tmforum

Autonomous Operations with AI, Data & Insights

Reducing risk and governing AI & Data to manage and monetize AI opportunities at scale

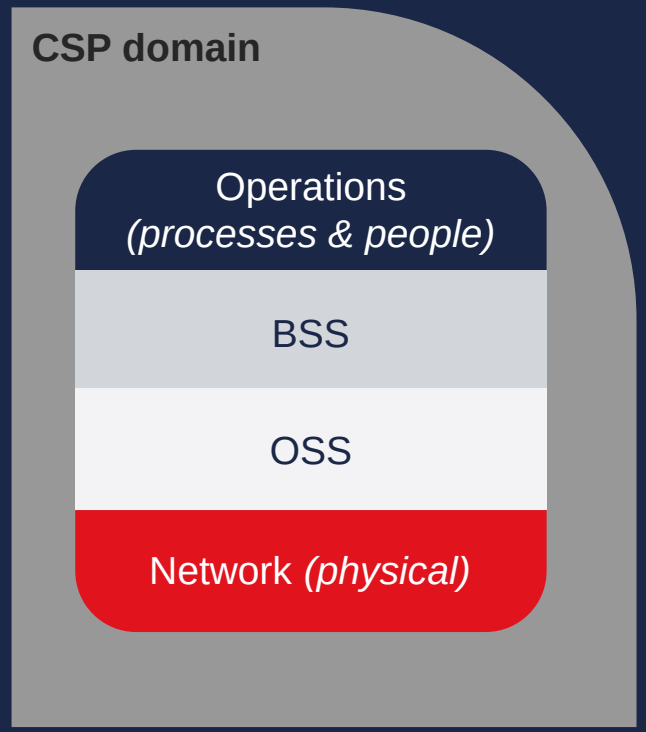
Aaron Richard Earl Boasman-Patel
Vice President, AI, Customer Experience & Data

tmforum

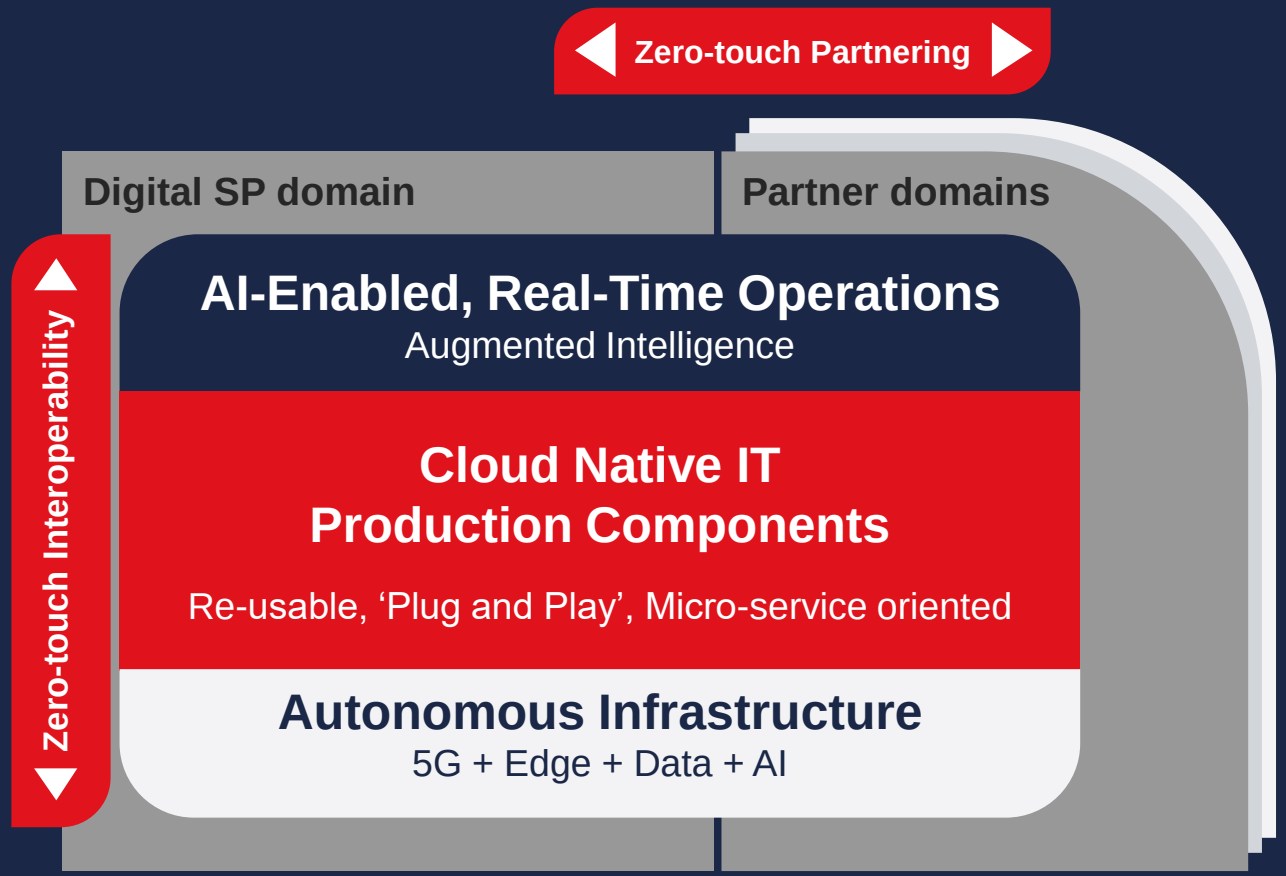
Delivering on the ambition requires change in mindset, end-to-end

Simplification, automation and intelligence are key principles driving the change

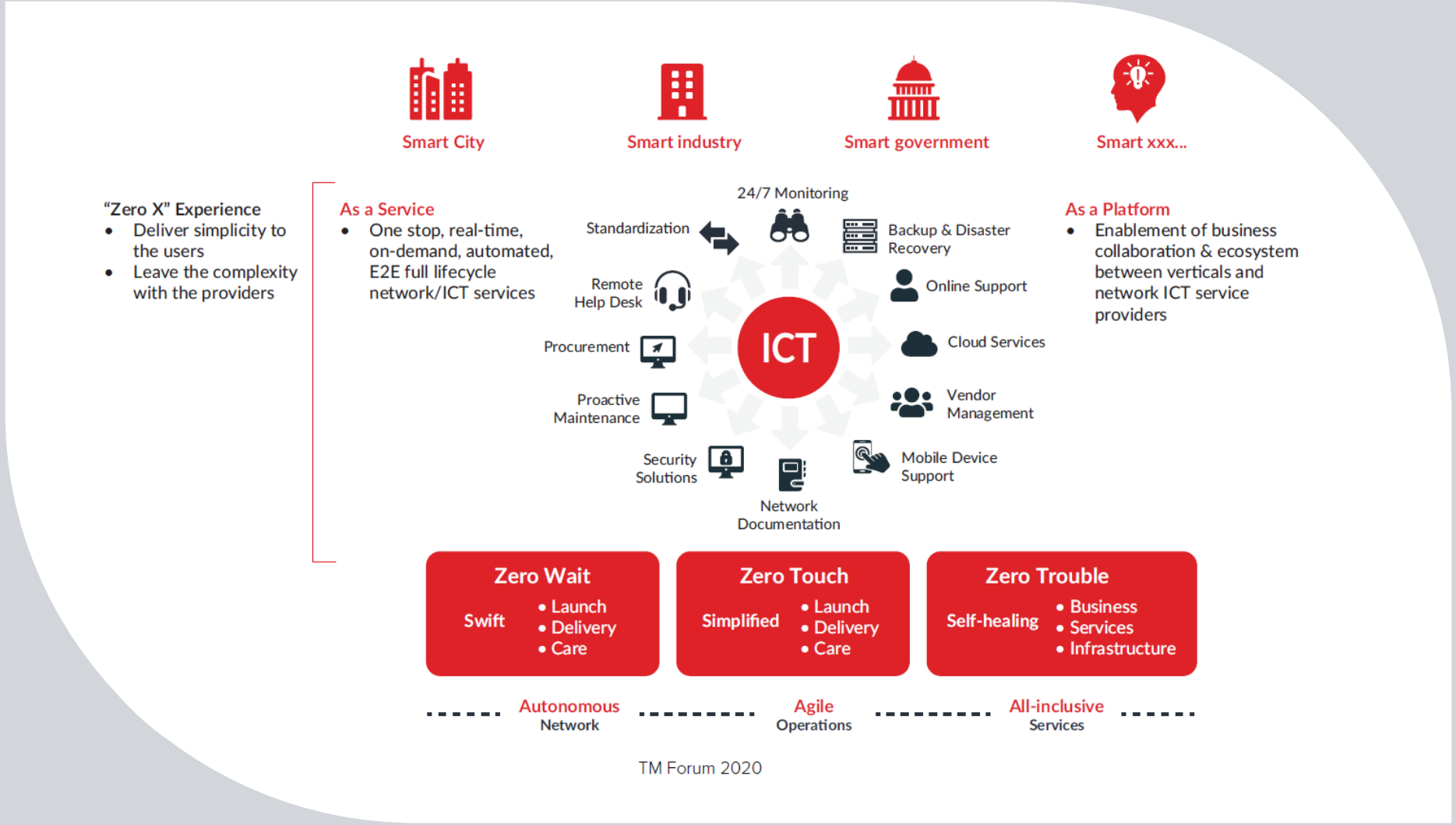
Traditional CSP



Digital Service Provider



The next generation of services require zero wait, zero touch and zero trouble

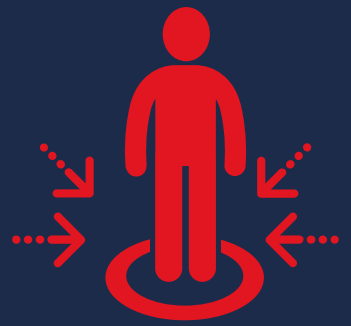


Two main reasons of AI interaction in the telco space

Modernizing managements and operations

- Without network automation the telecom business model is at risk of breaking down. For networks to support the billions of devices that are expected to be connected to the internet within the next decade, they must be self-optimizing and self healing.
- This requires machine learning.

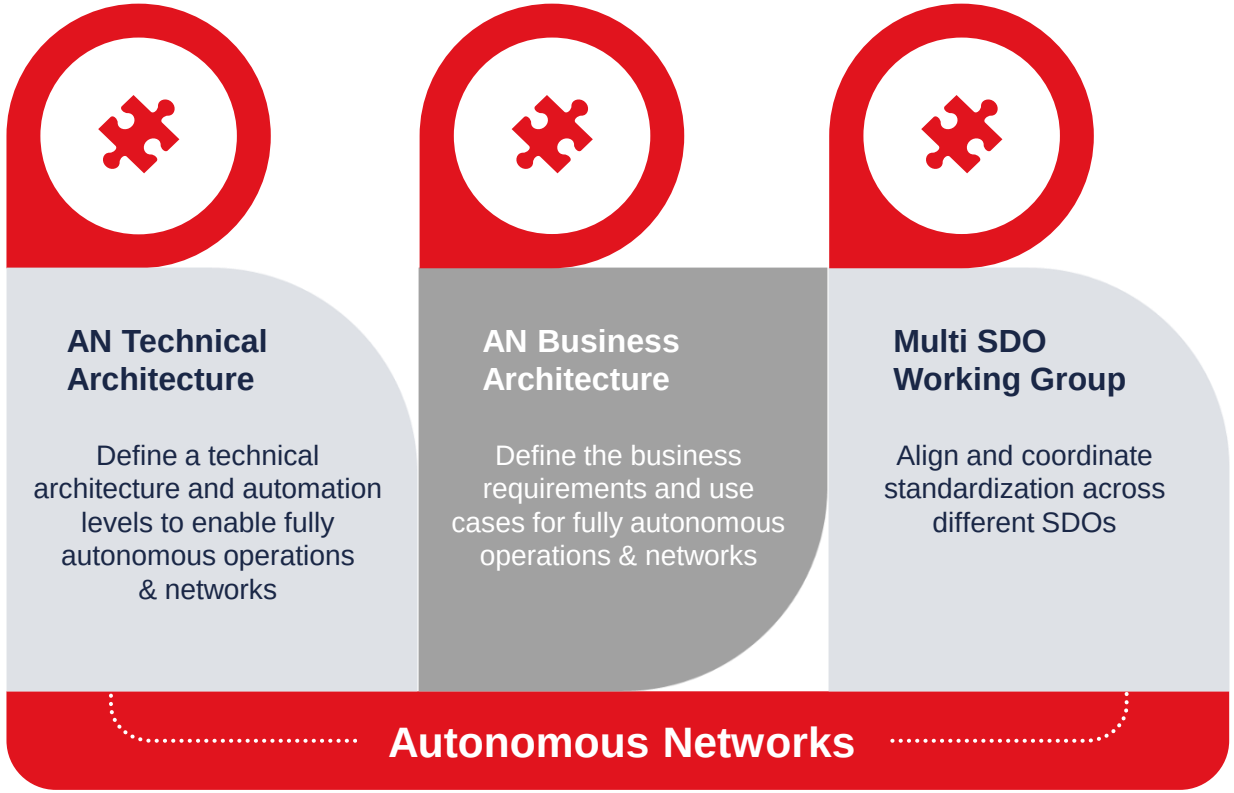
Improving customer centricity

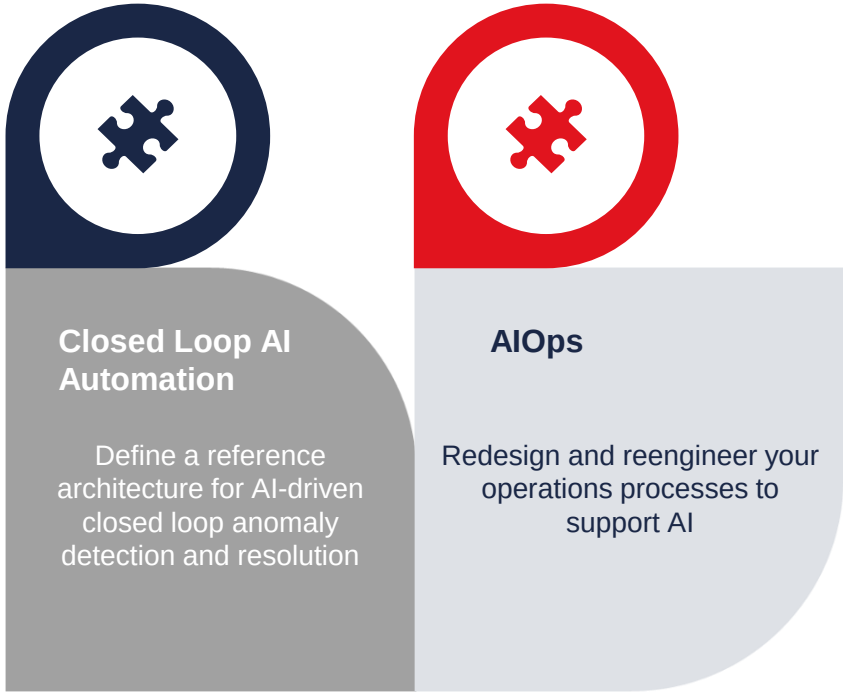


- Within the last three to five years, improving customer centricity has become the single biggest strategic priority for telecom operators
- AI is needed to give customers the kinds of digital experiences they are demanding, and it can deliver these capabilities through chatbots and voice assistants

