Latest Developments in Autonomous Networks:

Making the move to Autonomous Networks

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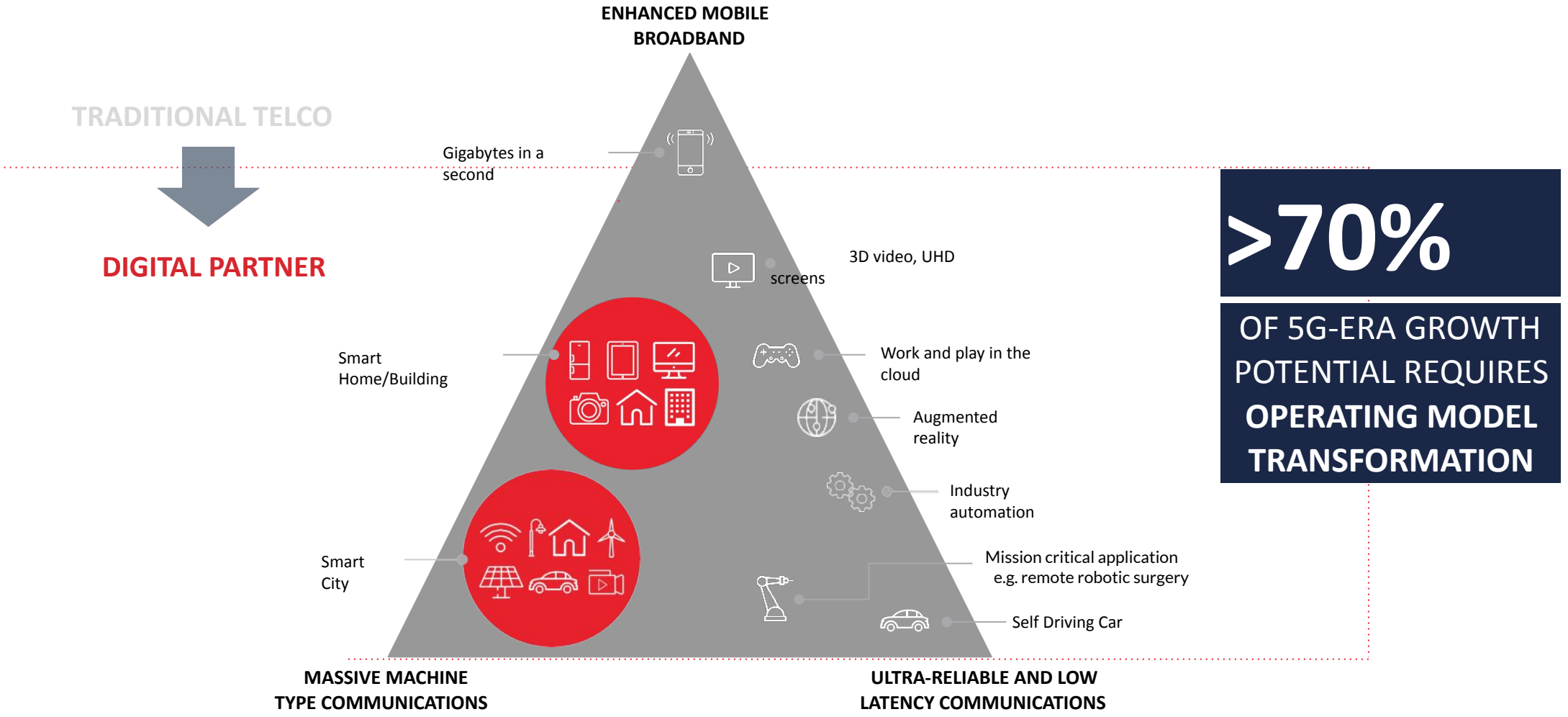
TM Forum

