNN stands for Recurrent Neural Network. This is a type of artificial neural network that can process sequential data, recognise patterns, and predict the final output. This type of neural network is called recurrent because it can repeatedly perform the same task or operation on a sequence of inputs.</p> <p>Reference(s) or Source: https://hackernoon.com/what-is-an-rnn-recurrent-neural-network-in-deep-learning</p>
Reinforcement learning	<p>A method of training algorithms, using a system of reward and punishment, to take suitable actions by maximising rewarded behaviour over the course of its actions. This type of learning can take place in simulated environments, such as game-playing, which reduces the need for real-world data.</p> <p>Reference(s) or Source: based on https://www.techopedia.com/definition/32055/reinforcement-learning-rl and “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgAMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OhtF0t4xlscukoNz3hRZAaDQuv_K/pubhtml), NIST(NSCAI)</p>
Resource Facing Services (RFS)	<p>A logical capability that is packaged as part of a product offering by service providers to their customers, but which is not directly visible to and/or usable by those customers. The logical functionality can be derived from underlying network or information technology (i.e., MPLS capabilities provided as part of a router), or may be delivered or supplied by staff or contractors employed by the service provider.</p> <p>Reference(s) or Source: https://www.itu.int/rec/T-REC-E.480-200609-I</p>
Resource slice	<p>A grouping of physical or virtual (network, compute, storage) resources. A resource slice could be one of the components of a network slice; however, on its own it does not fully represent a network slice.</p>

OAV Term	Definition and Reference(s) or Source
	<p>Reference(s) or Source: IETF Network Working Group Internet-Draft, “Network Slicing Architecture”, 2 June 2017 https://datatracker.ietf.org/doc/html/draft-geng-netslices-architecture-01</p>
Robotic Process Automation (RPA)	<p>Robotic Process Automation (RPA) is a type of AI; it is a software technology that allows people to configure robots to perform rules-based tasks. It can be particularly useful for processes with predictable and frequent interactions with multiple applications.</p> <p>Reference(s) or Source: based on TM Forum “AI Fundamentals” course [TMF AIF] and TM Forum “AI and its pivotal role in transforming operations” report and webinar [TMF AI]</p>
SecOps	<p>Security operations, also known as SecOps, refers to a business combining internal information security and IT operations practices to improve collaboration and reduce risks.</p> <p>Reference(s) or Source: https://www.cyberark.com/what-is/security-operations/</p>
Self-configuration	<p>A process by which computer systems or networks automatically adapt their own configuration of components without direct human intervention.</p> <p>Reference(s) or Source: based on https://www.igi-global.com/dictionary/aspect-oriented-self-configuring-p2p/26200 (retrieved Nov. 11, 2019) and ETSI GS ZSM 007 V1.1.1 (2019-08), “Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM” [ETSI ZSM 007]</p>
Self-learning AI	<p>Self-learning models are AI models that, once deployed, can be optimised by training them on data that becomes more available over time. This process prevents engineers from having to begin building new AI models from scratch every single time they collect more data.</p> <p>Reference(s) or Source: https://www.monolithai.com/blog/what-is-a-self-learning-model</p>
Self-organising network (SON)	<p>The term self-organising network comes from the mobile radio network industry and refers to automated planning, configuration, management, optimisation and healing of a network.</p> <p>Reference(s) or Source: based on https://www.celona.io/network-architecture/self-organizing-network</p>
Service access point	<p>A type of resource function (RF) that handles access into and out of another RF, such as an application RF or virtualised appliance RF.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: TM Forum Reference Document, “TMF071 ODA Terminology, Release 19.0.1”, October 2019 [TMF071]
Serverless Architecture	<p>Serverless architecture is a cloud-computing execution model where the cloud provider dynamically manages the allocation of machine resources. Pricing is based on the actual amount of resources consumed by an application, rather than pre-purchased units of capacity. This architecture allows developers to build and run applications without managing the underlying infrastructure.</p> <p>Reference(s) or Source: https://aws.amazon.com/serverless/</p>
Service chaining	<p>Network service chaining, also known as service function chaining (SFC), is a capability that uses software-defined networking (SDN) capabilities to create a service chain of connected network services (such as L4-7 firewalls, network address translation (NAT), or intrusion protection) and connects them in a virtual chain. This capability can be used by network operators to set up suites or catalogues of connected services that enable the use of a single network instance for many services, with different characteristics.</p> <p>Reference(s) or Source: https://www.sdxcentral.com/networking/virtualization/definitions/what-is-network-service-chaining/</p>
Single Source of Truth	<p>A single source of truth can be defined as a centralized and authoritative data repository that serves as the definitive reference for all relevant information within an organization.</p> <p>Reference(s) or Source: https://www.kohezion.com/technology-excellence/single-source-of-truth</p>
Software (Engineering) Governance	<p>Software Engineering Governance or Software Governance is the set of structures, processes and policies by which the software development and deployment function within an organisation is directed and controlled to yield business values and to mitigate risk.</p> <p>Reference(s) or Source: https://www.cs.uoregon.edu/events/icse2009/images/postConf/TB-Governance-ICSE09.pdf</p>
Software-defined exchange (SDX)	<p>A software-defined exchange (or IXP) (SDX) is an Internet exchange that uses SDN for interdomain routing. In addition, SDX design incorporates high levels of programmability, open APIs, shared resources across multiple domains, dynamic provisioning, resource discovery, quick resource integration and configuration, and granulated control of resources.</p> <p>Reference(s) or Source: internal definition based on https://sdx.cs.princeton.edu/ and Mambretti, J., Chen, J., & Yeh, F.,</p>