Autonomous Operations

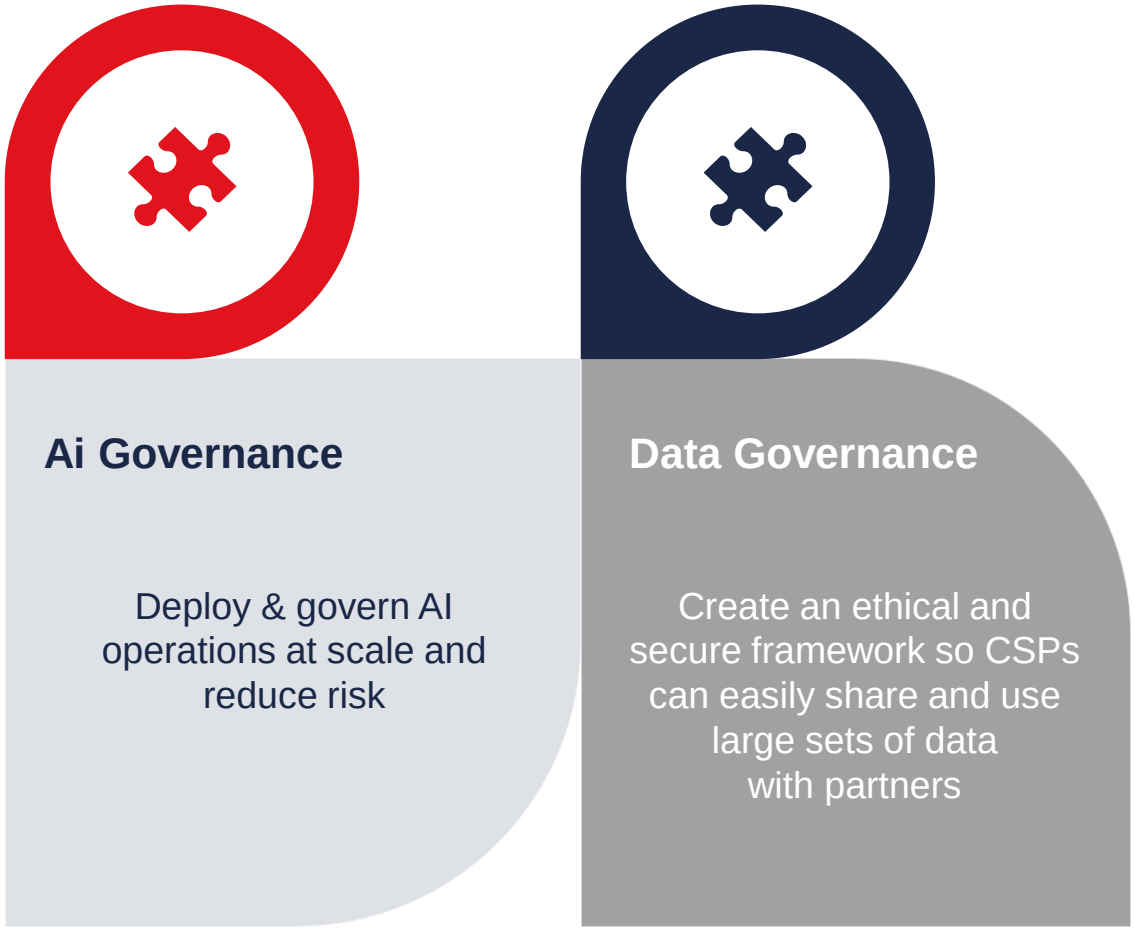
Making zero-touch operations a reality





AI & data

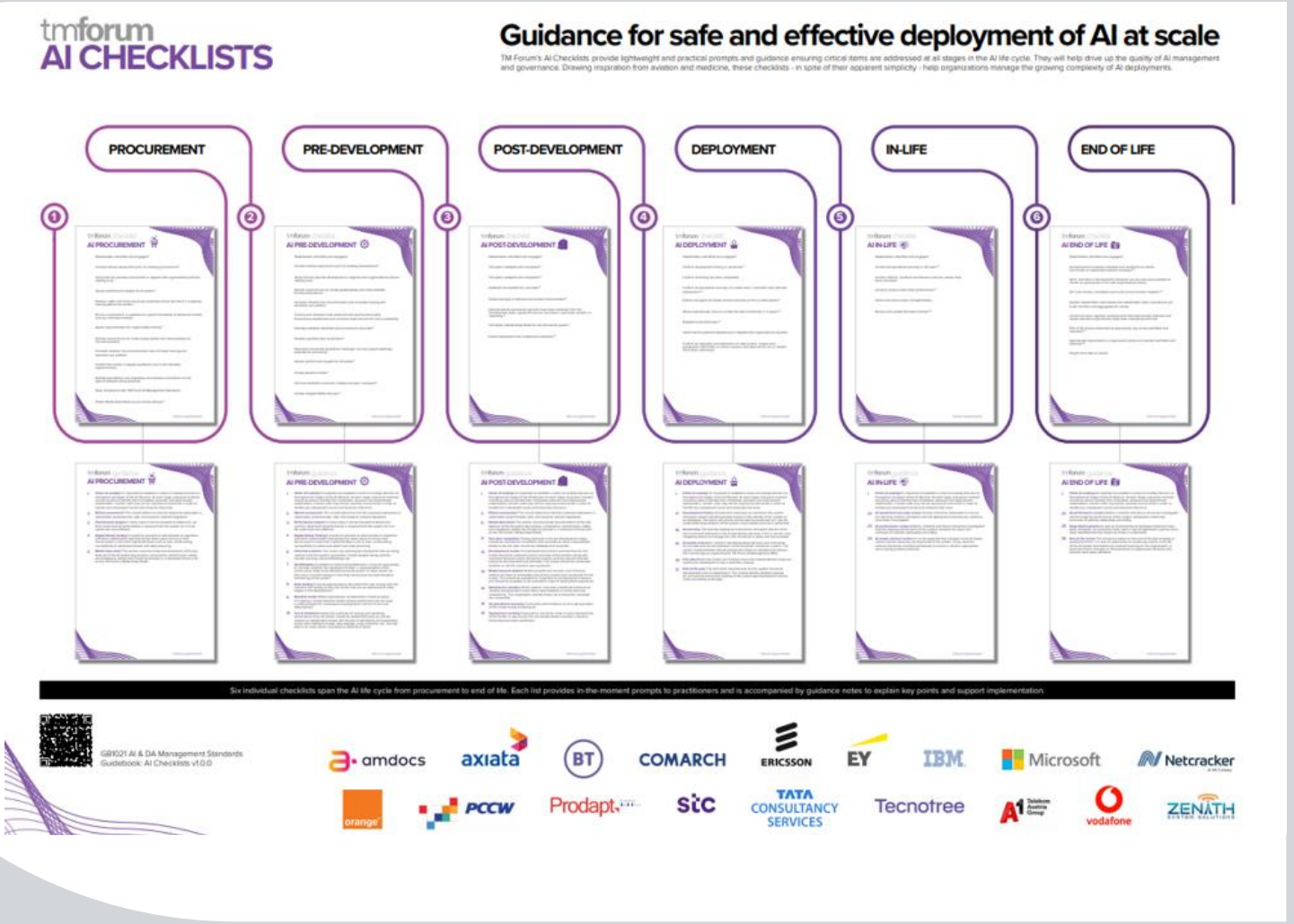
Reducing risk and governing AI and data usage at scale



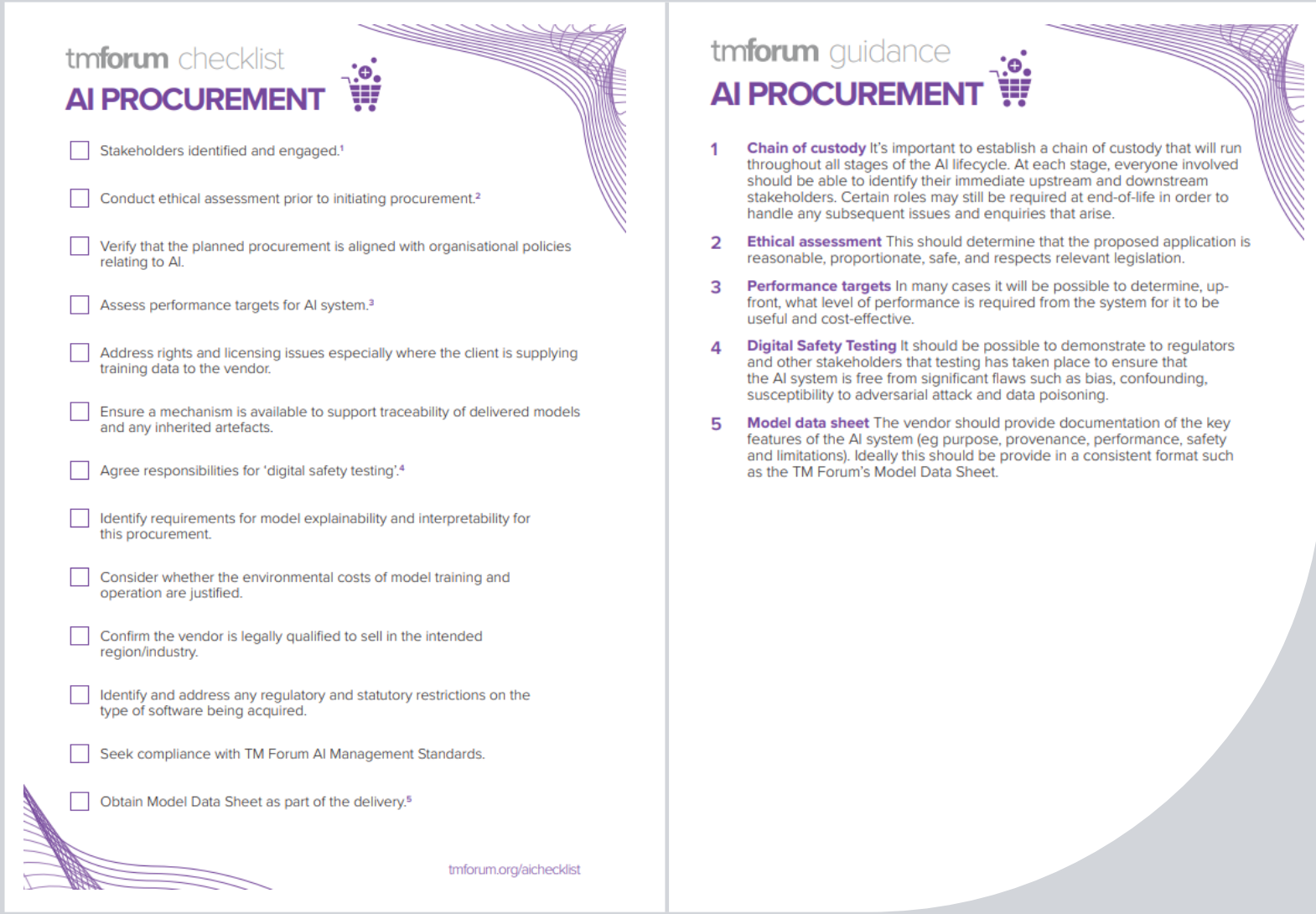
AI governance

tmforum

AI checklists



AI checklists



tmforum checklist

AI PROCUREMENT

- [ ] Stakeholders identified and engaged.[1]
- [ ] Conduct ethical assessment prior to initiating procurement.[2]
- [ ] Verify that the planned procurement is aligned with organisational policies relating to AI.
- [ ] Assess performance targets for AI system.[3]
- [ ] Address rights and licensing issues especially where the client is supplying training data to the vendor.
- [ ] Ensure a mechanism is available to support traceability of delivered models and any inherited artefacts.
- [ ] Agree responsibilities for 'digital safety testing'.[4]
- [ ] Identify requirements for model explainability and interpretability for this procurement.
- [ ] Consider whether the environmental costs of model training and operation are justified.
- [ ] Confirm the vendor is legally qualified to sell in the intended region/industry.
- [ ] Identify and address any regulatory and statutory restrictions on the type of software being acquired.
- [ ] Seek compliance with TM Forum AI Management Standards.
- [ ] Obtain Model Data Sheet as part of the delivery.[5]