UNLOCKING BUSINESS POTENTIAL BEYOND CONNECTIVITY…

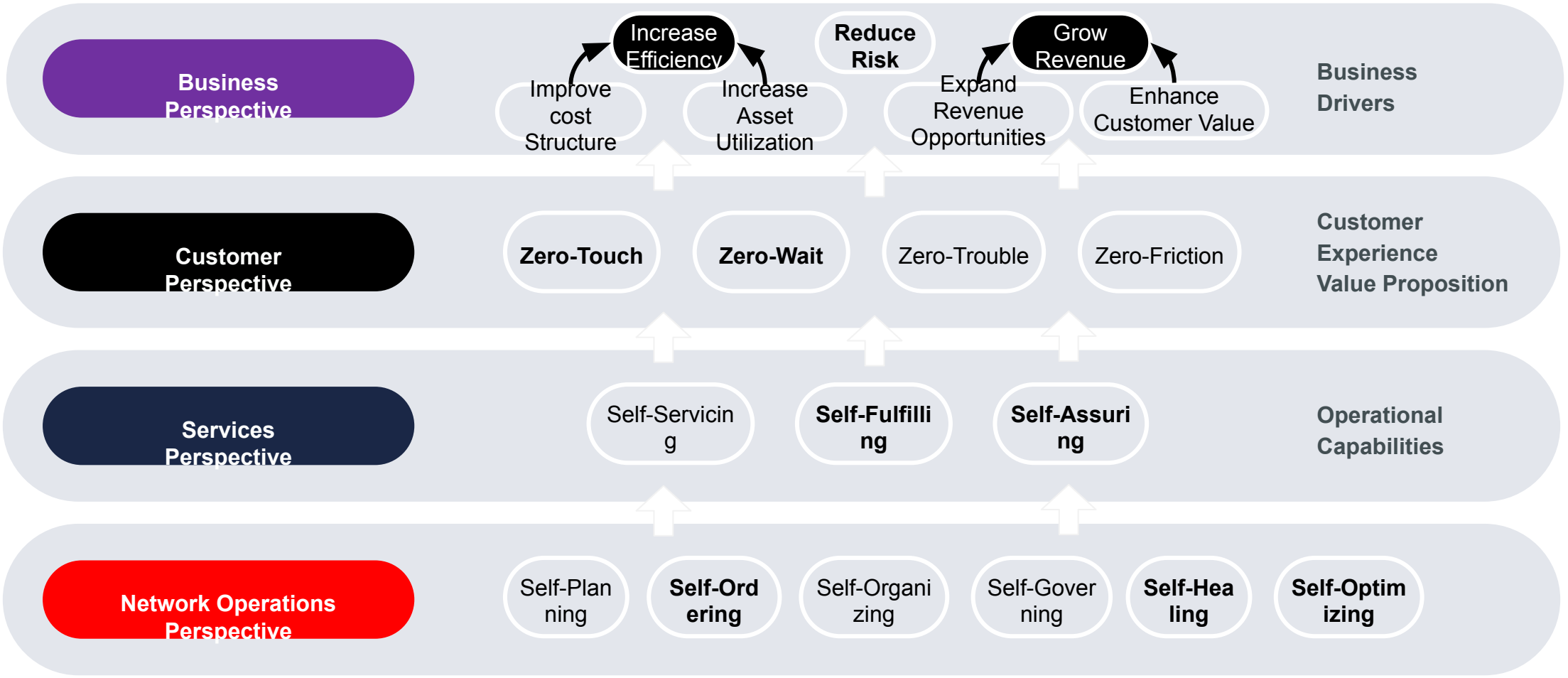
>$700bn of growth awaits those prepared to undertake true business, tech and operating model transformation



>70%

OF 5G-ERA GROWTH POTENTIAL REQUIRES **OPERATING MODEL TRANSFORMATION**

Objectives of Autonomous Networks (AN)



Autonomous Networks Benefits

Upgraded Telco Network using AN delivers solution value to the Verticals

Network Operations Perspective

Features

Cloudified Network
NFV and SDN virtualized deployments on telco cloud
Network Slicing / Deterministic Networking
Simplified consumption model for Network

Reduced complexity
Greatly simplified network architectures

Self-Managing Network
Network self-optimizes and self-repairs

Less OSS
Flattened and simplified O&M with domain model

Autonomous Domains
Domains are autonomous and collaborate

Reduced OpEx
Much lower human operations costs

APIs everywhere
Basis for all automation and flexible customer services

Services Perspective

Characteristics

Customized Offerings
'Bespoke' network offerings tuned for the customers

Reliability
Self-healing and self-optimizing network is more reliable, directly driven from SLA

Lower Cost
Step change in OpEx allows savings to be passed on

Reduced TTM
New services designed, implemented and launched much more quickly

Cross-Domain Orchestration
Ability to orchestrate network and non-network offerings collectively

Customer-facing APIs
Expose APIs to customers, allowing them to control services at a much lower cost

Customer Perspective

Capabilities

as-a-Service Models
NaaS, Network-Slice-aaS
Flexible commercial model
Scale-up Scale-down as required

Custom Services
Services delivering the correct mix of features for the specific vertical use case

On-demand
Services autonomously turned on and off as needed

Self-Service
Services autonomously adapt to customer intent. Customer flex services themselves, without order / ticket / phone call

Integration
Simple APIs and web service portals that allow telco services to be integrated directly with business

Autonomous Networks: Empowering Digital Transformation

"TechCo X" capability

CSP □ DSP

Co-creation, partnerships, automation, innovation

"Zero X" experience

Network-centric □ Experience-centric

- ✔ Deliver simplicity to the users
- ✔ Leave the complexity with the providers

"Self X" service

Traditional O&M □ Autonomous Network

Smart city | Smart industry | Smart government | Smart xxx…

Zero wait

Swift

- Launch
- Delivery
- Care

Autonomous Networks

Zero touch

Simplified

- Operating
- Development
- Maintenance

Agile Operations

Zero trouble

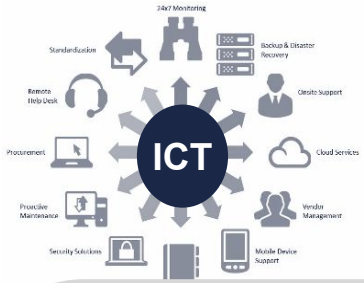
Self-healing

- Business
- Services
- Infrastructure

All-inclusive Services

As a service

- ✔ One stop, real-time, on demand, automated, E2E full lifecycle network/ICT services



As a platform

- ✔ Enablement of business collaboration & ecosystem between verticals and network/ICT service providers