OAV Term	Definition and Reference(s) or Source
	<p>“Software-Defined Network Exchanges (SDXs): Architecture, services, capabilities, and foundation technologies”, in 2014 26th International Teletraffic Congress (ITC), DOI: 10.1109/ITC.2014.6932970</p>
Software-defined networking (SDN)	<p>A programmable network approach that supports the separation of control and forwarding planes via standardised interfaces.</p> <p>Reference(s) or Source: Internet Research Task Force (IRTF), Request for Comments (RFC) 7426, Software-Defined Networking (SDN): Layers and Architecture Terminology, January 2015 https://datatracker.ietf.org/doc/html/rfc7426</p>
Supervised learning / Supervised machine learning	<p>Supervised learning, also known as supervised machine learning, is an approach to creating artificial intelligence (AI), where a computer algorithm is trained on input data that has been labelled for a particular output. The model is trained until it can detect the underlying patterns and relationships between the input and output labels, enabling it to yield accurate labelling results when presented with never-before-seen data.</p> <p>Also: “Note 2 – Supervised machine learning and unsupervised machine learning are two examples of machine learning types.” From ITU Recommendation Y.3172 (06/19).</p> <p>Reference(s) or Source: based on https://www.techtarget.com/searchenterpriseai/definition/supervised-learning and https://www.ibm.com/cloud/learn/supervised-learning</p>
Switch abstraction interface (SAI)	<p>Definition of the API to provide a vendor-independent way of controlling forwarding elements, such as a switching ASIC, an NPU or a software switch, in a uniform manner.</p> <p>Reference(s) or Source: Open Compute Project GitHub page https://github.com/opencomputeproject/SAI</p>
Technical Reference Model (TRM)	<p>Architecture of generic services and functions that provides a foundation on which more specific architectures and architectural components can be built.</p> <p>Reference(s) or Source: https://pubs.opengroup.org/architecture/togaf8-doc/arch/chap19.html (TOGAF™ stands for The Open Group Architecture Framework)</p>
Testing data	<p>‘Testing data’ means data used for providing an independent evaluation of the trained and validated AI system in order to confirm the expected performance of that system before its placing on the market or putting into service.</p> <p>Reference(s) or Source: “Proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts”</p>

OAV Term	Definition and Reference(s) or Source
	https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/CJ40/DV/2023/05-11/ConsolidatedCA_IMCOLIBE_AI_ACT_EN.pdf
The Network Data Analytics Function (NWDAF)	<p>A network function that collects data from various network functions, application functions, as well as operations, administration, and management (OAM) systems, and operational support systems.</p> <p>Note: This term is frequently used in 5G architecture.</p> <p>Reference(s) or Source: https://www.linkedin.com/pulse/network-data-analytics-function-nwdaf-5g-mintu-kumar-chetry/</p>
Training Data	<p>The data that are used to try to fit the best combination of weights and biases to a machine learning algorithm to minimize a loss function over the prediction range.</p> <p>Reference(s) or Source: Based on “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgaMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OhtF0t4xlscukoNz3hRZAaDQuv_K/pubhtml), NIST(C3.ai_Model_Training)</p>
Training model	<p>A machine learning training model is a process in which a machine learning (ML) algorithm is fed with sufficient training data to learn from. ML models can be trained to benefit manufacturing processes in several ways. The result of the process is a trained model.</p> <p>Reference(s) or Source: https://oden.io/glossary/model-training/</p>
Transfer Learning	<p>A technique in machine learning in which an algorithm learns to perform one task, such as recognising cars, and then is used as the starting point for a second, different task such as recognising cats. By using the knowledge from the first task the model can learn more quickly and effectively on the second task.</p> <p>Reference(s) or Source: based on: https://www.geeksforgeeks.org/ml-introduction-to-transfer-learning/</p>
Transformers	<p>A procedure that modifies a dataset.</p> <p>Reference(s) or Source: “The Language of Trustworthy AI: An In-Depth Glossary of Terms (updated August 4, 2024)” (https://docs.google.com/spreadsheets/d/e/2PACX-1vTRBYglcOtgaMrdF11aFxfEY3EmB31zslYI4q2_7ZZ8z_1lKm7OhtF0t4xlscukoNz3hRZAaDQuv_K/pubhtml) NIST (AI_Fairness_360)</p>
Unsupervised learning / Unsupervised machine learning	<p>Unsupervised learning, also known as unsupervised machine learning, uses machine learning algorithms to analyse and cluster unlabelled datasets. These algorithms discover hidden patterns or data groupings without</p>