tmforum.org/aichecklist

tmforum guidance

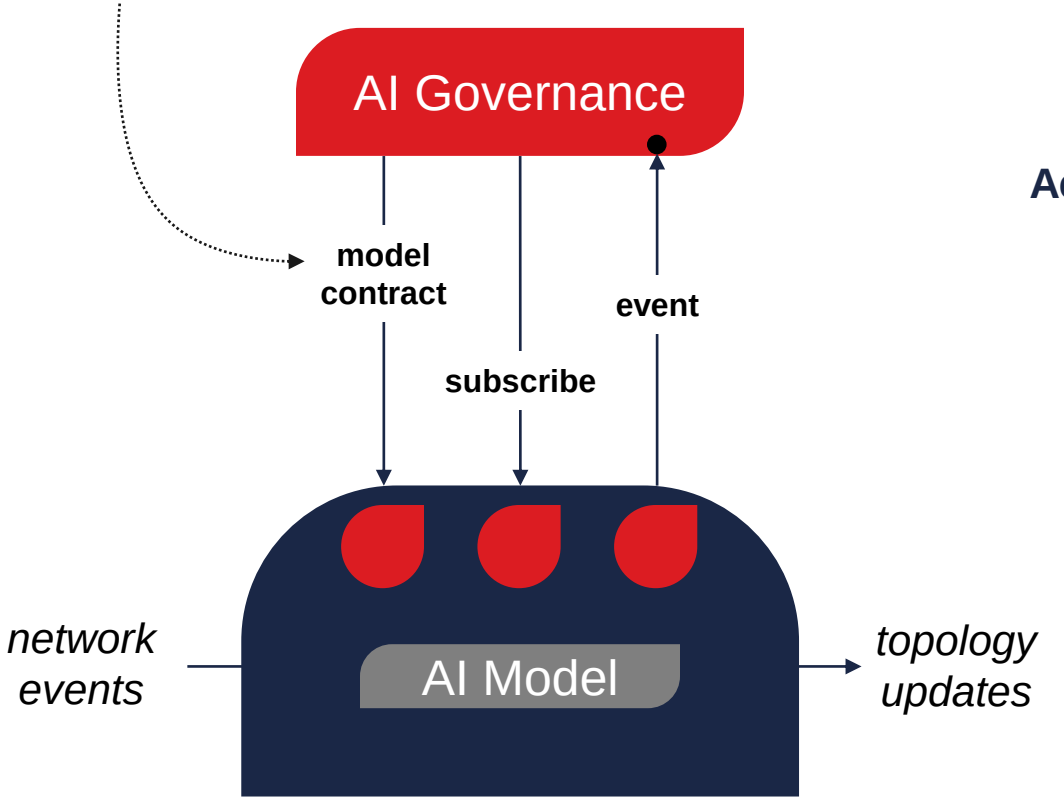
AI PROCUREMENT

1. **Chain of custody** It's important to establish a chain of custody that will run throughout all stages of the AI lifecycle. At each stage, everyone involved should be able to identify their immediate upstream and downstream stakeholders. Certain roles may still be required at end-of-life in order to handle any subsequent issues and enquiries that arise.
2. **Ethical assessment** This should determine that the proposed application is reasonable, proportionate, safe, and respects relevant legislation.
3. **Performance targets** In many cases it will be possible to determine, up-front, what level of performance is required from the system for it to be useful and cost-effective.
4. **Digital Safety Testing** It should be possible to demonstrate to regulators and other stakeholders that testing has taken place to ensure that the AI system is free from significant flaws such as bias, confounding, susceptibility to adversarial attack and data poisoning.
5. **Model data sheet** The vendor should provide documentation of the key features of the AI system (eg purpose, provenance, performance, safety and limitations). Ideally this should be provide in a consistent format such as the TM Forum's Model Data Sheet.

AI contract management API component suite

Model Contract

- Conditions that must remain satisfied for correct operation
- Expected operational boundaries and thresholds
- Actions to take in the event of a rule being triggered



Rule

```
{
   "name": "Topology update rate",

   "description": "Rate of topology updates over past hour",

   "ruleType": "rate",

   "rule": {
      "primitiveType": "threshold",

      "maxValue": "0.05"
   },
```

Actions

```
"actions":
      {
         "action": {
            "alert": "alerts@csp.com",
            "msg": "Topology rate triggered",
            "when": "0"
         }
      },
      {
         "action": {
            "when": "500",
            "operatingState": "DEGRADED"
         }
      },
      {
         "action": {
            "when": "1000",
            "operatingState": "STOPPED"
         }
      }
}
```

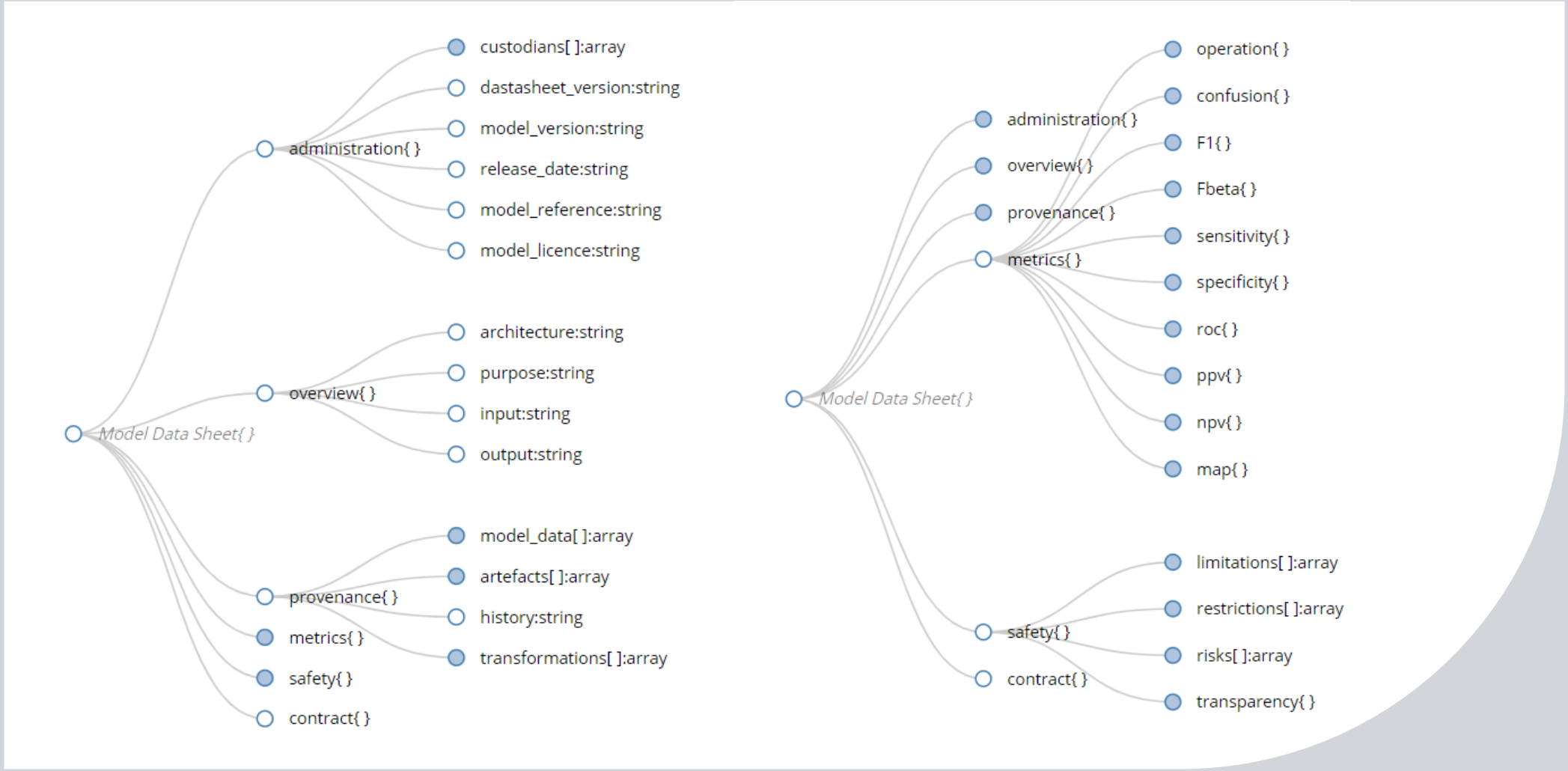
AI Model data sheets

- **Capture** pertinent information about AI models in a **consistent** manner, such that potential consumers of the model can determine whether it suits their **purpose** and, if so, how to **deploy** and **operate** the model **safely** and **effectively**.

We want to promote…

- Consistent reporting of model ‘metadata’ to aid in understanding and comparing models.
- Minimum standards of information across such areas as model provenance, metrics, limitations and restrictions.
- Best practice, especially concerning the reporting of model testing and performance.

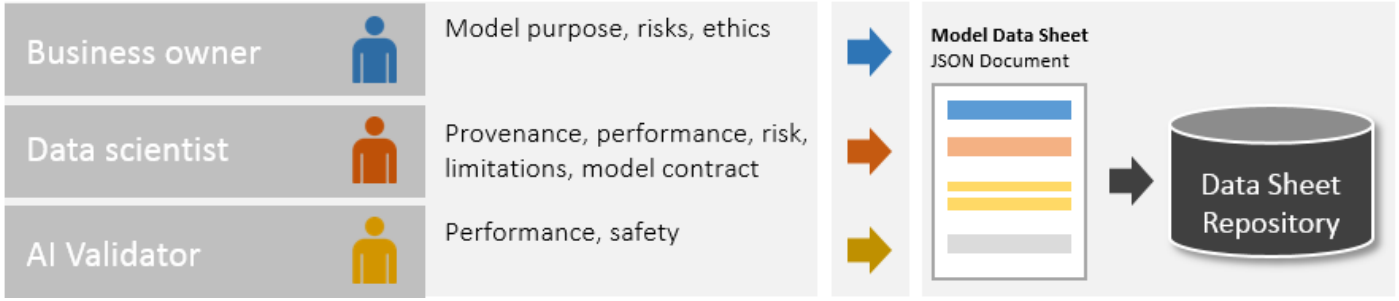
AI Model data sheets



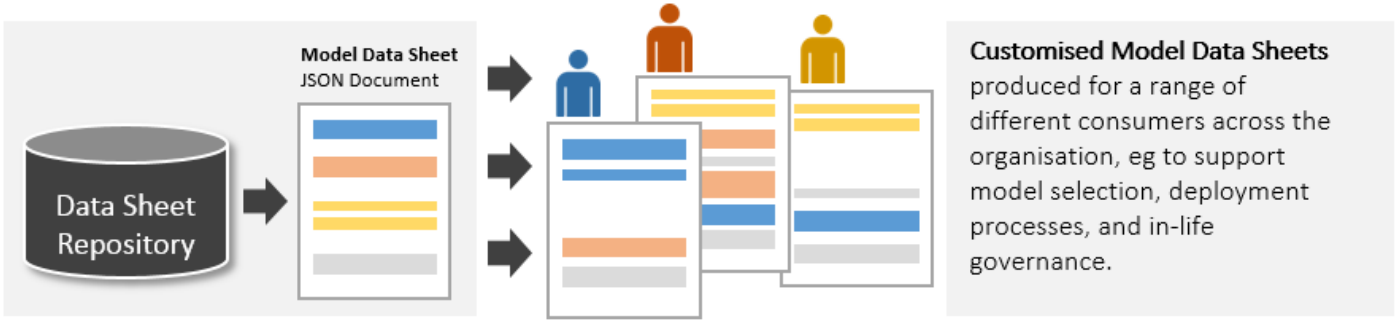
AI Model data sheets

consistent documentation for consumers of AI models

Populating the **model data sheet**



Consuming the **model data sheet**

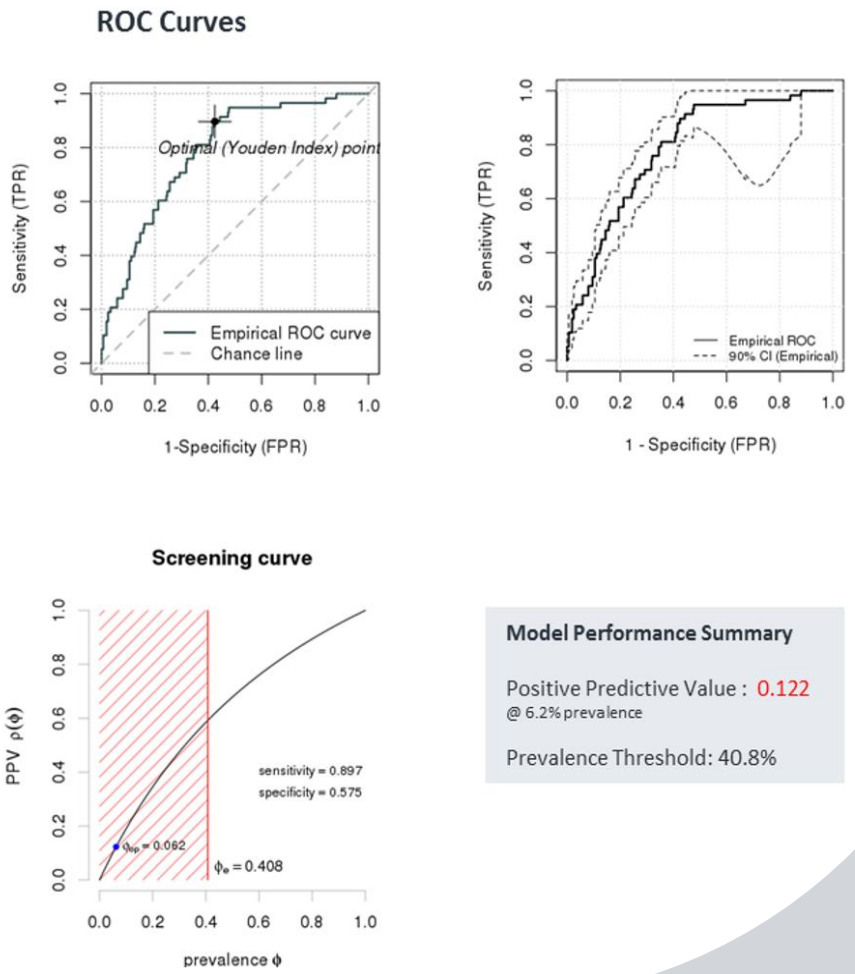


Customised Model Data Sheets produced for a range of different consumers across the organisation, eg to support model selection, deployment processes, and in-life governance.