Self-serving

Lean

- Planning
- Ordering
- Marketing

Self-fulfilling

Agile

- Organizing
- Orchestration
- Configuration

Self-assuring

Preventive

- Monitoring
- Healing
- Optimizing

Network Monetization

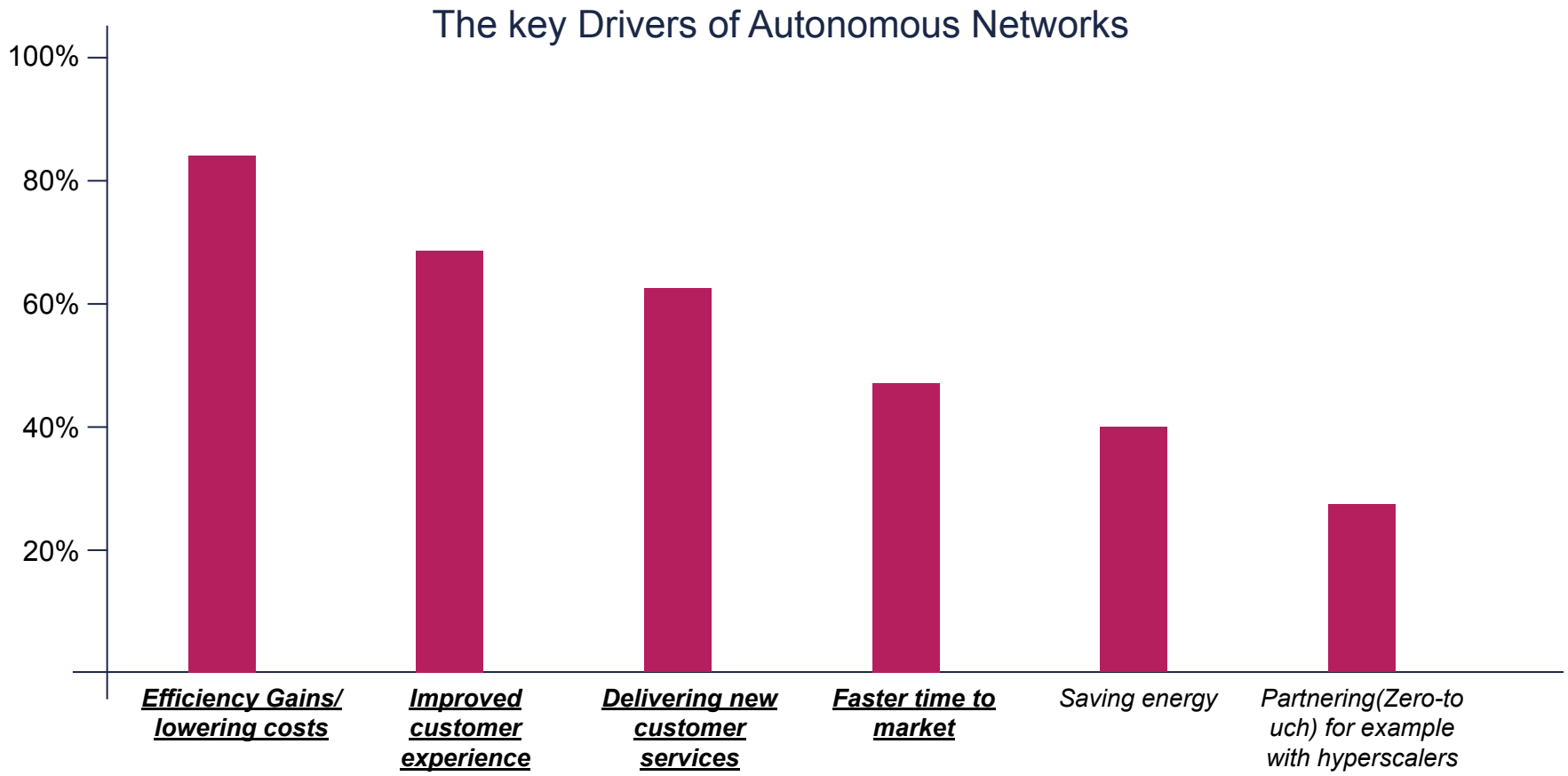
Optimal Experience

Resource Efficiency

Employee Efficiency

The most important drivers for Autonomous Networks

Efficiency gains and lowering costs, delivering new services and faster time to market continue to dominate



Source: AN report, TM Forum 2022: https://inform.tmforum.org/research-and-analysis/reports/autonomous-networks-from-concept-to-reality/

Big Ambitions with Autonomous Networks lie ahead

91% CSPs have a vision or ambitious strategy on network automation

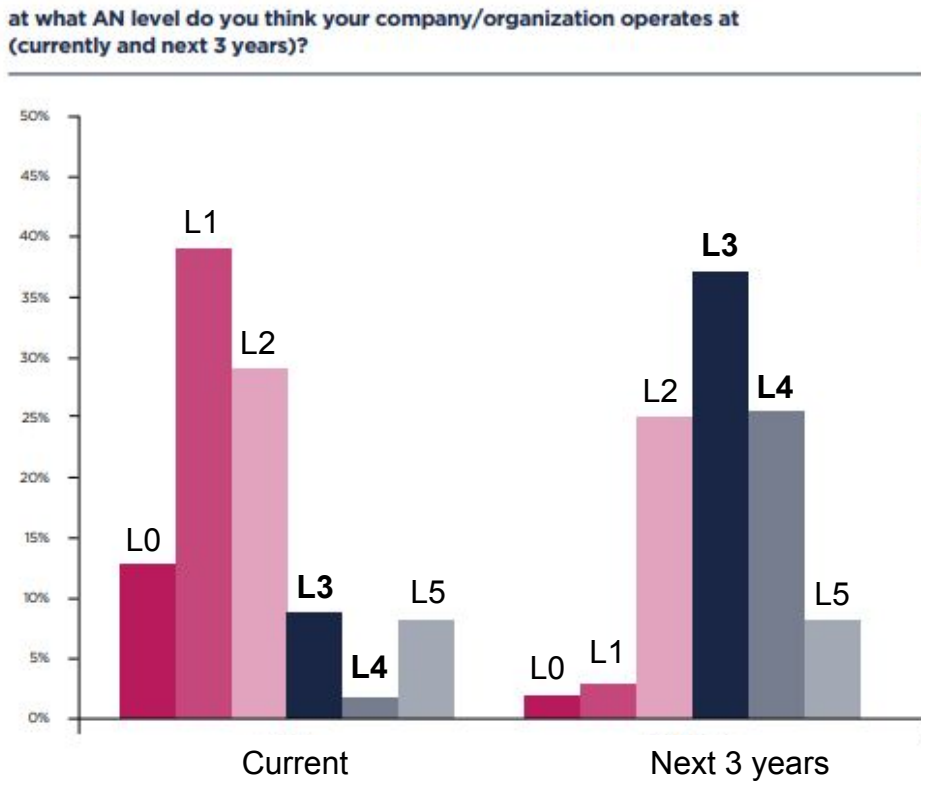
91% We have a **vision** with increased investment, or **automation strategy** with significant investment planning .