OAV Term	Definition and Reference(s) or Source
	<p>human intervention. The ability of this type of learning to discover similarities and differences in information makes it the ideal solution for exploratory data analysis, cross-selling strategies for offering different products to customers, customer segmentation, and image recognition.</p> <p>Reference(s) or Source: https://www.ibm.com/cloud/learn/unsupervised-learning</p>
User interface orchestration	<p>User interface orchestration defines, formats and structures the sequence of user interfaces (UIs) needed for a process. An example of this is the orchestration of UIs during a service request from a customer.</p> <p>Reference(s) or Source: based on TM Forum Reference Document, “TMF071 ODA Terminology”, Release 19.0.1, October 2019 [TMF071] and IG1167 R18.0.0 ODA Functional Architecture Reference R21</p>
Validation Data	<p>‘Validation data’ means data used for providing an evaluation of the trained AI system and for tuning its non-learnable parameters and its learning process, among other things, in order to prevent underfitting or overfitting; whereas the validation dataset is a separate dataset or part of the training dataset, either as a fixed or variable split.</p> <p>Reference(s) or Source: “Proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts” (https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/CJ40/DV/2023/05-11/ConsolidatedCA_IMCOLIBE_AI_ACT_EN.pdf)</p>
Vertical scaling	<p>Vertical scaling (or scaling up) means that you scale by adding more power (CPU, RAM) to an existing machine.</p> <p>Reference(s) or Source: https://ibm.github.io/data-science-best-practices/scaling.html</p>
Virtual content delivery network	<p>A content delivery network using virtualisation technology that enables the allocation of virtual storage, virtual machines, and network resources according to a provider’s requirements in a dynamic and scalable manner.</p> <p>Reference(s) or Source: based on Telecommunication Standardisation Sector of ITU (ITU-T) Recommendation F.743.4 (03/2017), “Series F: Non-Telephone Telecommunication Services – Multimedia services: Functional requirements for virtual content delivery networks” (https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-F.743.4-201703-I!!PDF-E&type=items)</p>
Virtual eXtensible Local Area Network (VXLAN)	<p>Enables the encapsulation of Ethernet frames inside UDP packets with a designated UDP destination port (4789). VXLAN allows users to overlay L2 networks on top of existing L3 networks. In the data centre, it is commonly used to stretch an L2 network across multiple racks.</p>