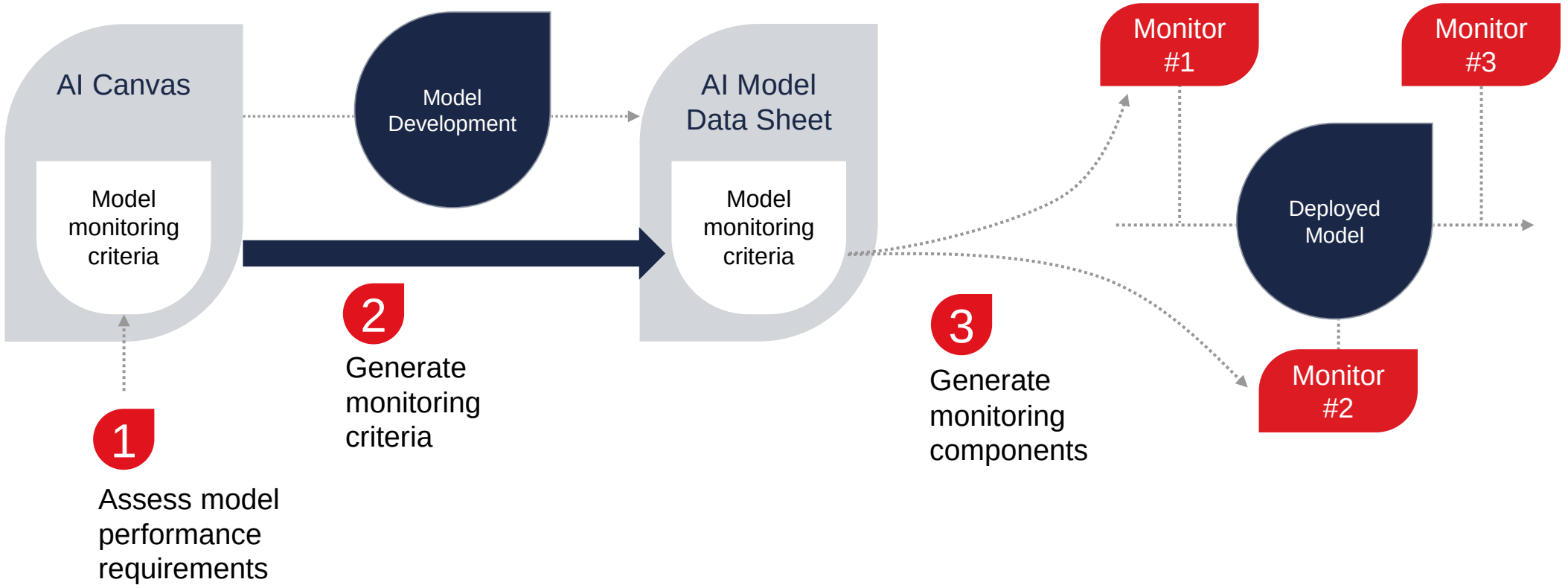
Machine to human-readable transformation

Example JSON only


```
{ model_metrics: {
  model_configuration : {
   family : { "binary_classifier" },
   type : { "logistic_regression" },
   target_prevalence : { 0.062 }
  },

  sensitivity: {
    val: 0.897,
    cutoff: -2.112,
    ci_upper: 0.981,
    ci_lower: 0.812,
    ci: 0.9,
    ci_method : "bootstrap"
  },

  ...

  roc_curve : {
   sensitivity : { 0.00000000, 0.01724138 0.03448276 , ... },
   specificity : { 1.000000000 1.000000000 1.000000000, ... },
   ci_upper : { 0.00000000 0.04535538 0.07389166, ... },
   ci_lower : { 0.000000000 0.000000000 0.000000000, ... },
   ci : 0.9,
   ci_method : "bootstrap",
   youden_index : {
    fpr : 0.425,
    tpr : 0.897,
    cutoff : -2.112
   }
  }

 ...

 }
}
```

E2E model management



Developing the AI Canvas to help guide AI implementations and use of TM Forum assets and ensure governance to reduce risk

Motivation

Early-stage examination of an AI "problem worth solving"

WHY

Understanding early risk

- AI a new frontier. When embarking on a new venture it is always good to examine the reason for travel
- Planning to take the right Route. In advance of starting the journey a CSP should explore the perils of the different routes in advance of setting off with everybody involved
- Early validation Considering the routes and choosing the ones with the least risk and the greatest reward to the business is a key first step.

WHAT

Things you need to succeed

- AI Canvas. A practical framework to allow CSP to undergo the early stage examination of any AI Project and the establishment of a set of early stage question to be asked and considered so that effort and resource in this highly competitive field is optimised against the Business Strategy on a use case basis.
- Fit for purpose. The application of certain rules and criteria that need consideration to come to the right decision for each use case.
- Outcomes. Measuring Use Case applicability and achievability against business strategy and enabling quick decision points whilst considering financial impact, productivity gains and compliance risks.
- Collaboration. Provision of a business wide environment to enable none siloed decision making.

HOW

Enable the use of AI Canvas

- Top-down engagement. Senior leadership must endorse the use and execution.
- A reusable template and methodology that provides an organization the basic components to understand risk (both Business and execution) and opportunity in equal measure.
- Value driven. Generating tangible benefits for the business that ensure further buy-in and enhances the TM Forum concept of AI Chain of Custody (CoC).
- Relevance. Enabling a cross reference to external asset both inside and outside of TM Forum and the C/DSP

Develop the AI Canvas to help guide AI implementations and use of TM Forum assets and ensure governance to reduce risk

Problem Statement	Diagnosis of faults in customer premises often requires accurate identification of the equipment involved – e.g., which version of master socket is installed, or which model and version of broadband hub is in use. Customers may have to be guided through this process
Business Value	Improving the time to identify equipment will have a direct impact on call center efficiency and reduce customer stress. Correct identification of equipment will allow for faster and more accurate fault diagnosis and repair. Average of 1200 fault calls/day involving identification of CPE. Average time to manually identify CPE = 2.5 minutes, which add £2 to call handling costs.
Measurable Goals with Direct Linkage to this Use Case	Call handling time, NPS, Time-to-fix, repeat calls.

As a....	Relative (care) of an elderly person who is showing signs of dementia but is determined to live in their own home and whom I am worried about their safety and security in their house whilst unaccompanied.
I need to...	Be able to monitor their safety whist living in their house
So that I can...	Feel confident that the person is safe and secure whilst I am remote from the scene
To do this I need...	Access to a system which monitors their movement and actions and allows me to be fully confident that they are safe

What is the addressable business problem	**How will the AI be deployed to address this?**	**What are the performance criteria for the model?**	**What's the minimum performance required (include assumptions)?**
Reduce agent time in correctly identifying customer premises equipment during fault diagnosis.	Customer uses smartphone app to image and identify the CPE and information sent electronically to the agent. AI object classification model identifies the customer premises equipment – e.g., type and variant.	Average sensitivity across all classes of object – i.e., the proportion of customer premises equipment that are correctly identified.	*Fixed Assumptions*: • Average cost saving of AI-driven CPE identification = £2 per call • Cost penalty of incorrect CPE classification = £5 per call **Average sensitivity for neutral benefit = cost/(cost+saving) = 71%** *Modeling uncertainty:* • Average cost saving of AI-driven CPE identification = £1.50 to £2.50 (90%CI) • Cost penalty of incorrect CPE classification = £4.60 to £5.40 (90%CI) per call **Average sensitivity for neutral benefit = 72%** **Sensitivity range (90%CI): 66.3 to 77.1%**

Model Procurement	Is there is a requirement to maintain strict provenance traceability for the model and training data that might be difficult to meet for models procured from a third party?
Environmental Impact	Is the model's environmental footprint a concern?
Data	Is there some property of the data that will preclude or favor particular model types, e.g., data quality?
Transparency	Does the application make specific demands on explainability or interpretability of the model?
Implementation	Are there limitations imposed by the environment the model will work within, e.g., AI will run on edge devices, or non-GPU infrastructure only?
Safety	Does the application make specific 'safety' demands that will influence model choice, e.g., high resistance to adversarial attack or privacy exposure?
Ethics	Are there ethical concerns that will influence model selection? These might arise from the type of data that is used, or indeed its sourcing – i.e., the desire to maintain an ethical supply chain.
Policy	Any other organizational policy implications on model selection.
Legal / Regulatory	Any other legal or regulatory implications for model selection.

tmforum

AIOps

AI Models: Offline & online

Traditional software

- Software lifecycle is driven from left to right, from Dev to Ops
- Evolution is planned
- Production environments are static and locked down
- Changes go through a planned change management process
- Baselines of software are usually well known.
- Deterministic
- Easily auditable
- Fragile.

AI software

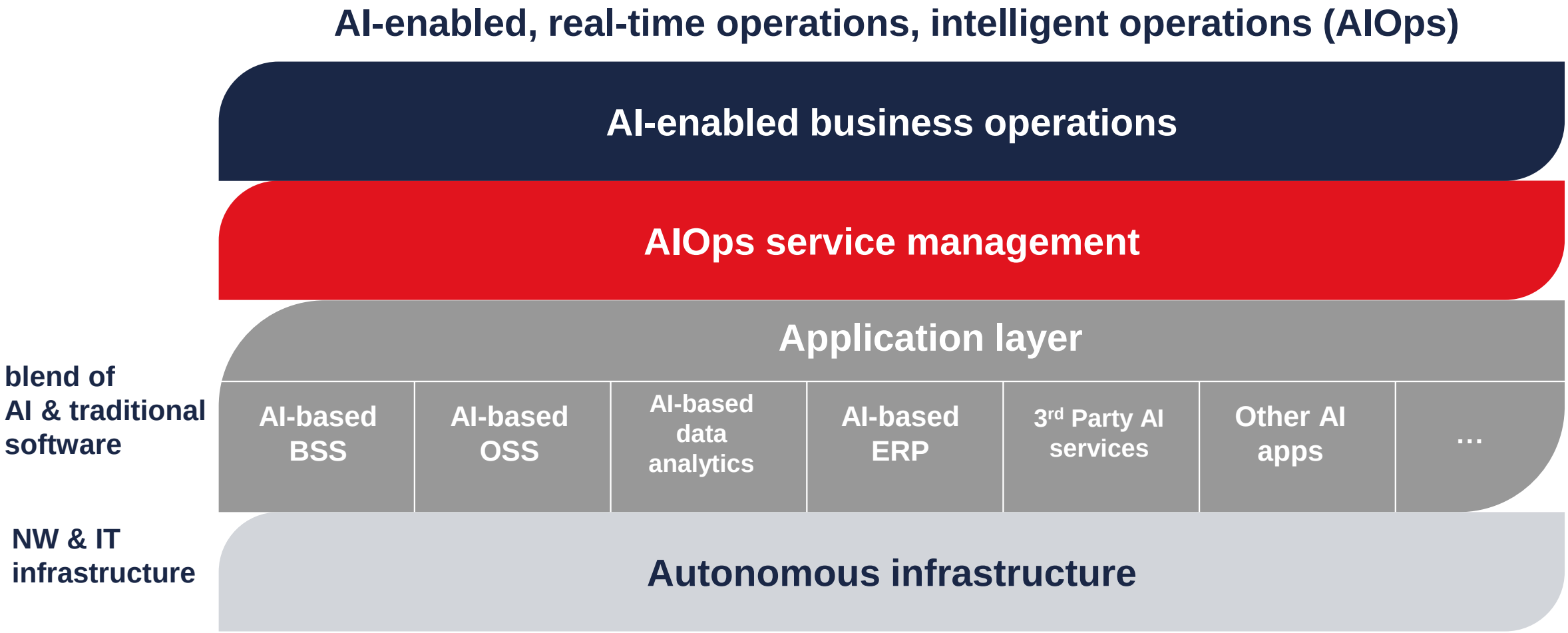
- Online learning, generate a new flow from right to left, from Ops to Dev
- Evolution is both planned autonomous/self-driven
- Production environments become dynamic, constantly changing
- Base lines of software become blurred
- Nondeterministic
- Black boxes
- Even more fragile than traditional software and exposed to bias and corrupted knowledge
- ML training and retaining of AI models are brand new processes in the software lifecycle
- Operations (including data ops) become even more central than today.

