TM Forum Reference

Autonomous Networks Project Deliverables Guide

IG1260

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1. Introduction

TM Forum members, working in the Autonomous Network collaboration project, have published a series of best practice guides and standards on autonomy and autonomous networks. This guide catalogs the published standards from this project. It also lists planned guides or documents currently in development or in review.

2. What is the Autonomous Networks Project?

The journey from automation to autonomy is both a business and a technology challenge that requires some straightforward implementation and integration patterns to achieve self-governing autonomous networks. These concepts and patterns need to be agreed upon and adopted by all stakeholders in the larger AN ecosystem. TM Forum has created the Autonomous Networks collaboration project to begin this work.

As stated in the AN Vision guide (IG1193), Autonomous Networks will:

1. Provide fully automated Zero-X (zero-wait, zero-touch, zero-trouble) innovative, critical network/ICT services for vertical industries users and consumers.
2. Support Self-X (self-serving, self-fulfilling, and self-assuring) network/ICT infrastructures and services for enabling the digital transformation of vertical and telecom industries through the full lifecycle of operations.
3. Offer disruptive services for innovative user experience, mission-critical services based on fully automated lifecycle operations and self-organizing, dynamic optimized resources.
4. Comprise a simplified network architecture, virtualized components, automating agents and intelligent decision engines to create intelligent automated business/network operations for the closed-loop of new digital business.

3. Getting Started

The table below lists the leadership team for the AN project and also the project workstreams.

Project Role	Name	Company
Program Director	Aaron Boasman-Patel - VP, AI and Customer Experience	TM Forum
Project Manager	Alan Pope, Collaboration Manager	TM Forum
Subject Matter Expert	Dave Milham, Chief Architect	TM Forum
Project Sponsor	Christian Maître, Orange	Orange
Workstream Leaders		
AN Business Architecture	Dong Sun, Chief Business Transformation Architect	Futurewei
AN Technical Architecture	Kevin McDonnell, Senior Director, Intelligent Automation Yuval Stein, AVP Technologies	Huawei TEOCO

3.1. Business Architecture workstream

The Business Architecture (BA) workstream focused on business requirements and AN framework - and as such represents the business need and solution to end-users and CSPs. It is developed per the AN Vision (IG1193) and define the overall business requirements, services, framework, AN levels, key business capabilities, E2E full lifecycle of AN operations and provides example use cases to illustrate the usage of AN. It serves as an input to the detailed work in the Technical Architecture (TA) workstream, as well as the baseline to the regularly published AN white paper and the SDO industry collaboration efforts.

3.2. Technical Architecture workstream

The Technical Architecture (TA) workstream details how the TM Forum AN Framework can help realize these future autonomous networks. The AN TA builds upon the AN Framework (while also leveraging other TMF frameworks as ODA, eTOM, SID, and Open API program) to propose an evolutionary path toward the mechanisms that are required to deliver a layered architecture (operational layers and autonomous domains), one that decouples integration complexity (intent) and leverages autonomic closed control loops to realize self-operating capabilities.

3.3. AN Multi-SDO Collaboration

Autonomy and autonomous systems are complex areas and the industry needs standards to guide on the best way to achieve autonomy and ultimately deliver on Autonomous Networks vision. Ideally, these standards should fit well together and form a coherent whole. Several standards developing organizations (SDOs) have been

working together for an aligned vision of AN with better collaboration between Industry Stakeholders. TM Forum has facilitated this multi-SDO initiative with these leading SDOs and this MSDO group have met regularly since early 2021. For details of the collaboration see AN-SDO Collaboration Home or contact dmilham@tmforum.org.

4. AN Blueprint

The AN project deliverables combine to form an *AN Blueprint* - a series of guides and standards that together form the steps to take to achieve the AN vision. This AN Blueprint is organized into 3 subject areas 1) Vision, 2) Business Architecture and 3) Technical Architecture