OAV Term	Definition and Reference(s) or Source
	<p>Reference(s) or Source: https://github.com/Mellanox/mlxsw/wiki/Virtual-eXtensible-Local-Area-Network-(VXLAN)</p> <p>Internet Engineering Task Force (IETF), Request for Comments (RFC) 7348, “Virtual eXtensible Local Area Network (VXLAN): A Framework for Overlaying Virtualized Layer 2 Networks over Layer 3 Networks, August 2014” (https://datatracker.ietf.org/doc/html/rfc7348)</p>
Virtual routing and forwarding (VRF)	<p>A layer 3 abstraction, which provides a separate routing table for each instance. Usually this is done by adding some sort of VRF ID to the routing table lookup.</p> <p>Reference(s) or Source: internal definition based on https://en.wikipedia.org/wiki/Virtual_routing_and_forwarding</p>
Virtualisation	<p>Abstraction of network or service objects to make them appear generic, i.e. disassociated from the underlying hardware implementation specifics.</p> <p>Reference(s) or Source: internal definition</p>
Virtualised network function (VNF)	<p>A network task written as software that can be provided in a virtualised manner (e.g., firewall, router, switch).</p> <p>Reference(s) or Source: internal definition based on https://www.sdxcentral.com/networking/nfv/definitions/virtual-network-function/ and https://www.webopedia.com/TERM/V/virtualized-network-function.html</p>
Workflow	<p>The sequence of steps through which a piece of work passes from initiation to completion.</p> <p>Reference(s): https://www.merriam-webster.com/dictionary/workflow</p>
Workflow management (WFM)	<p>A technology supporting the re-engineering of business and information processes. It involves defining workflows and providing fast (re)design and (re)implementation of the processes, as business needs and information systems change.</p> <p>Reference(s) or Source: D. Georgakopoulos, D., Hornick, M., & Sheth, A., “An Overview of Workflow Management: From Process Modeling to Workflow Automation Infrastructure”, Distributed and Parallel Databases, 3, 119–153 (1995), (http://www.workflowpatterns.com/documentation/documents/workflow95.pdf)</p>
Zero-touch provisioning (ZTP) or Zero-touch enrolment	<p>Zero-touch provisioning (ZTP), or zero-touch enrolment, is the process of remotely provisioning large numbers of network devices such as switches, routers and mobile devices without having to manually program each one individually.</p>

OAV Term	Definition and Reference(s) or Source
	Reference(s) or Source: https://en.wikipedia.org/wiki/Zero-touch_provisioning and https://www.techtarget.com/searchitoperations/definition/zero-touch-provisioning-ZTP

Table 2.1: Term definitions

3 Acronyms

A list of abbreviations and the corresponding terms relating to OAV commonly used in the GÉANT and NREN community is given below:

Acronym	Full Term
ABE	Aggregate Business Entity
ACMM	Analysis Capability Maturity Model
AI	Artificial Intelligence
AIOps	Artificial Intelligence for IT Operations
AMC	Autonomic Management and Control
AMM	Automation Maturity Model
ACMM	Architecture Capability Maturity Model
AWS	Amazon Web Services
BPMM	Business Process Maturity Model
BPMN	Business Process Model and Notation
BSS	Business Support System
CBP	Ciena Blue Planet
CCITT	International Telegraph and Telephone Consultative Committee
CDE	Component DDescription
CDN	Content Delivery Network
CMM	(Service) Capability Maturity Model
CMMI	Capability Maturity Model Integrated
CNA	Cloud Native Application
CNI	Container Network Interface

Acronym	Full Term
CSP	Communications Service Provider
D&I	Decoupling & Integration
DC	Data Centre
DCN	Data Communication Network
DE	Decision Element
DPMM	Document Process Maturity Model
DPRA	Digital Platform Reference Architecture
DTN	Data Transfer Node
EACM	Enterprise Architecture Content Metamodel
EGM	Engagement Management
eLMM	e-Learning Maturity Model
ETSI	European Telecommunications Standards Institute
EVPN	Ethernet VPN
FOSS	Free and Open-Source Software
FRR	Free Range Routing
GANA	Generic Autonomic Network Architecture
Geneve	Generic Network Virtualisation Encapsulation
GNA-G	Global Network Advancement Group
GRE	Generic Routing Encapsulation
GS	Group Specification
GVM	Generalised Virtualisation Model
IaaS	Infrastructure as a Service
IaC	Infrastructure as Code
IDE	Integrated Development Environment
IDSP	Integrated Digital Service Provider

Acronym	Full Term
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IG	Information Governance
IM	Intelligence Management
IMS	IP Multimedia Subsystem
IRTF	Internet Research Task Force
IS/ICT CMF	Information Systems and Information Communication Technology Management Capability Maturity Framework
ISO	International Organisation for Standardisation
ISO 15504 – SPICE	Software Process Improvement and Capability Determination
IT-BSC Maturity Model	IT governance tool Balanced Scorecard Maturity Model
ITPM3	IT Performance Measurement Maturity Model
ITU	International Telecommunication Union
ITU-T	Telecommunication Standardisation Sector of ITU
IXP	Internet Exchange Point
K8s	Kubernetes
LAN	Local Area Network
LSO	Lifecycle Service Orchestration
M2M	Machine-to-Machine
MANO	Management and Orchestration
MCC	Management-Control Continuum
MDSO	Multi-Domain Service Orchestration
MDVPN	Multi-Domain Virtual Private Network
ME	Managed Entity
MEF	Metro Ethernet Forum