9% No specific vision apart from a continued commitment to 9% cutting costs

- **LEVEL 3 - conditional Autonomous Networks:** The system can sense real-time environmental changes, and in certain network domains, optimize and adjust itself.

- **LEVEL 4 - high Autonomous Networks:** The system, in a cross-domain environment, analyzes and makes decisions based on predictive or active closed-loop management of service and customer

Most CSPs surveyed think their organisation will move to level 3 by 2025



Source: AN report, TM Forum 2022

AN Consensus Has Been Reached

Industry consensus

- AN industry partners: 7 -> 55

AN Standards

standard	TMF	3GPP	ETSI	IETF	CCSA
Architecture	√	√			√
AN Level	√	√	√	√	√
API	√	√	√	√	√

- Establish the AN M-SDO collaboration platform and initiate 70+ projects.

AN is incorporated into Strategies

- 10 CSPs released the AN strategic goals.

Co-initiation of the 2023 TMF Autonomous Networks catalyst project “AN empowers distinctive experience for cognitive transformation” (quote from Telkomsel)

Industry Requires an Implementation Framework to enable AN Strategy

Existing Methodologies and Systems

General Methodology for Enterprise Transformation

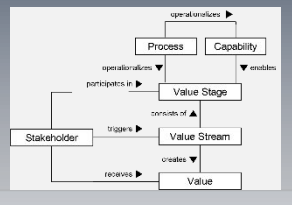
TOGAF

ADM

4A Arch.

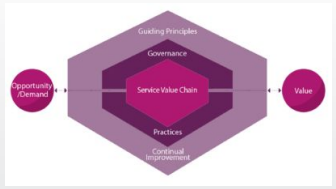
- Service
- Application
- Data
- Technical

Value Stream Model

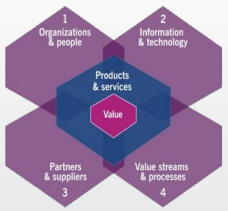


The Open Group, 1995
Global Organization for Technical Standards and Certification Development

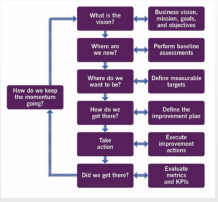
IT Service Mgmt. System



ITIL Service Value System(SVS)



ITIL Four-dimensional Model of Value Creation



ITIL Continuous Improvement Model

Requirements of AN Implementation

- What is the benefit of Autonomous Networks?
- What is the cross-generation(target) capabilities?
- How to build the architecture of AN?
- How to implement continuous AN evolution?

ANF: Form the framework based on member best practices

Basic Proposition

Benefits

Value propositions
- Business
- Society

Evolution

Cross-generation Characteristics
- General
- Service / network related

Collaboration

Architecture Principles
- Hierarchical autonomy
- Full-stack AI
- Intent-driven

Implementation

Workflow Approaches
- Value stream
- Process and operation

Key Elements

1- Effectiveness Indicators
- Layered indicators
- Reference indicator set

2- AN Level Standards
- Standards
- Assessment tool

3- Target Architecture
- Business architecture
- Technical architecture

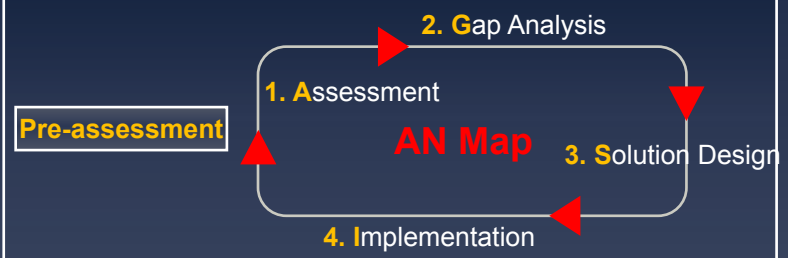
4- AN Map
- Panorama of value scenarios
- Priorities

Implementation Practice

AN Strategy Plan

Input	Output	
Business Strategy Stakeholder Requirement AN Industry Standards ……	• AN Strategy • Stakeholder Commitment • AN Industry Contribution <AN Blueprint>	Effectiveness Indicators AN Level Standards Target Architecture AN Map

5 - AN Journey



Organization
- **Support:** Administrative Team, Steering Team, Execution Teams
- **Transformation:** Personnel transformation, process transformation, organization evolution

1. From Value Proposition to Effectiveness Indicators

AN Value Proposition

Network Monetization | **Optimal Experience** | **Employee Efficiency** | **Resource Efficiency**