From operations perspective, they are similar to traditional software

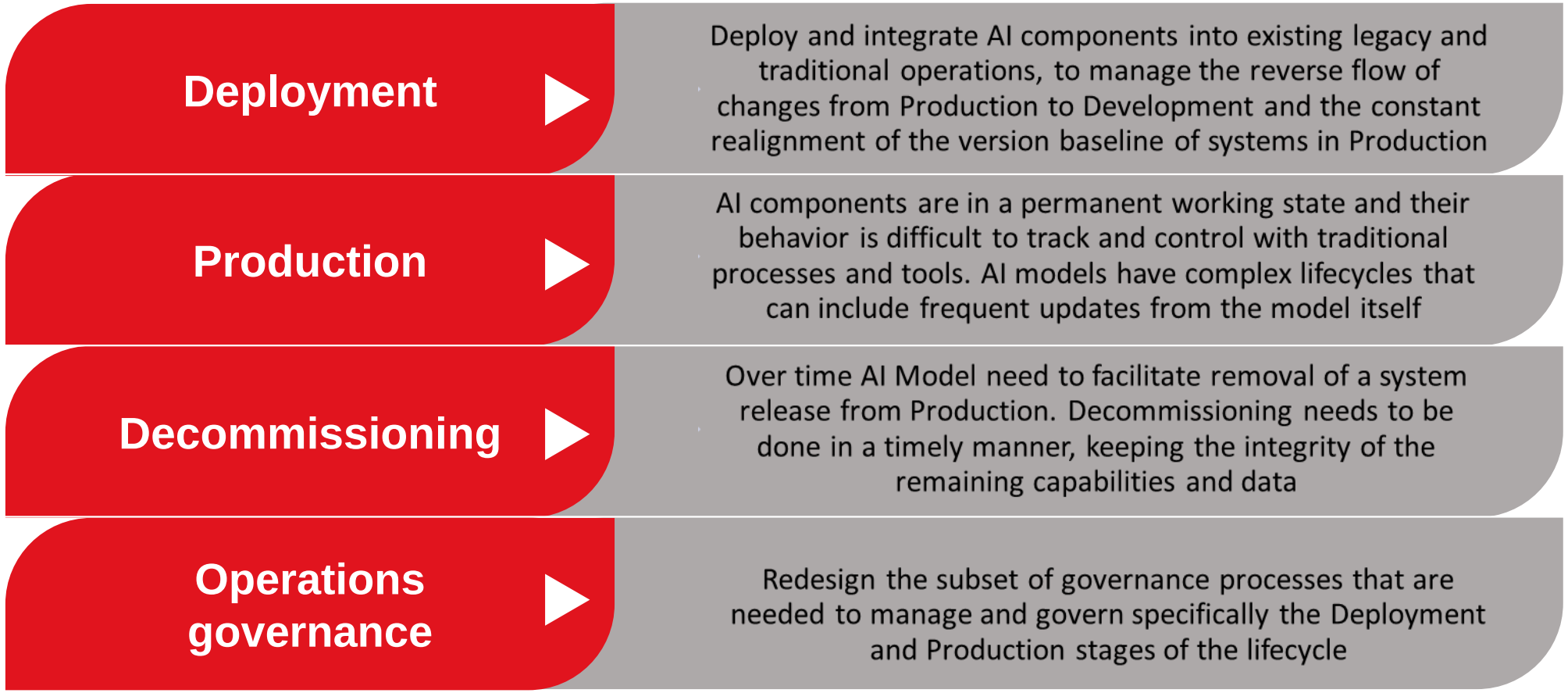
New challenge

AIOps Operating Model

Customers/End-users



Understanding the implications of AIOps



Showing the challenges of AIOps through the in-scope lifecycle stages

Understanding the implications of AIOps

Click on the process to view the description

Process	Brief description
Configuration management	Configuration management ensures that all components (also called configuration items, CIs) of systems and services are uniquely identified, baselined and maintained and that changes to them are controlled across the whole service lifecycle.
Change management	
Acceptance testing	
Release management	
Knowledge management	
Monitoring & event management	
Incident management	
Problem management	
Service desk management	
Application maintenance (preventive and perfective maintenance)	
Capacity management	
AIDataOps	

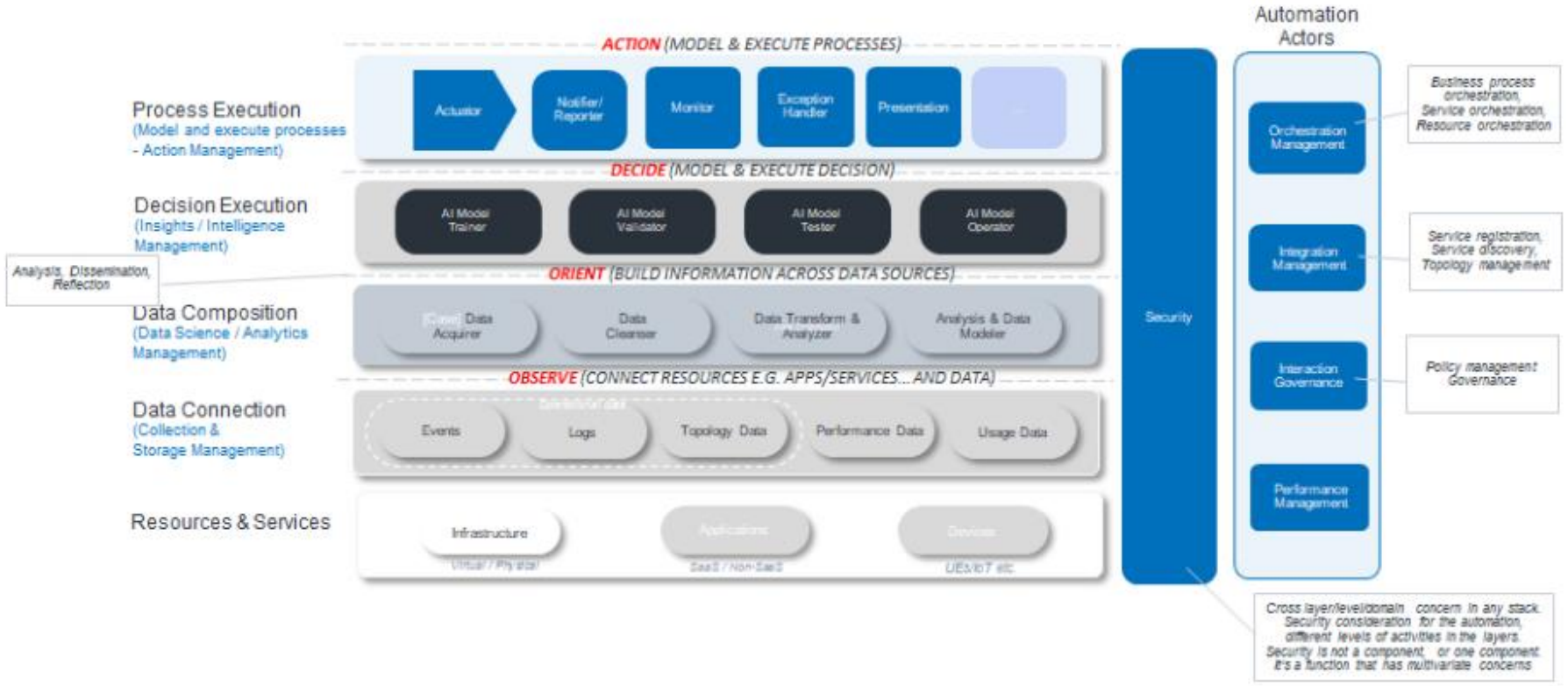
Closed loop anomaly detection & resolution

tmforum

TM Forum is helping solve those challenges by working with our members to…

“Define a reference architecture and related collateral to enable CSP's to transform network operations by using AI driven closed loop automation to detect anomalies, determine resolution and implement the required changes to the network within a continuous highly automated framework”

Logical architecture



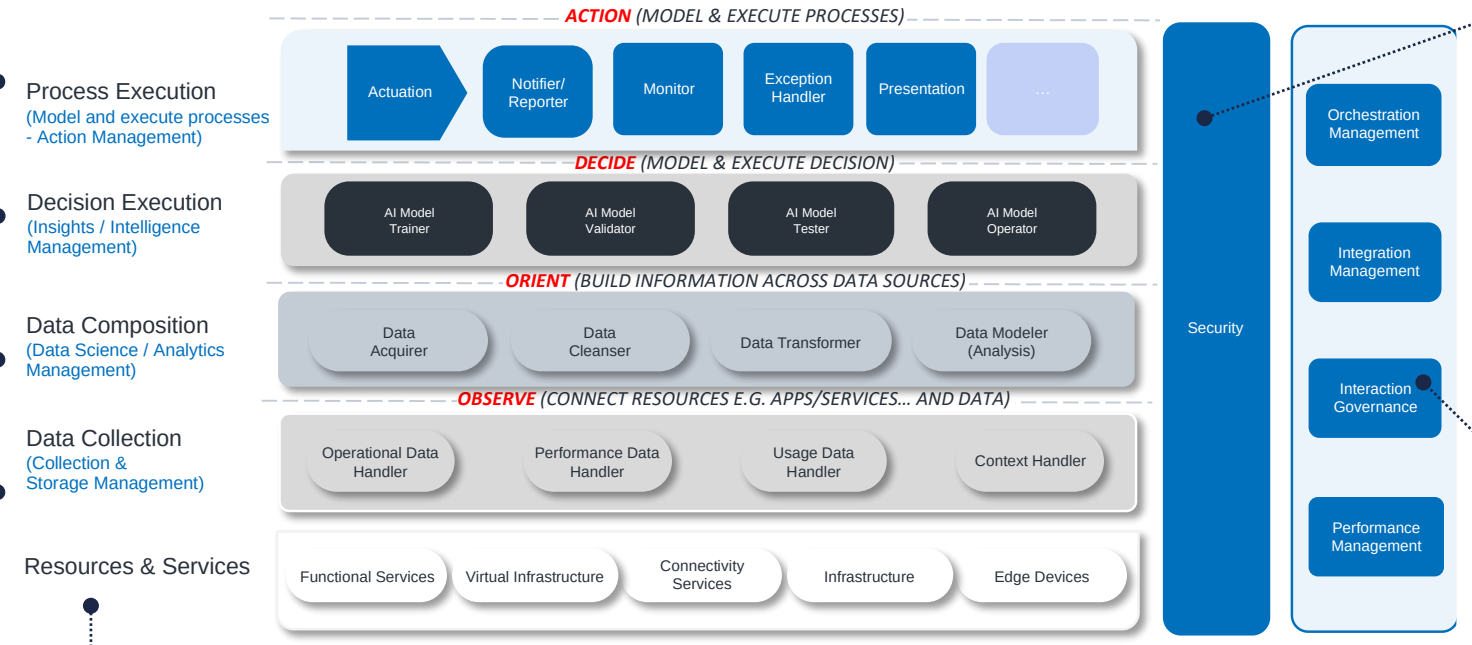
Closed loop automation logical reference architecture

Models and execute processes.
Through process orchestrator, human-related workflows, use of RPA etc.

Models and executes decisions.
decision models, business, AI based decisions and recommendations.

Builds information across Data sources through analysis, dissemination and reflection

Connects resources and services with Data. This includes data from compute, storage, network, applications, interfaces etc.



The Resources and Service layer provide logical representation of all components, devices, systems and interfaces that are at target for anomaly detection and resolution.