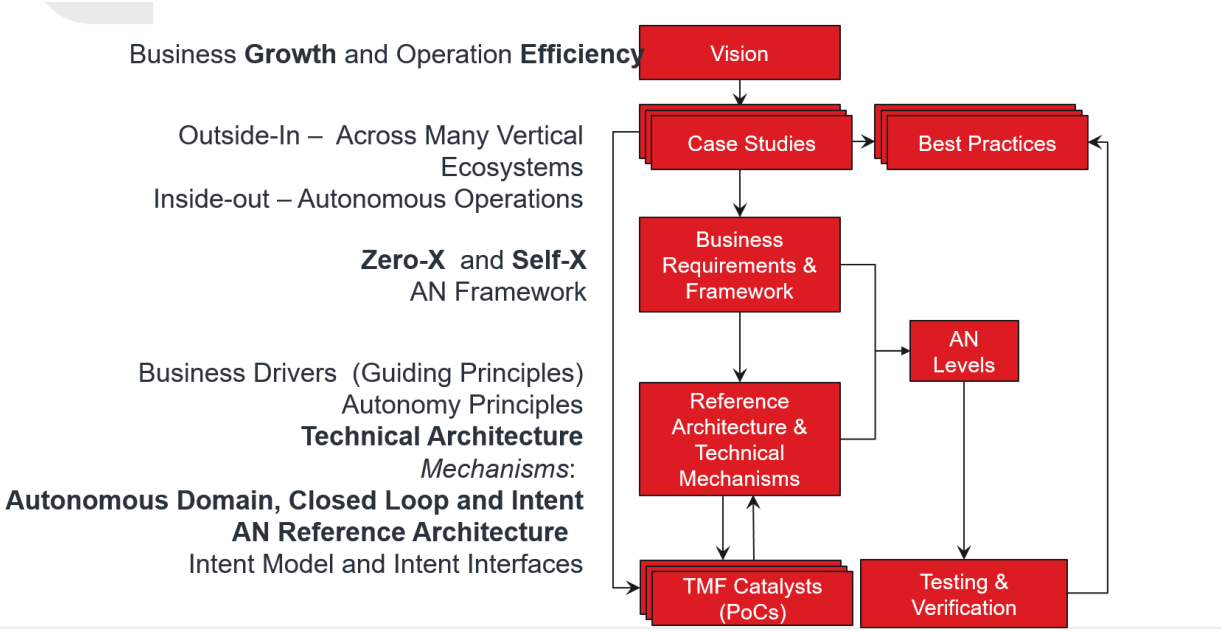

Figure 1: AN Blueprint

4.1. Vision Standards

Document Number	Deliverable	Description	Version	Workstream
IG1193	Cross-Industry Autonomous Networks – Vision and Roadmap.	This document aims to share the vision and roadmap of autonomous networks, including the motivation, vision, new ecosystem, collaboration, and business models, overarching framework and autonomous levels, roadmap and industry collaboration. It is intended to serve as the general guideline for pertinent work streams and work items, including user stories and use cases, business requirements/metrics and architecture, technical architecture and interface/APIs specs, PoCs/catalyst projects, testing and verification, as well as industry collaboration. Moreover, it will be used as the baseline for the marketing plan, campaign, social events, and public whitepaper on behalf of the TM Forum and member companies.	1.0.0	
IG1229	Guiding Principles for building and measuring Autonomous Network Solutions v1.0.0	This document outlines a set of guiding principles to help support the design, build, and measurement of an autonomous network (AN) solution. The principles are varied: some are high level to guide solutions design, whereas others address more granular issues regarding contextual, cultural, and pragmatic aspects of an implementation.	1.0.0	TA
IG1260	Autonomous Networks Project Deliverables Guide (this guide)	One of the main drivers for automation in communications service providers' (CSPs') networks is the urgent need to reduce complexity so that they can lower operating costs. This is especially important as networks become software-defined and 5G is deployed. Even more importantly, CSPs must automate their networks and operations to deliver	3.0.0	TA

Document Number	Deliverable	Description	Version	Workstream
		rapid service adaptation and deployment, with the dual objectives of improving customer satisfaction and increasing revenue. A new TM Forum project is addressing the complex business issues surrounding both, along with solving technical challenges.		