Value-driven design

inherit AN value proposition and expand the EI indicators at multiple levels

Examples:

Network as a service	QoE proactive optimization	Fault auto closed-loop	Green energy saving
TTM: Days -> Mins	Marketing success rate: **x4↑**	Number of work orders **40%↓**	**On-demand** energy saving
Differentiated SLA	Wi-Fi experience**: 20%↑**	Work order automation rate **80%**	Network consumption: **25% ↓**
Intent API interface	Churn rate: **20%↓**	MTTR **20%↓**	Optimal **Exp. & efficiency**

- **IG1193 Cross-Industry Autonomous Networks – Vision and Roadmap**
- **IG1256 Autonomous Network Effectiveness Indicators**

2- AN Level Standards(L0~L5): Define Contextual Autonomy Capability

- To fulfill and measure customer experience and SLAs, ANLs are defined to guide network and service automation and intelligence, evaluate the value and benefits of AN services, and guide the intelligent upgrade of CSPs and vendors.

Autonomous Levels	L0: Manual Operation & Maintenance	L1: Assisted Operation & Maintenance	L2 Partial Autonomous Networks	L3 Conditional Autonomous Networks	L4 High Autonomous Networks	L5 Full Autonomous Networks
Execution	P	P/S	S	S	S	S
Awareness	P	P/S	P/S	S	S	S
Analysis	P	P	P/S	P/S	S	S
Decision	P	P	P	P/S	S	S
Intent/ Experience	P	P	P	P	P/S	S
Applicability	N/A	Select scenarios				All scenarios

P People (manual) S System (autonomous)

- **Level 0 – manual management:** The system delivers assisted monitoring capabilities, which means all dynamic tasks must be executed manually.
- **Level 1 – assisted management:** The system executes a certain repetitive sub-task based on pre-configuration to increase execution efficiency.
- **Level 2 – partial Autonomous Networks:** The system enables partial automatic O&M for certain units based on predefined rules/policy under certain external environments.
- **Level 3 – conditional Autonomous Networks:** Building on L2 capabilities, the system with awareness can sense real-time environmental changes and in certain network domains optimize and adjust itself to the external environment.
- **Level 4 – high Autonomous Networks:** Building on L3 capabilities, the system enables, in a more complicated cross-domain environment, analysis and decision-making based on predictive or active closed-loop management of service and customer experience-driven networks.
- **Level 5 – full Autonomous Networks:** This level is the goal for telecom network evolution. The system possesses closed-loop automation capabilities across multiple services, multiple domains and the entire lifecycle, achieving Autonomous Networks.

IG1252 Autonomous Networks Levels Evaluation Methodology

- The technical work of ANL evaluation methodology is published in Autonomous Network Levels Evaluation Methodology (IG1252), which describes the ANL evaluation approach and operation flows, tasks evaluation criteria, scoring method, etc.

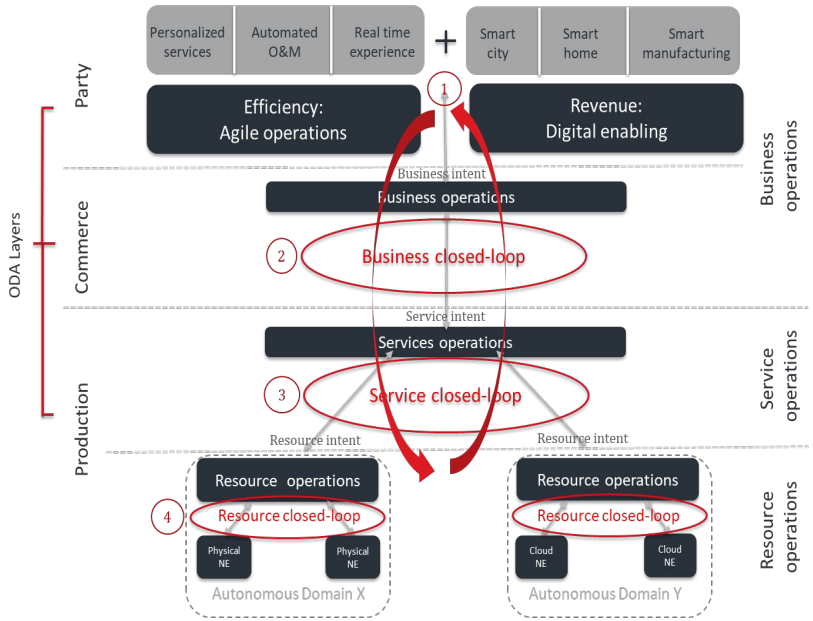
3. Target Architecture: Business Architecture and Technical Architecture

Architecture Principles

- Single-domain autonomy
- Cross-domain collaboration
- Intent-driven interaction
- Full-stack AI
- Closed-loop automation