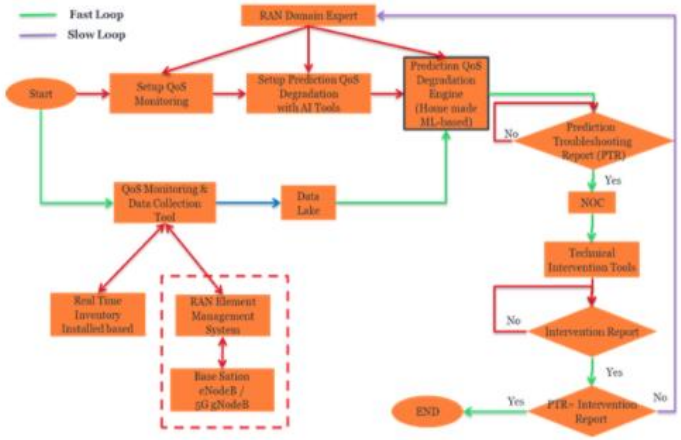
secure the solution from various aspects of infiltration and vulnerability, such as, user security, data security, application & infrastructure security

This is a vertical capability that combine all the tools that automate operations to manage key components across different layer

Use cases and future work

Use Case ID	Use Case Name	Use Case Area	Key Benefits	Closed-loop Automation KPIs
IM-010	Fault Detection in Radio Access Network	RAN	• High QoS • Reduced Opex • Optimal Capacity Utilization	• QoS • Opex • Capacity Utilization
IM-011	Fiber-To-The-Home Fault Diagnosis	FTTx	• Enhanced customer satisfaction • Simplified FTTH diagnosis processes • Fast service recovery after a call to the hot line	• Degradation of Quality and Alarms collected through E-UTRAN's E-RAB services.
IM-012	Traffic Flow Optimization	Transport	• Automatically manage network traffic performance in traffic layer • Reduce NOC engineer workload • Create self-healing network and achieve efficient network optimization	• Mean time to Detect (MTTD) • Mean Time to Resolve • Percentage of incidents resolved zero touch • Average response time from AI
IM-013	xNF Security Violations Detection and Resolution	xNF Security	• Reduced Mean time to Detect incidents • Reduced mean time to resolve incidents	• Mean time to Detect (MTTD) • Mean Time to Contain • Mean Time to Resolve • Days to Patch • Number of Security incidents
IM-014	System Performance Prediction by Trend	DC Infrastructure	• Predictive capacity planning • Intelligent Root Cause Analysis • Deep insights about operational data (Covariance parameters) & application behavior	• Customer experience • Application availability • Application performance
IM-015	Database Tablespace Management	Database Management	• Proactive operations • Proactive capacity management • Application uptime and performance • Customer experience and revenue metrics	• Application availability • Table space usage %
IM-016	Alert Correlation for Operations	Operations Management	• Increased Application availability • Increased Application performance • Customer experience & revenue metrics • Intelligent operations • Improving the efficiency of operations • Reduction in MTTR	• Resolution time of outages • Automation index - No of alerts automated/ Total no of alerts • No of operational resources • Other business metrics like uptime, availability, Customer experience
IM-017	CDN Root Cause Analysis	Content Delivery Network	• TBD	• TBD
IM-018	Charging Service Anomaly Detection	Charging Service	• Quicker Resolution of outages • Increased service availability.	• Reduced outage time • Reduced manual effort

C. Process diagram



Some key items captured for future consideration are:

1. Mapping to ODA
2. Compliance framework the connects the Logical with Physical and Operational architectures.
3. Reference Solution
4. Development of physical assets, like APIs and Data Models (as extensions to SID)

TM Forum sprint 4 & onward

Project activity plan (wip)

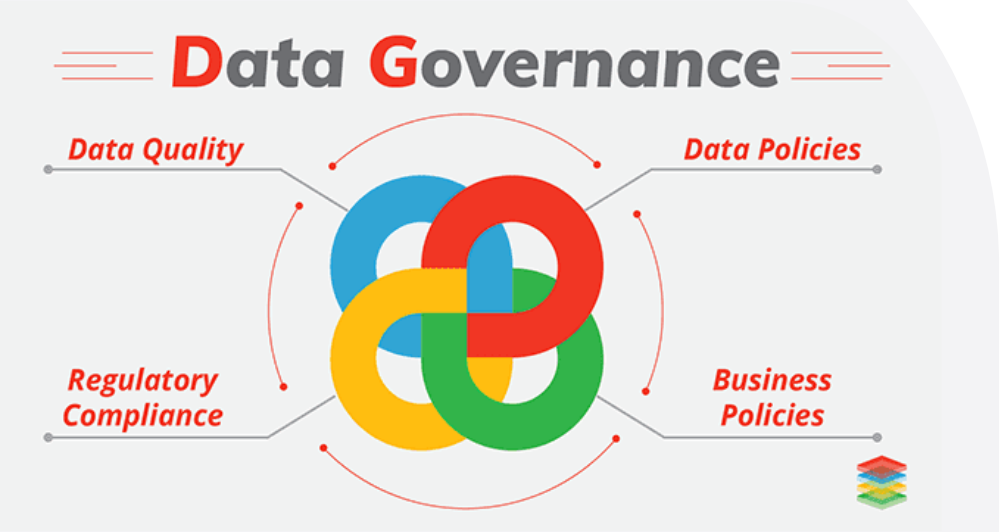
Activity block	Scoped tasks
Physical and Operational Architecture	• Physical architecture wrapped up the Sprint ending March 31st. Released on 12th April • Operational architecture to be finalized in Sprint 4 (Ending July ‘21)
Fast and Slow loops Standardization and Specification template	• Identify and define the Key Closed Loops for full anomaly detection and resolution workflow • Develop Specification and Optimization patterns for Fast and Slow Closed loops
Expose Services as Open APIs	• Identify APIs • Corpus/model training APIs • Anomaly Publishing APIs • Anomaly-to-Topology mapping APIs • Runbook Automation APIs • Interfaces to ETSI MANO APIs
AI Models References and Training Best Practices	• COTS Product models • Custom model Training techniques
Mapping to ODA	• Mapping CLADRA functional components to the TM Forum Open Digital Architecture framework

Data governance

tmforum

Objective

The aim of the TM Forum Data Governance Project is to allow service providers as well as public and private organizations and governments to have an ethical and secure framework which they can conform to, allowing easy sharing and use of large data sets across different sources and origins. The framework will comprise of some core technical components such as APIs and governance models as well as including technologies which rely on heavy data processing and use such as AI, blockchain and advanced data analytics.



Data governance white paper

Great participation - 30 active project members contributing to the whitepaper, 13 unique CSPs (18 members) and 12 vendors.

tmforum

TM Forum Introductory Guide

Data Governance Whitepaper - A new vision for the future of data governance

IG1225

Team Approved Date: 28-Jan-2021

Release Status: Production	Approval Status: TM Forum Approved
Version 1.0.0	IPR Mode: RAND

Figure 4: Diagram identifying the data governance functions as defined by DAMA

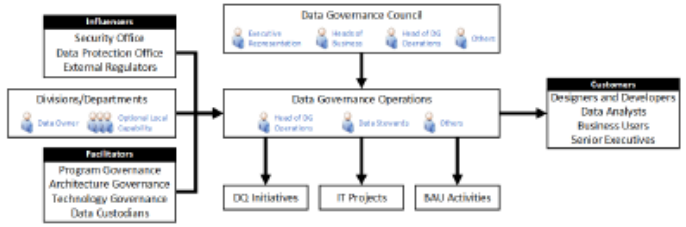


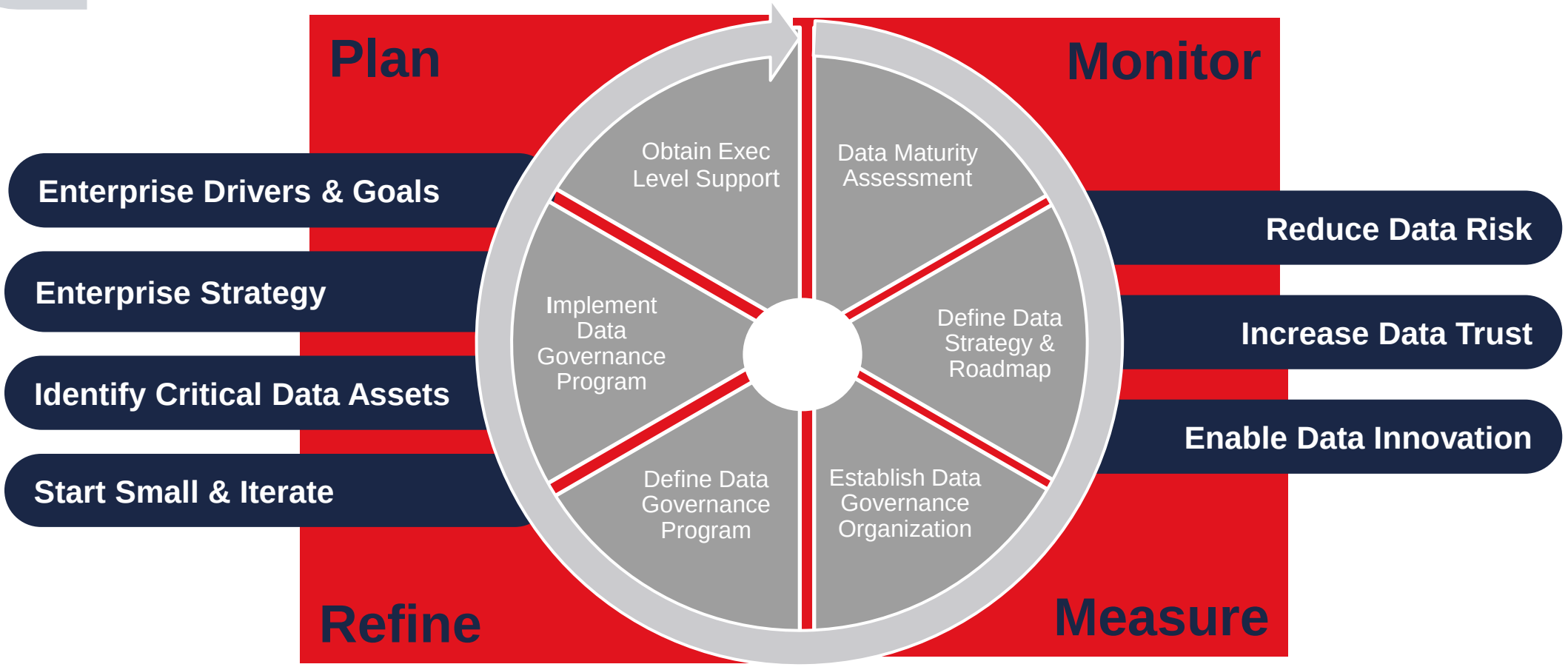
Figure 2: Typical Data Governance organization structure

Data Governance Guidebook - Executive Summary

The Data Governance Guidebook provides guidance to enable organisations, at all levels of data maturity, to take steps to define a data governance program specific to the organisation's business and data strategy

Content created by industry experts	Overwhelmed? We take you step by step	Not just theory, created from practise
Data Governance Program key considerations	Secure C-Level Support	Provides guidance for building the business case for data governance
Data Governance Program benefits	Perform Data Maturity Assessment	Recognizes every organisation has different goals and needs.
Data Governance Program role in becoming a Data-driven organisation	Define Data Strategy and Roadmap	Leverage knowledge of those that have implemented and sustained a data governance program
Data Strategy and Roadmaps	Define Data Governance Organisation	Providing guidance with planning, strategy and roadmaps
Data Governance program definition, organisation, frameworks and step by step implementation guide	Define a Data Governance Program Implement a Data Governance Program Track and Measure a Data Governance Program	The guidebook breaks down the process into easy to follow and flexible steps to fit every organisation's needs

Data Governance Guidebook



1
2
3

Data Governance Maturity Model

Tools Panorama

Data Governance API Engine

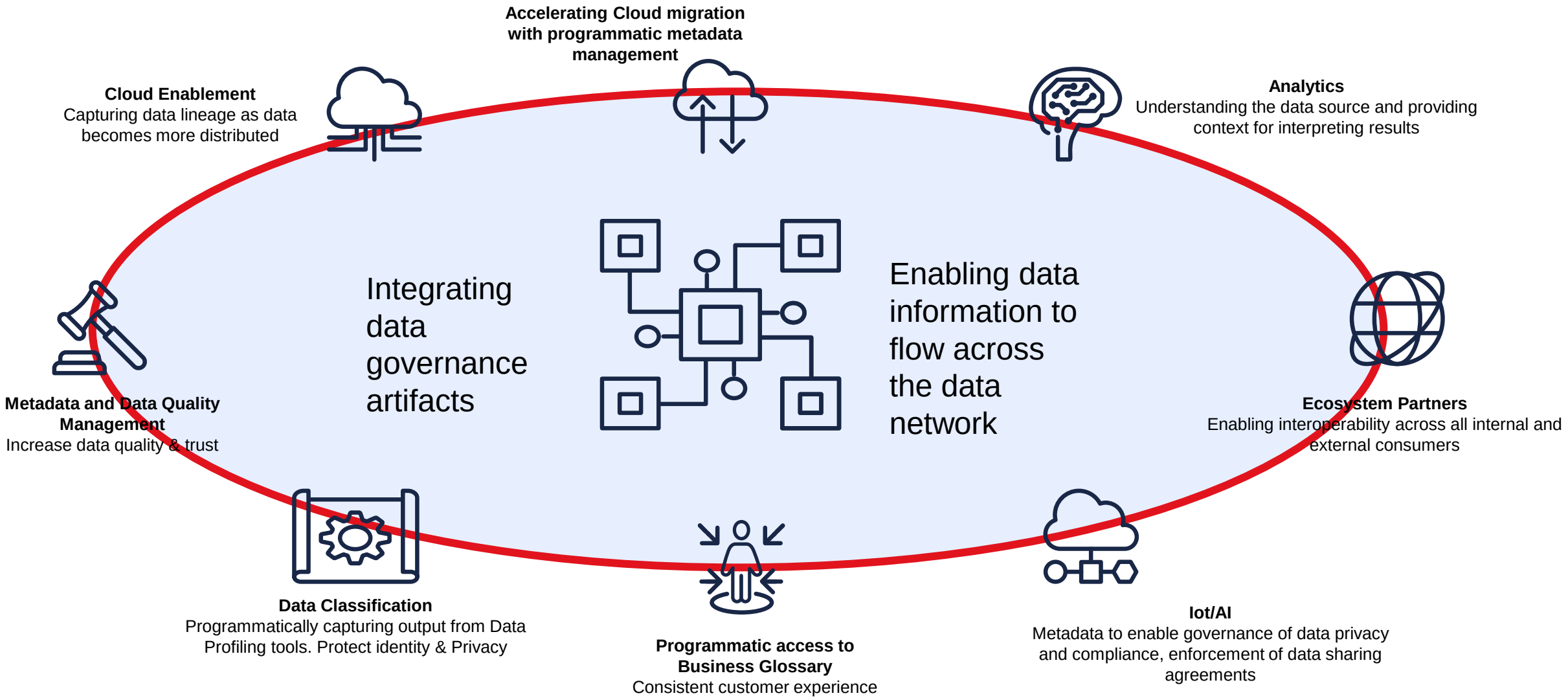
Data Governance API Suite - Executive Summary

The Data Governance Suite of APIs provide a standard specification to integrate and automate Data Governance through the definition of machine-readable service and data models.