4.2. Business Architecture Standards

Document Number	Deliverable	Description	Version	Workstream
IG1218	Autonomous Networks – Business requirements & architecture.	This document provides business requirements and business architecture of services and infrastructure supported by Autonomous Networks, including the user requirements per user stories, key business capabilities and architecture, and related key metrics for measuring autonomous levels, as well as new business models of production, ecosystem, and collaboration.	2.1.0	BA
IG1218A	China Mobile's Practice on Autonomous Networks	This document provides case studies of Autonomous Networks, covering the usages of AN on operational efficiency improvement and business revenue growth. The cases illustrate the key operations and related Autonomous Networks Levels, which could be based on specific network operations issues e.g., network planning & deployment, maintenance & assurance, or could be more comprehensive scenarios e.g., enabling digital business. This document serves as the input for distilling general user stories/use cases, business requirements, framework, key capabilities and E2E	1.0.0	BA

Document Number	Deliverable	Description	Version	Workstream
		lifecycle of AN operations, as well as for technical reference solutions.		
IG1218B	Autonomous Networks Realization Studies	In order to guide more industry partners to share experience, build consensus, and jointly innovate with the common goal of achieving network autonomy, this article introduces China Mobile's relevant motivation, methodology, and current practice of autonomous networks, followed by a gap analysis for and collaborative suggestions to further industry development. This document covers the best practice from China Mobile in applying autonomous network methodology into realizing its "digital and intelligent transformation" strategy.	1.1.0	BA
IG1218C	Autonomous Networks Realization Studies v1.0.0	One of the main drivers for automation in communications service providers' (CSPs') networks is the urgent need to reduce complexity so that they can lower operating costs. This is especially important as networks become software-defined and 5G is deployed. Even more importantly, CSPs must automate their networks and operations to deliver rapid service adaptation and deployment, with the dual objectives of improving customer satisfaction and increasing revenue. A new TM Forum project is addressing the complex business issues surrounding both, along with solving technical challenges.	1.0.0	BA
IG1218D	CSP Practice on Autonomous Networks	This document describes the level evaluation indicators for Autonomous Networks service experience across all operations processes of site-to-cloud private lines for vertical industry customers.	1.0.0 (alpha)	BA

 AN Business Architecture Toolkit (download all)

4.3. Technical Architecture Standards

Document Number	Document Title	Description	Version	Workstream	Published Date	Maturity Level
IG1230	Autonomous Networks Technical Architecture v1.1.1	One of the main drivers for automation in communications service providers' (CSPs') networks is the urgent need to reduce complexity so that they can lower operating costs. This is especially important as networks become software-defined and 5G is deployed. Even more importantly, CSPs must automate their networks and operations to deliver rapid service adaptation and deployment, with the dual objectives of improving customer satisfaction and increasing revenue. A new TM Forum project is addressing the complex business issues surrounding both, along with solving technical challenges.	1.1.1	TA	R22.5	GA
IG1230A	IG1230A Autonomous Networks Scenario Realizations v1.1.0	Autonomous Network practices can improve both the operational efficiency and end-user experience of today's operator use case. This guide describes scenario realizations of operator use cases using an autonomy mindset and, in particular, the mechanisms described in the AN technical architecture (IG1230).	1.1	TA	28-May-2021	GA
IG1230B	IG1230B Autonomous Networks Industry Standards v1.1.0	Autonomous Network initiatives are being progressed in multiple standards developing organizations (SDOs), such as ETSI, 3GPP, and GSMA to name but a few. An alignment on Autonomous Network concepts, a shared vision and framework would help the industry to progress in a coordinated way on this important initiative.	1.1	TA	28-May-2021	GA
IG1251	Autonomous Networks	A normative architecture with identified reference points that builds on the context of parent deliverable	1.0.1	TA	15-Jul-2022	GA

Document Number	Document Title	Description	Version	Workstream	Published Date	Maturity Level
	Reference Architecture	AN TA IG1230. This document focuses on the architecture within the scope of AN Framework scope and describes the architectural principles and requirements the informs the architecture.				
IG1251A	Autonomous Networks Reference Architecture - realizations	This guide provides more detailed realizations of the AN reference architecture in IG1251. These realizations taken from proof-of-concepts, real-world projects and other SDO architectures help to describe how the AN reference architecture and interfaces can be used to build solutions that realize autonomy use cases.	1.0.0	TA	R22.5	New
IG1251B	Autonomous Networks API Map	The AN API Map promotes the usage and evaluation of AN Levels and also displays a way for stakeholders to move up through the AN Levels through the use and adoption of specific APIs and interfaces.	1.0.0	TA	R22.5	New
IG1252	Autonomous Networks Levels Evaluation Procedure	A guide on using AN Level evaluation methodology. A common understanding of the levels of autonomy within an autonomous network - a way to indicate the maturity of the network autonomy, so that CSPs can first focus on the important features that should be prioritized to achieve a desired level of autonomy in their networks.	1.2.0	TA	R22.5	GA
IG1253	Intent in Autonomous Networks	A suite of guides that explains how the concept of intent can be used to specify the interactions between autonomous domains within the AN Framework.	1.3.0	TA	15-Aug-2022	GA