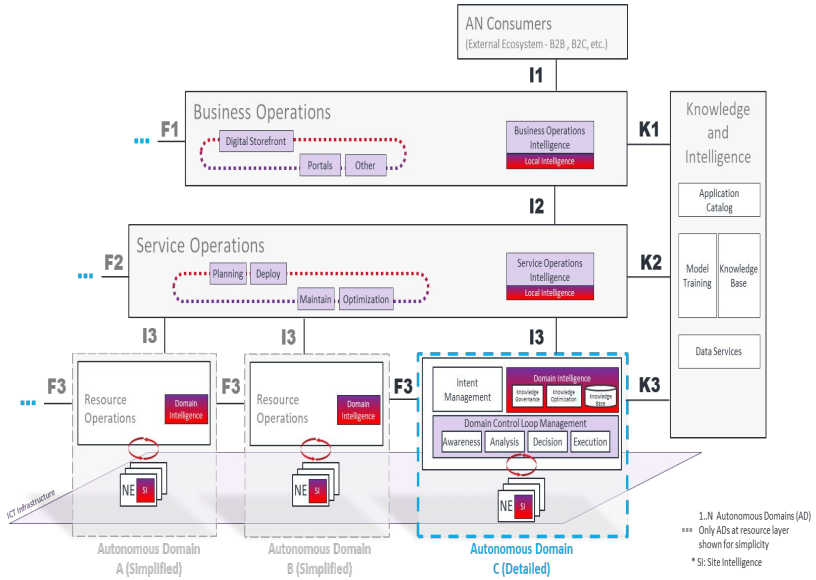
Business Architecture

3 Layers, 4 Close loop



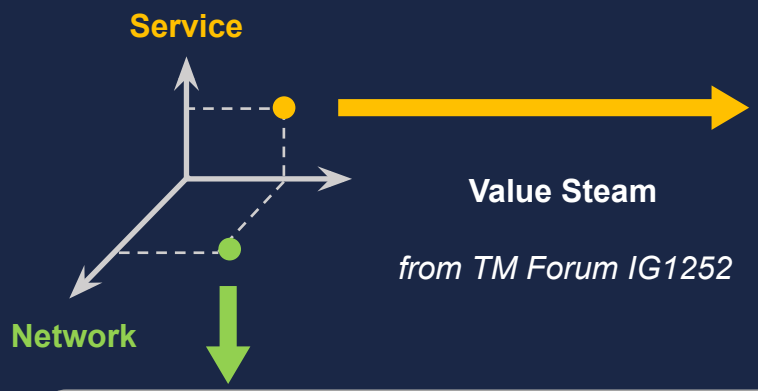
Technical Architecture

Key Architectural Characteristics of Autonomy Domain



- **IG1230 Autonomous Networks Technical Architecture**
- **IG1251 AN Reference Architecture**
- **IG1251A AN Reference Arch Realizations**
- **IG1251B AN API Map**
- **IG1253 Intent in AN**

4- AN Map: Prioritizing Value Scenarios to Guide AN Journey

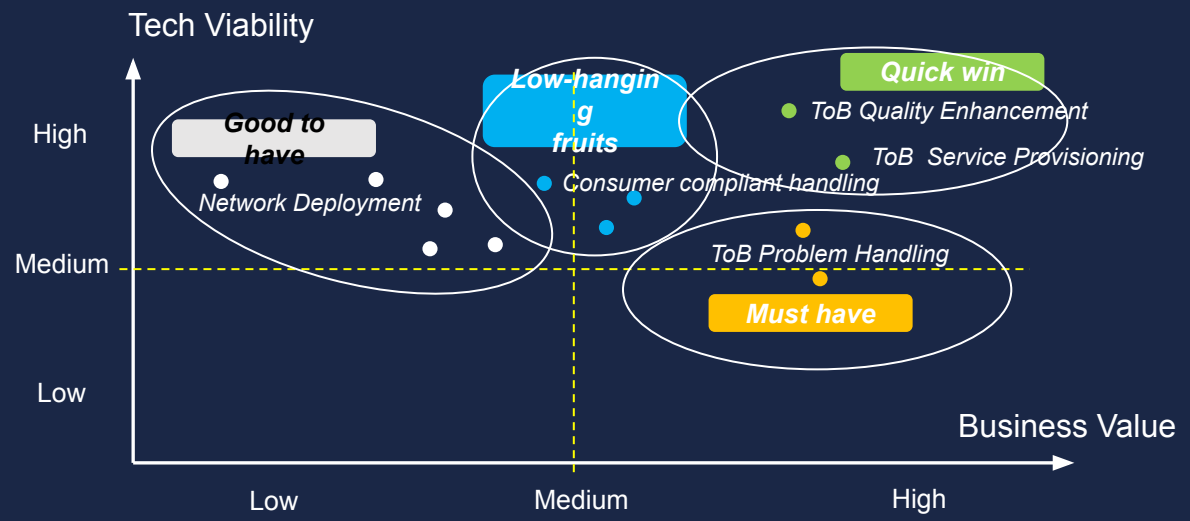


Service Oriented Value Streams	ToC		ToH		ToB			
	Voice	Data	HSI	TV	ToCloud	5GtoB	OTN	VPN
Service Fulfillment							√	
Service Compliant Handling								
Service Quality Enhancement	√	√	√		√		√	

Network Oriented Value Streams	WDM	IP	MW	RAN	Access	…
Plan & Deploy				√	√	
Test						
Change Management						
Trouble Shooting	√			√	√	
Performance Optimization	√	√	√			
Energy Saving			√	√		

Value Scenario

4-quadrant method for priority selection of value scenarios from TM Forum IG1269



- Selecting value-scenarios according to the Service & Network dimensions by using 4-quadrant method
- Using AN Map to guide the AN Journey

5- Iterative Evolution of AN

Pre-Assessment

- Select high-priority high-value scenarios from the AN map through pre-evaluation,
- incorporate the scenarios into the work plan.