Metadata and Quality Management API	Metadata and Data Sharing Management	Policy Management and Enforcement Risk Management
Metadata Catalog Management • Metadata Catalog Management • Business Glossary, Report and Reference Catalog Management • Data Classification and dimensions	Understanding Metadata Catalog Sharing and Use • Current and historical usage • Management of entitlement	Policy Management • Management of compliance policies such as records retention, regulatory, privacy, security
Metadata Asset Management • Metadata Catalog Asset Management • Metadata Catalog Asset Relationship Management • Lineage and Provenance	Understand Data asset data sharing and usage • Current and historical sharing and usage • Ensure compliance to privacy and entitlement	Policy Enforcement • Supporting runtime policy enforcement • Supporting streaming policy enforcement
Data Quality Management • Management of quality dimensions, objectives and specifications	Managing and reporting on quantifiable metrics • Providing insights • supporting strategic decisions • proactively managing risk and compliance • providing knowledge to drive innovation	Risk Management • Threat and risk assessment • Runtime application of security and privacy policies • Anomaly detection

Designed to enable the automation of Data Governance
Leveraging and extending the current suite of TMForum Open APIs

Data Governance API Suite - Connecting the Data Value Stream Network

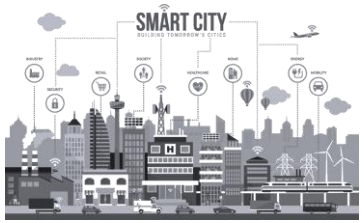


Autonomous networks

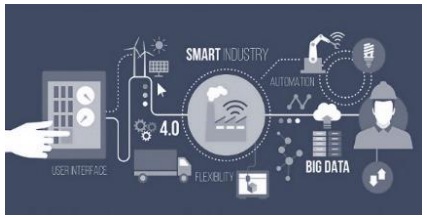
tmforum

Opportunities to ICT Industry - “Zero X” experience

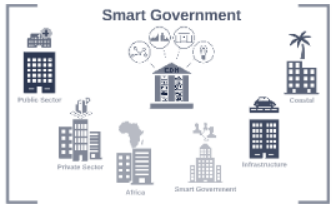
Autonomous networks/ICT services for intelligent society



Smart city



Smart industry



Smart government

Smart xxx…

“Zero X” experience

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

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

Zero wait

Swift

- Launch
- Delivery
- Care

Autonomous Network

Zero touch

Simplified

- Operating
- Development
- Maintenance

Agile Operations

Zero trouble

Self-healing

- Business
- Services
- Infrastructure

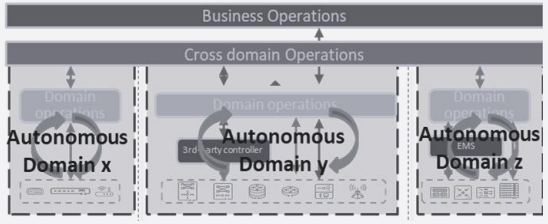
All-inclusive Services

Autonomous networks: automation levels

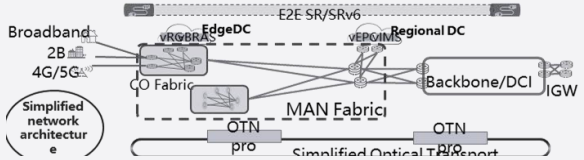
Data & knowledge driven intelligent, simplified networks

Knowledge as a service

Full lifecycle closed-loop



Simplified architecture



Self-configured, self-healing, self-optimized

✓ Simple ✓ Static ✓ Automation → ✓ Complicated ✓ Dynamic ✓ Autonomous

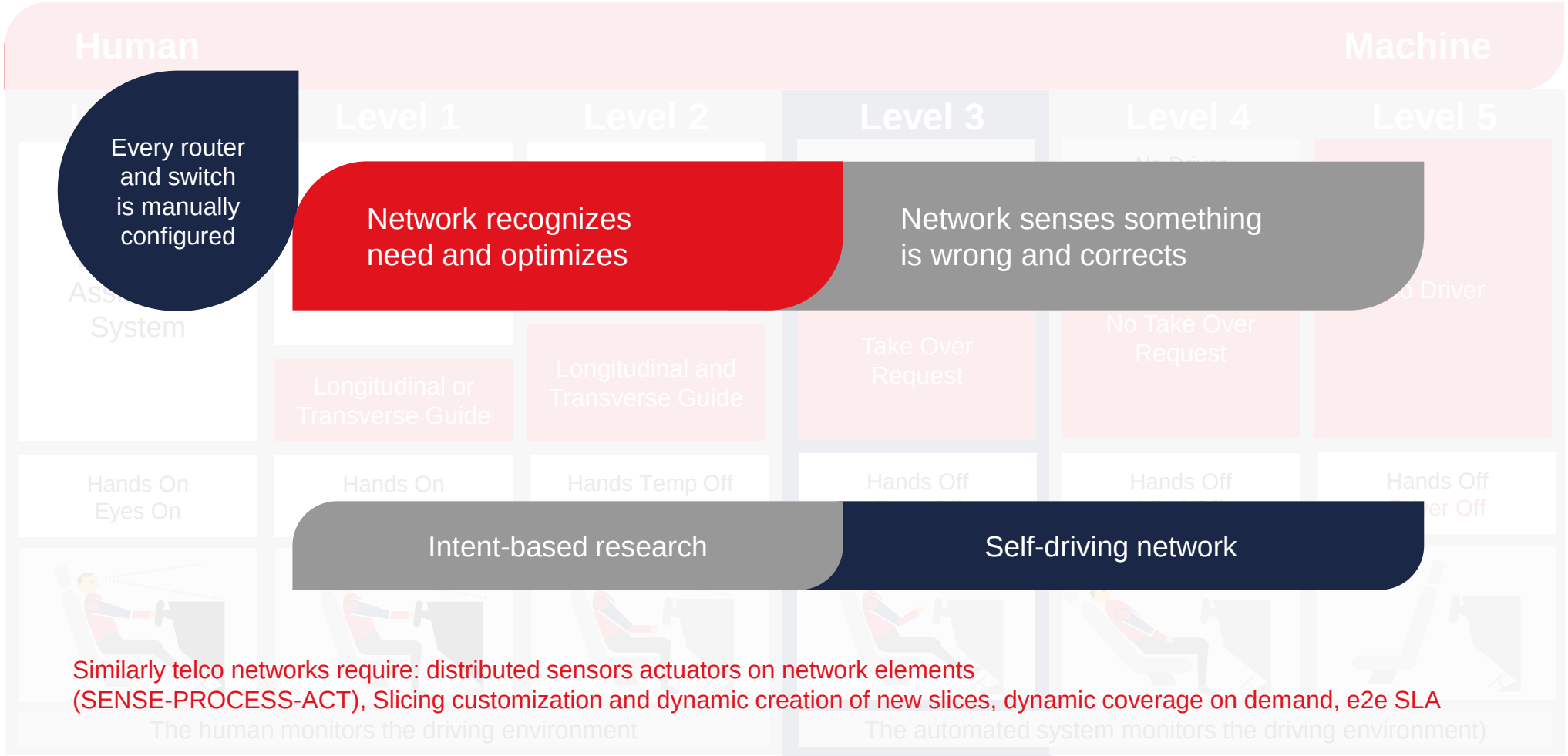
Level Definition	L0: Manual Operation & Maintenance	L1: Assisted Operation & Maintenance	L2: Partial Autonomous Network	L3: Conditional Autonomous Network	L4: High Autonomous Network	L5: Full Autonomous Network
Execution	P	P/S	S	S	S	S
Awareness	P	P	P/S	S	S	S
Analysis	P	P	P	P/S	S	S
Decision	P	P	P	P/S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

P: Personnel **S**: Systems

Best user experience, full lifecycle automation, maximum utilization

Revolution through evolution

Autonomous cars vs autonomous networks



Similarly telco networks require: distributed sensors actuators on network elements (SENSE-PROCESS-ACT), Slicing customization and dynamic creation of new slices, dynamic coverage on demand, e2e SLA

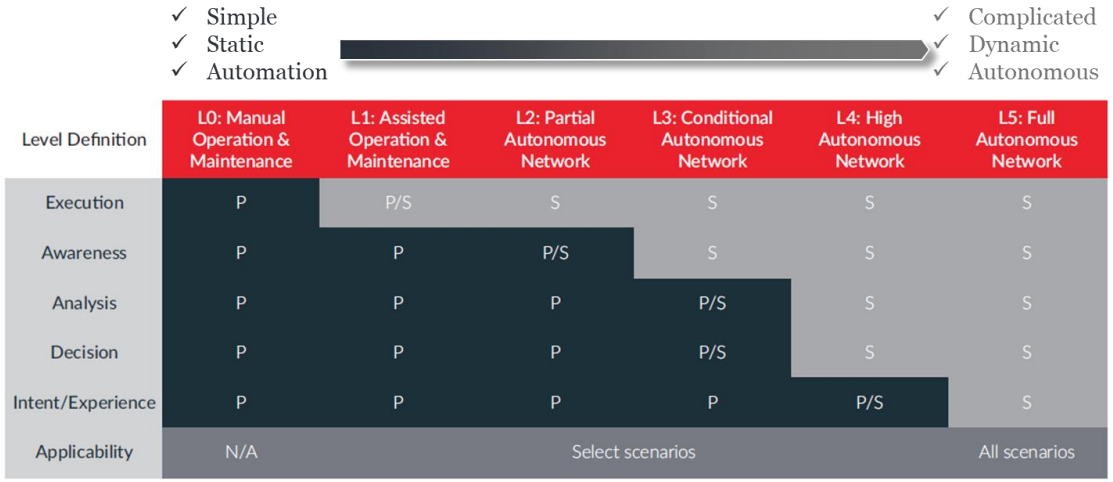
Levels of autonomous networks

Automation level definition and levels of functional aspects of technology

- **Level 0** - **manual management**:
  The system delivers assisted monitoring capabilities, which means all dynamic tasks have to be executed manually.

- **Level 1** - **assisted management:**
  The system executes a certain repetitive sub-task based on pre-configured to increase execution efficiency.

- **Level 2** - **partial autonomous network:** The system enables closed-loop O&M for certain units based on an AI model under certain external environments.

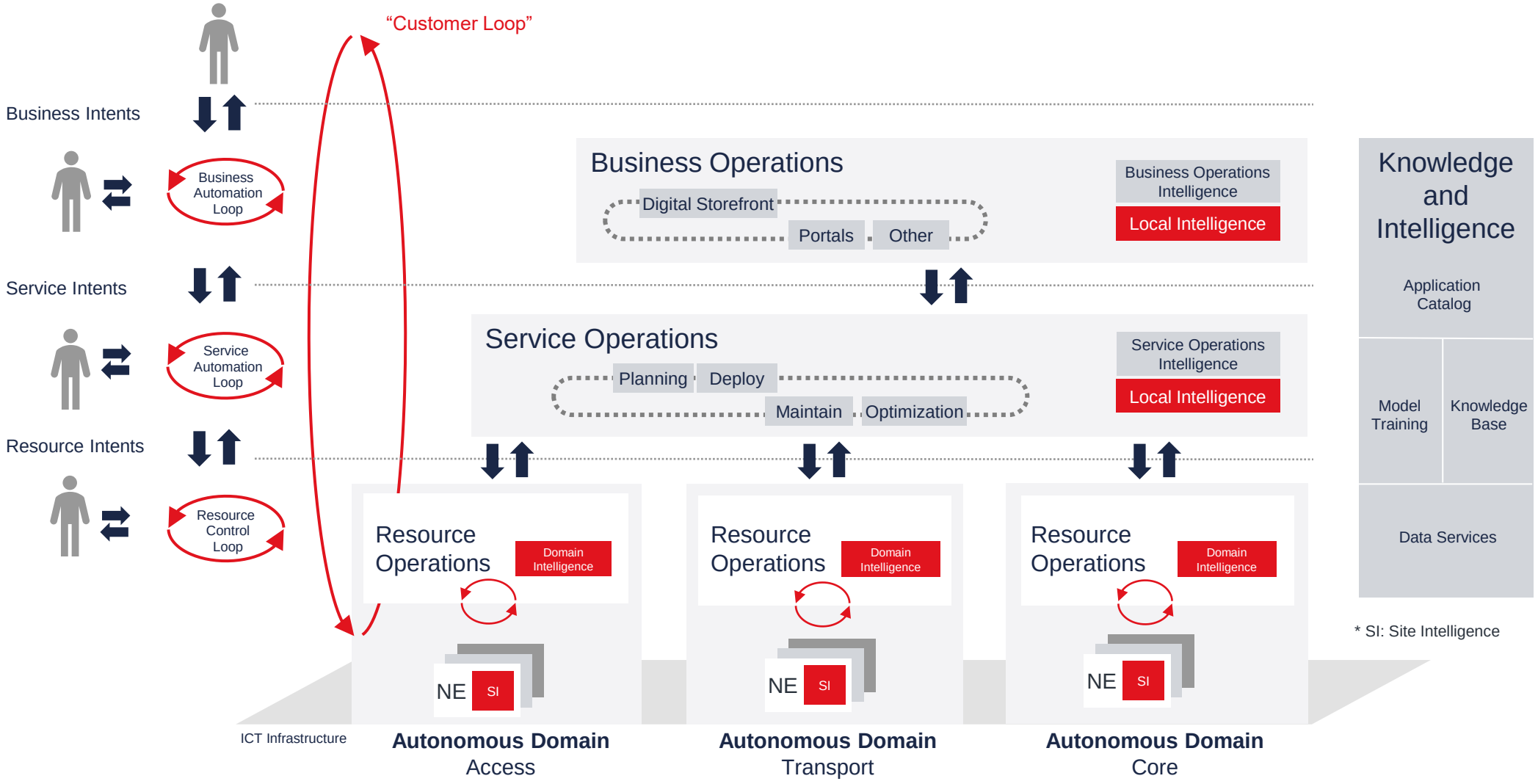


Level Definition	L0: Manual Operation & Maintenance	L1: Assisted Operation & Maintenance	L2: Partial Autonomous Network	L3: Conditional Autonomous Network	L4: High Autonomous Network	L5: Full Autonomous Network
Execution	P	P/S	S	S	S	S
Awareness	P	P	P/S	S	S	S
Analysis	P	P	P	P/S	S	S
Decision	P	P	P	P/S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