Document Number	Document Title	Description	Version	Workstream	Published Date	Maturity Level
TR290	Intent Common Model	The Common Model of the TM Forum Intent Ontology (TIO) is described in this technical report (Note that IG1253A discontinued and replaced by TR290)	2.1.0	TA	31-Mar-2022	Beta
TR291	Intent Extension Models	TR291 Intent Extension Models v1.0.0 alpha Explains the extension mechanism of the TM Forum Intent Ontology (TIO). This document describes a set of proposed intent extension models. They extend the vocabulary and semantics of the intent common model introduced in TR290.	1.0.0 alpha	TA	31-Mar-2022	GA
TR291 (A to G)	Extension Models	TR291A Intent Validity Model v1.0.0 alpha TR291B Intent Temporal Validity Model v1.0.0 alpha TR291C Proposal of Best Intent Model v1.1.0 beta TR291D Intent Acceptance and Rejection Control Model v1.1.0 betaTR291E Intent Compliance Latency Model v1.1.0 beta TR291F Intent Family Relation Model v1.1.0 beta TR291G Property Context Model v1.0.0 alpha	1.1.0	TA	beta 07-Jun-2022 alpha 31-Mar-2022	various
TR292	Intent Management Ontology	The intent management ontology defines common and general vocabulary about intent management and the intent interface. This is used as basis for other models, such as the intent common model and intent extension models.	1.1.0	TA	31-Mar-2022	beta

Document Number	Document Title	Description	Version	Workstream	Published Date	Maturity Level
IG1256	Autonomous Networks Effectiveness Indicators	The indicator for the effectiveness of an autonomous network describes the effect of introducing autonomy capability into a telecommunications system. ANLs describe the level of autonomy capability in a particular operational workflow or for an autonomous domain, but they are not sufficient to reflect the effect of an autonomous network. Therefore, Key Effectiveness Indicators (KEI) are defined to help CSPs identify what benefits from OAM, customer, and business perspectives they could receive by upgrading their telecommunications system with more autonomy capabilities.	1.0.0	TA	R22.5	New
IG1259	Study of Telecom Industry Intent Meta-Modeling Approaches	This study explores the approaches followed by different standardization organizations for intent meta-modeling and highlights the readiness, relevance of use, and the context of usage of these techniques relative to the ontology-based approach taken in IG1253.	1.0.0	TA	28-May-2021	GA
IG1269	IG1269 Autonomous Networks from Concept and Framework to Practice v1.0.0	This guide links the autonomous networks concept and framework to a practice model that provides direction guidance to the operation. The practice model is formulated as a result of mapping the TM Forum Autonomous Networks Concept and Framework, in IG1218C, to the field proven project methodology. In assisting the planning and assessment stage of the project methodology, the Autonomous Operations Maturity Model (AOMM) assessment tool and Value Operation Framework (VOF) tool are developed, based on the IG1252	1.0.0	TA	21-Dec-2021	GA

Document Number	Document Title	Description	Version	Workstream	Published Date	Maturity Level
		Autonomous Network Levels Evaluation Methodology and Value Tree frameworks respectively.				
TMF921A	Intent Management API Suite (Profile)	API requirements standard for the Intent APIs developed based on the TM Forum Intent guides and other TM Forum catalyst inputs.	1.1.0	TA Approved by Open API Team	04-Apr-2022	GA
TMF921	Intent Management API Documentation	TMF921 Intent Management API Suite (includes API Profile, Specification (Swagger), and User Guide)	1.1.0	Open API	19-Sep-2022	GA
GB922	Intent ABE added to SID (Information Framework)	A focused model covering the Intent and Intent Report model as part of SID can be used in Intent expressions and outcomes	R22.0	TA/SID	R21.5	GA

AN Technical Architecture Toolkit (download all)

Intent Toolkit (download all)