Assessment

- Base line ANL assessment
- Effectiveness indicators analysis

Gap Analysis

- Operation process analysis
- Gap analysis

Solution Design

- Application architecture design
- Capability design

Implementation

- Test verification
- Pilot and deployment

- **IG1218C Autonomous Networks Realization Studies**
- **IG1218A Autonomous Networks Case Studies**
- **IG1218B China Mobile's Autonomous Network Practice**
- **IG1218C Autonomous Networks Realization Studies**
- **IG1218D Level Evaluation for Autonomous Networks Service Experience**
- **IG1218E AIS Practice on Autonomous Networks**

ANF: Iterative Evolution – From Strategy to Implementation

Operator C Example

2019 Initial Proposal → **2020** Define Architecture → **2021** → **2022** Nationwide Iterative Evolution → **2023**

AN Strategy Plan

Strategy Plans

- AN into **3/5 Yearly Rolling Plan** since 2021
- **Chairman** confirmed: "accelerating L4 AN evolutions" in 2021

Stakeholder L4 Commitments

- Same-day service fulfillment
- NPS leads competitors
- O&M staff & cost no more increasing
- Low-utilization resources halved

Industry Contributions

- Participants in target architecture, AN level standards, whitepaper, etc.
- 10+ standards docs

AN 4 Key Elements

AN Map

- Phase I: 800+ tasks
- Phase II: 40+ scenarios

Effectiveness Indicators

- Phase I: 26 indexes
- Phase II: 2-layers (14 generic indexes)

AN Levels Standards

- Generic level criteria
- Domain-specific level criteria

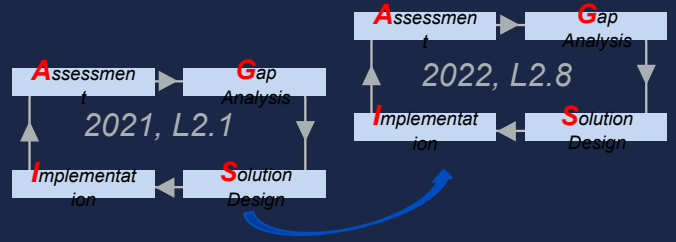
Target Architecture

- Systems Framework
- Single domain autonomy

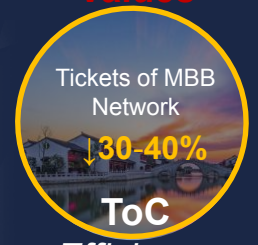
AN Journey

Nationwide Iterative Evolution

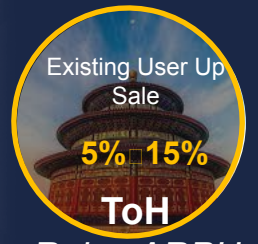
All 31 subnets in 3 groups		Evolution	
		2021	2022
Lighthouse (3)	AA	X.X	X.X
	BB	X.X	X.X
	CC	X.X	X.X
Pilot (7)	DD	X.X	X.X
	EE	X.X	X.X
	…	…	…
Scale Deploy (21)	FF	X.X	X.X
	GG	X.X	X.X
	…	…	…



Business Values



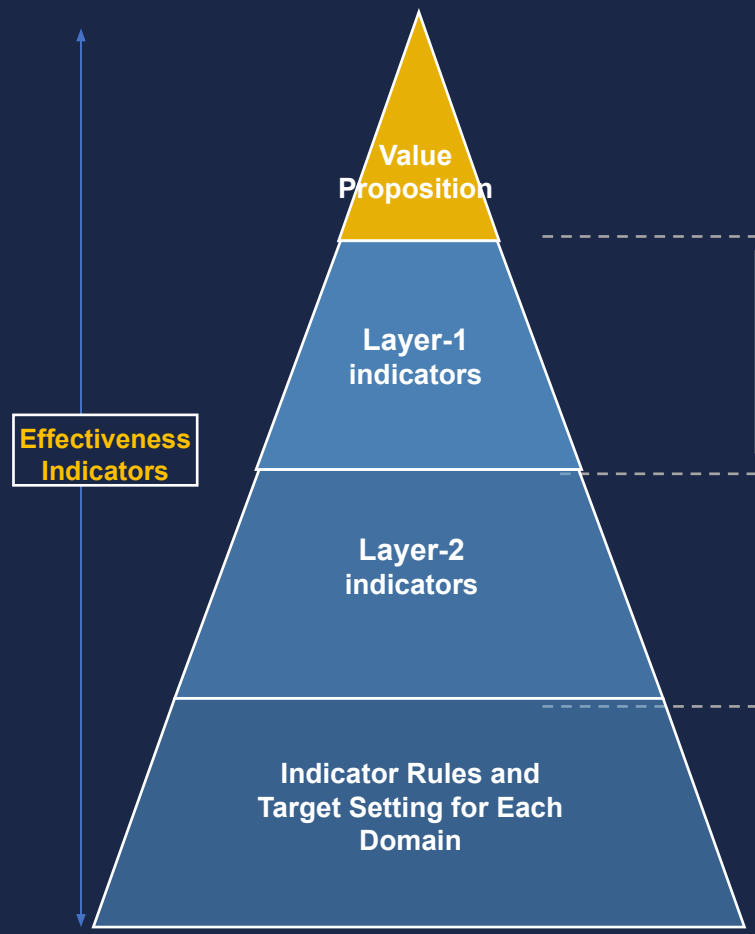
Efficiency



Raise ARPU

Reduce TTM

Effectiveness Indicator: Business Value Based Assessment, Propelling AN Evolution