Acronym	Full Term
NaaS/naas	Network as a Service
NaC	Network as Code
NAO	Network Automation and Orchestration
NAT	Network Address Translation
NCO	Network Controls and Orchestration
NE	Network Element
NEP	Network Equipment Provider
NETCONF	Network Configuration Protocol
NF	Network Function
NFD	Network Function Disaggregation
NFV	Network Function Virtualisation
NFVI	Network Function Virtualisation Infrastructure
NFV-O	Network Function Virtualisation Orchestrator
NGN	Next-Generation Network
NMM	Network Maturity Model
NREN	National Research and Education Network
NRO	Network Resource Optimisation
NS	Network Service
NSA	Network Service Agent
NSI	Network Service Interface
NSSAI	Network Slice Selection Assistance Information
NVGRE	Network Virtualisation over GRE (Generic Routing Encapsulation)
OAMP	Operations, Administration, Maintenance and Provisioning
OASIS	Organisation for the Advancement of Structured Information Standards

Acronym	Full Term
OAV	Orchestration, Automation and Virtualisation
OCP	Open Compute Project
ODA	Open Digital Architecture
ODL	OpenDaylight
ODM	Operational Domain Management
ODM	Operational Domain Manager
OESS	Open Exchange Software Suite
OGF	Open Grid Forum
ONAP	Open Networking Automation Platform
ONOS	Open Network Operating System
OPNFV	Open Platform for NFV Project
OSM	Open-Source MANO
OSS	Operations Support System
OVN	Open Virtual Network
OVS	Open vSwitch
AnLF	Analytics Function
APT	Advanced Persistent Threat
CFS	Customer Facing Services
CLI	Command Line Interface
CNF	Containerised Network Function
DevOps	Development and Operations
IDS	Intrusion Detection System
IOA	Indicators of Attack
IOC	Indicators of Compromise
IPS	Intrusion Prevention System

Acronym	Full Term
KPI	Key Performance Indicator
NOC	Network Operations Centre
NWDAF	Network Data Analytics Function
PaaS	Platform as a Service
R&D	Research and Development
R&E	Research & Education
REST	Representational State Transfer
RF	Resource Function
RFS	Resource Facing Services
SaaS	Software as a Service
SAI	Switch Abstraction Interface
SDDC	Software-Defined Data Centre
SDN	Software-Defined Network
SDO	Standards Developing Organisation
SD-WAN	Software-defined networking in a wide area network (WAN)
SDX	Software-Defined Exchange
SFC	Service Function Chaining (also known as Network Service Chaining)
SIEM	Security Information and Event Management
S-NSSAI	Single Network Slice Selection Assistance Information
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SOAR	Security Orchestration, Automation, and Response
SOC	Security Operations Centre
SPA	Service Provider Architecture
STF	Service and Technology Forum

Acronym	Full Term
STP	Service Termination Point
STT	Stateless Transport Tunneling
TEVV	Test and Evaluation, Verification and Validation
TMF	TM Forum
TOGAF	The Open Group Architecture Framework
TOSCA	Topology and Orchestration Specification for Cloud Applications
TTPs	Tactics, Techniques, and Procedures
VCDN	Virtual Content Delivery Network
VIM	Virtual Infrastructure Management
VM	Virtual Machine
VNF	Virtual Network Function
VNFM	Virtualised Network Function Manager
VNO	Virtual Network Operator
VPN	Virtual Private Network
VPP	Vector Packet Processing
VRF	Virtual Routing Function
VSI	Virtual Switch Instance
VTEP	Virtual Tunnel End Point
VXLAN	Virtual eXtensible LAN
WAN	Wide Area Network
WFM	Workflow Management
XaaS	Anything as a Service
XDP	eXpress Data Path
XML	eXtensible Markup Language
XSOAR	Extended Security Orchestration, Automation, and Response

Acronym	Full Term
YANG	Yet Another Next Generation
ZOOM	Zero-touch Orchestration, Operations & Management
ZSM	Zero-touch network and Service Management
ZTP	Zero-Touch Provisioning

Table 3.1: Acronyms

4 Conclusions

This document has presented a list of terms and acronyms commonly used in the context of Orchestration, Automation and Virtualisation. Definitions have been provided based on standardisation documents wherever possible. In some cases, these definitions have been extended based on internal definitions developed within the WP6 consensus-building team, and thus reflect the understanding of the terms as used by a large number of NRENs in the GÉANT community.

Therefore, this document is intended to serve as a guideline for member organisations in their ongoing efforts to find commonalities and strategic visions for further OAV work in the community. Moreover, the adoption of this latest version 3.0 (and previous versions) of this terminology document by the GNA-G Network Automation working group creates the potential for improved OAV collaborations beyond the GÉANT community.

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