4.4. Planned Deliverables

Document Number	Document Title	Description	Version	Work stream	Release	New or Updated
IG1255	Knowledge Management	This guide develops a standardized knowledge management process system in AN, which can provide unified requirements and guidance for collaborative operation and timely revision of different types of knowledge.	1.0.0	TA	R23.0	New
IG1230G	AN Glossary	This document provides a glossary of terms and concepts related to Autonomous Networks across all the AN project guides and serves as terminology reference for use across the industry.	1.0.0	TA	R23.0	New
TMF921	Intent Management API Suite	Intent API moves from Open API "Beta" table to Production with the additional approval of the Conformance Profile, Postman, RI and CTK	4.0	Open API	R23.0	Update
IG1218	AN Business Requirements and Framework	This document provides business requirements and details of AN Framework.	2.2.0	BA	R23.0	Update
IG1272	Autonomous Networks transformation journey and business benefits	The purpose of this document is to record the main drivers for moving towards different levels of Autonomous Networking solutions, an outline of the main benefit that will accrue at each stage of that journey and an Exemplar Business case that can be used as a template to be used by CSP for preparing their business case. A major focus is on the business benefits in terms of Operational improvements, OPEX and Capex savings and other business benefits.	1.0.0	TA	R23.0	New

Document Number	Document Title	Description	Version	Work stream	Release	New or Updated
IG1253E	Intent Use Cases and examples	A step-by-step walkthrough of how to use the TIO with examples from TM Forum catalysts showing intent expressions across all AN operational layers and how these expressions can be exchanged with TMF921 Intent API.	1.0.0	TA	R23.0	New
TR293	Intent Connector Models	This document describes the base vocabulary for connector models which can be used to create intent extension models that are specific to different SDOs, and are applicable for the relevant domains or use cases. The corresponding intent extension models are defined in another suite of models.	1.0.0	TA	R23.0	New
TIO	TM Forum Intent Ontology	A new formal ontology maintained as part of AN Project	1.0.0	TA	R23.0	New
TMFYYY	TIO Governance	A guide for TIO Governance and Management Processes (explaining IRIs etc.)	1.0.0	TA	R23.0	New
TMFXXX	Control Loop API	Closed Loop / Control loop API Suite	1.0.0	TA/API		New
TRXXX	Control Loop Model	A focused model covering closed loop as managed entity model.	1.0.0	TA/SID		New

5. Member Whitepapers

Version	Name	Author	Date	Link
v4.0	IG1305 Autonomous Networks: Empowering digital transformation – from strategy to implementation	 Member Whitepaper. Contributors from 59 companies	08 Sep 2022	Link
v3.0	Autonomous Networks: Empowering Digital Transformation	Member Whitepaper. Contributors from 39 companies	20 Sep 2021	Link
v2.0	Autonomous Networks: Empowering Digital Transformation for Smart Societies and Industries	Member Whitepaper. Contributors from 23 companies	05 Oct 2020	Link Article
v1.0	Autonomous Networks: Empowering Digital Transformation for the Telecoms Industry	Member Whitepaper. Contributors from 7 companies	15 May 2019	Link

6. Contact the team

- Aaron Boasman-Patel - VP, AI and Customer Experience, TM Forum
- David Milham, Chief Architect, TM Forum
- Alan Pope, Collaboration Manager, TM Forum

7. Administrative Appendix

7.1. Document History

7.1.1. Version History

Version Number	Date Modified	Modified by:	Description of changes
0.0.1	30-Apr-2021	Kevin McDonnell, Huawei	All sections
1.0.0	30-Apr-2021	Alan Pope	Final edits prior to publication
2.0.0	28-Mar-2022	Kevin McDonnell, Huawei	Updated All sections
3.0.0	24-Nov-2022	Kevin McDonnell, Huawei	Updated All sections

7.1.2. Release History

Release Status	Date Modified	Modified by:	Description of changes
Pre-production	30-Apr-2021	Alan Pope	Initial release
Production	26-Jul-2021	Adrienne Walcott	Updated to reflect TM Forum Approved status
Pre-production	31-Mar-2022	Alan Pope	Updated to refer to the latest documents
Production	20-May-2022	Adrienne Walcott	Updated to reflect TM Forum Approved status
Pre-production	08-Dec-2022	Alan Pope	Updated to refer to the latest documents
Production	13-Feb-2023	Adrienne Walcott	Updated to reflect TM Forum Approved Status

7.2. Acknowledgments

This document was prepared by Kevin McDonnell (Huawei) on behalf of the TM Forum Autonomous Networks Project.