	Description	Example
Value Proposition	Reach a consensus on the value that AN can bring to operators and customers and establish a unified direction.	Customer experience improvement
Layer-1 indicators	Take on the value proposition of AN and present the value of AN at the corporate/industry level in a simple way without paying attention to details.	Net Promoter Score (NPS)
Layer-2 indicators	Support Layer-1 indicators, and further break down Layer-1 indicators based on service/network effectiveness guidance and appraisal.	Service delivery duration / Service Availability Rate
Indicator Rules and Target Setting for Each Domain	Select indicators for detailed specifications and target setting based on the value scenarios of service / network domains.	OTN private line service delivery duration L4 target: < XX minutes / OTN private line service availability L4 target: >XX%

Operator A in Southeast Asia: AN Overall Progress Updates

Strategy

Cognitive Tech-Co

DISTINCTIVE CUSTOMER EXPERIENCE

Mobile | FBB | Enterprise | Digital Services

Data & Insights

Network Data | Customer 360 | Partners' Data

Zero-touch Operations

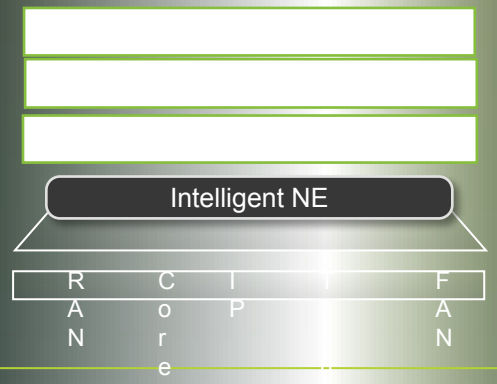
Autonomous Networks | IT Intelligence

Objectives

Target to L3 by Y2023
Reach L4 by Y2025

AN Evolution Project

AN Target Architecture



AN Level Evaluation

High-value AN Practice

Initiated **20+** high-value UCs covering all domains

O&M Efficiency
Less Work Order
Short MTTR

Customer Experience
Less Complaint
High Customer Satisfaction

Service Agility
Guaranteed SLA
Short TTM

Target Values

Customer Complaint Handling Process

30% ↓
Repeat Complaint

15% ↑
First call resolution

10% ↑
Customer Satisfaction

Intelligent Incident Mgmt. Process

10% ↓
MTTR

10% ↓
Service Impact Hours

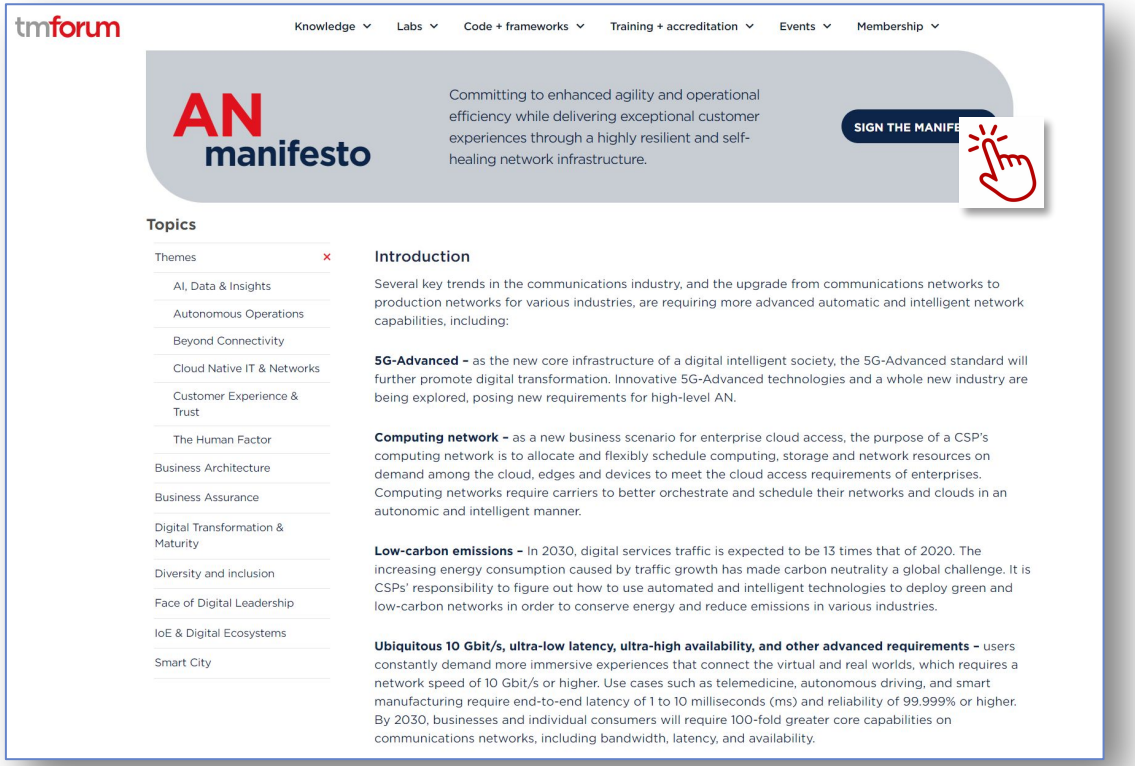
TM Forum Autonomous Networks Manifesto

initiated by TM Forum and partners, strive to usher in a new era of growth and transformation for the teleco. industry

Vision

- **TM Forum** has successfully designed, standardized an AN target architecture, AN maturity levels, effective indicators, and operational best practices.
- **TM Forum** objective is to expedite the widespread adoption of Autonomous Networks.
- **CSPs can unlock new revenue streams** by offering innovative digital services and **enhance agility and operational efficiency** while delivering exceptional customer experiences through a highly resilient and self-healing network infrastructure.

Link:
https://www.tmforum.org/autonomous-networks-manifesto/



thank you

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