P: **P**ersonnel **S**: **S**ystems

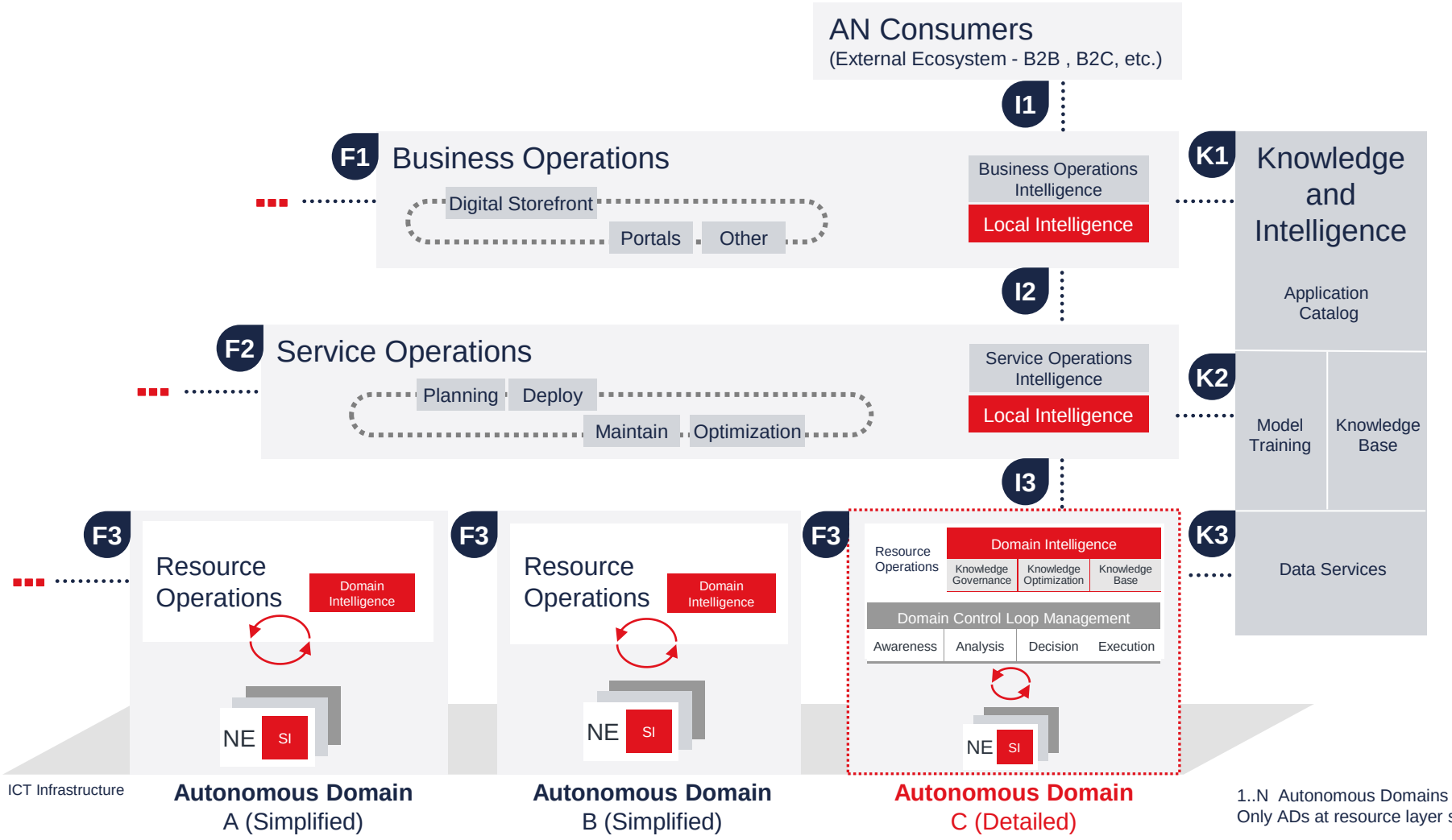
AN Technical Architecture (IG1230)

Business, Service and Resource Operations with Closed Loop Autonomy



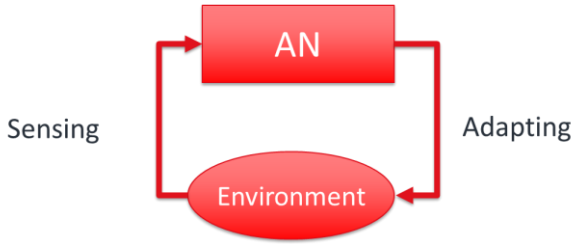
AN Reference Architecture (IG1251)

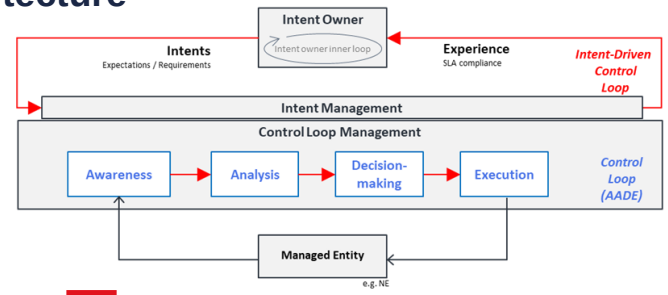
9 Reference Points

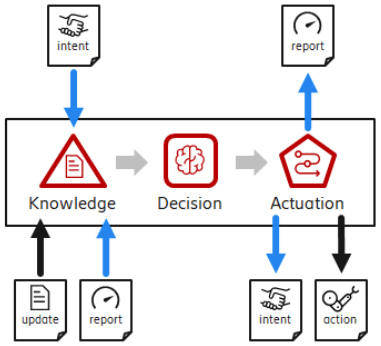


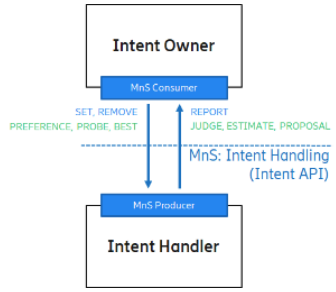
How guides bring TA together?

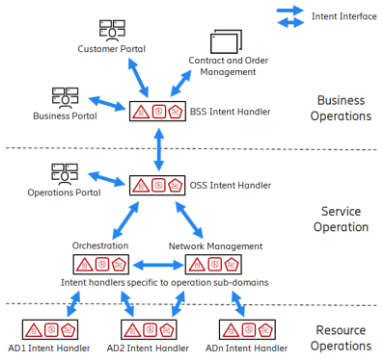
IG1230 v1.1
Autonomous Networks
Technical Architecture







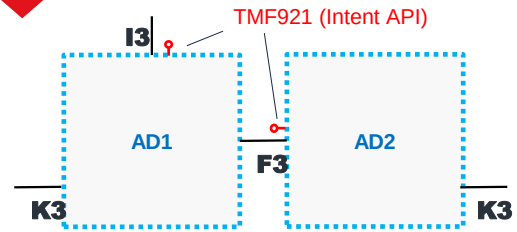




Intent Interface

Another interface (not intent based)

IG1253 v1.0
Intent on Autonomous Networks

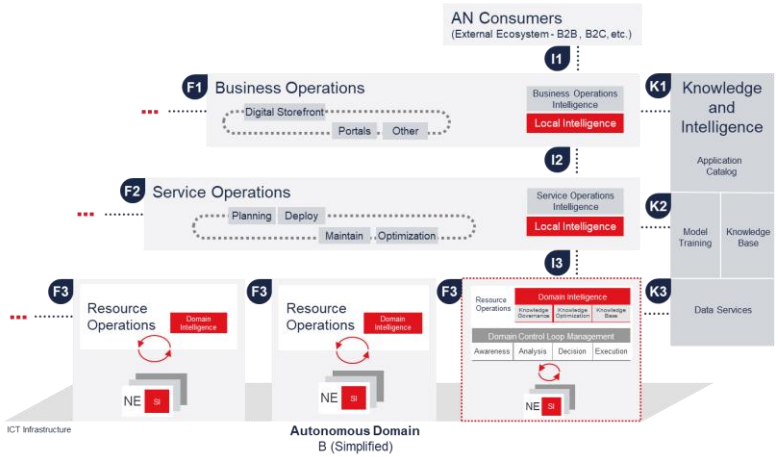


IG1252 v1.0
Autonomous Networks Levels
Evaluation Methodology

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	Selected Scenarios				All

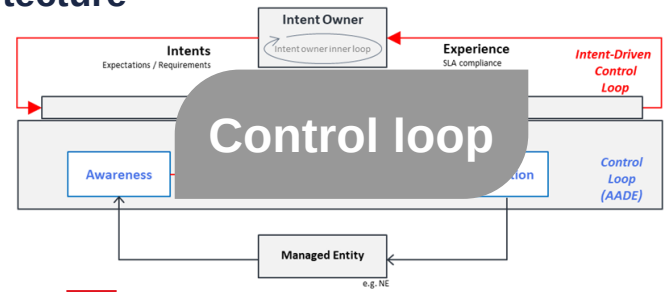
P People (manual) S Systems (autonomous)

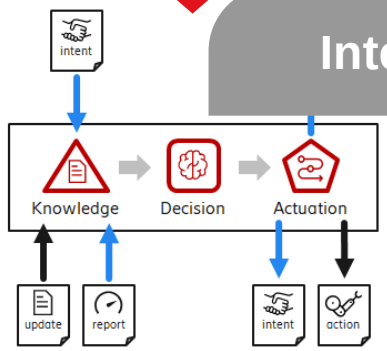
IG1251 v1.0
Autonomous Networks
Reference Architecture

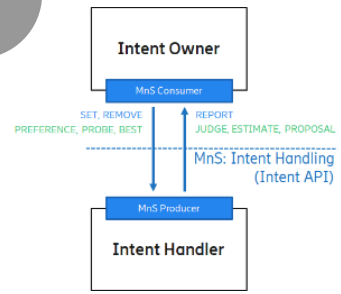


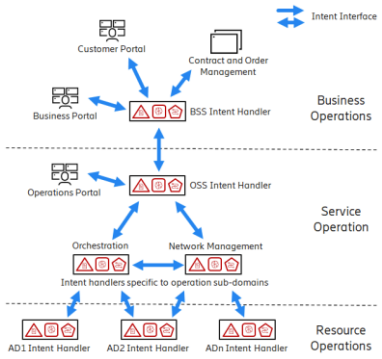
6 core concepts - Logical architecture to functional architecture

IG1230 v1.1 Autonomous Networks Technical Architecture





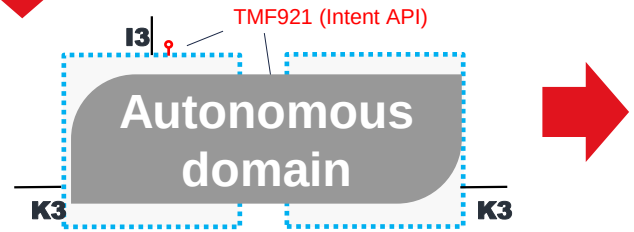




Intent Interface

Another interface (not intent based)

IG1253 v1.0 Intent on Autonomous Networks



IG1252 v1.0 Autonomous Networks Levels Evaluation Methodology

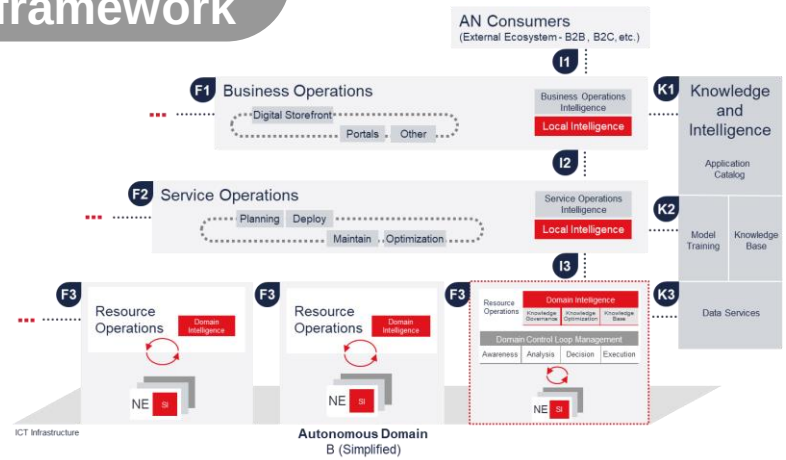
Autonomous Levels	L0: Manual Operation & Maintenance	L1: Assisted Operation & Maintenance	L2: Partial	L3: Conditional	L4: High	L5: Full Autonomous Networks
Execution	P					S
Awareness	P					S
Analysis	P					S
Decision	P					S
Intent/ Experience†	P	P	P	P	P/S	S
Applicability	N/A	Selected Scenarios				All

P People (manual) S Systems (autonomous)

AN level

AN framework

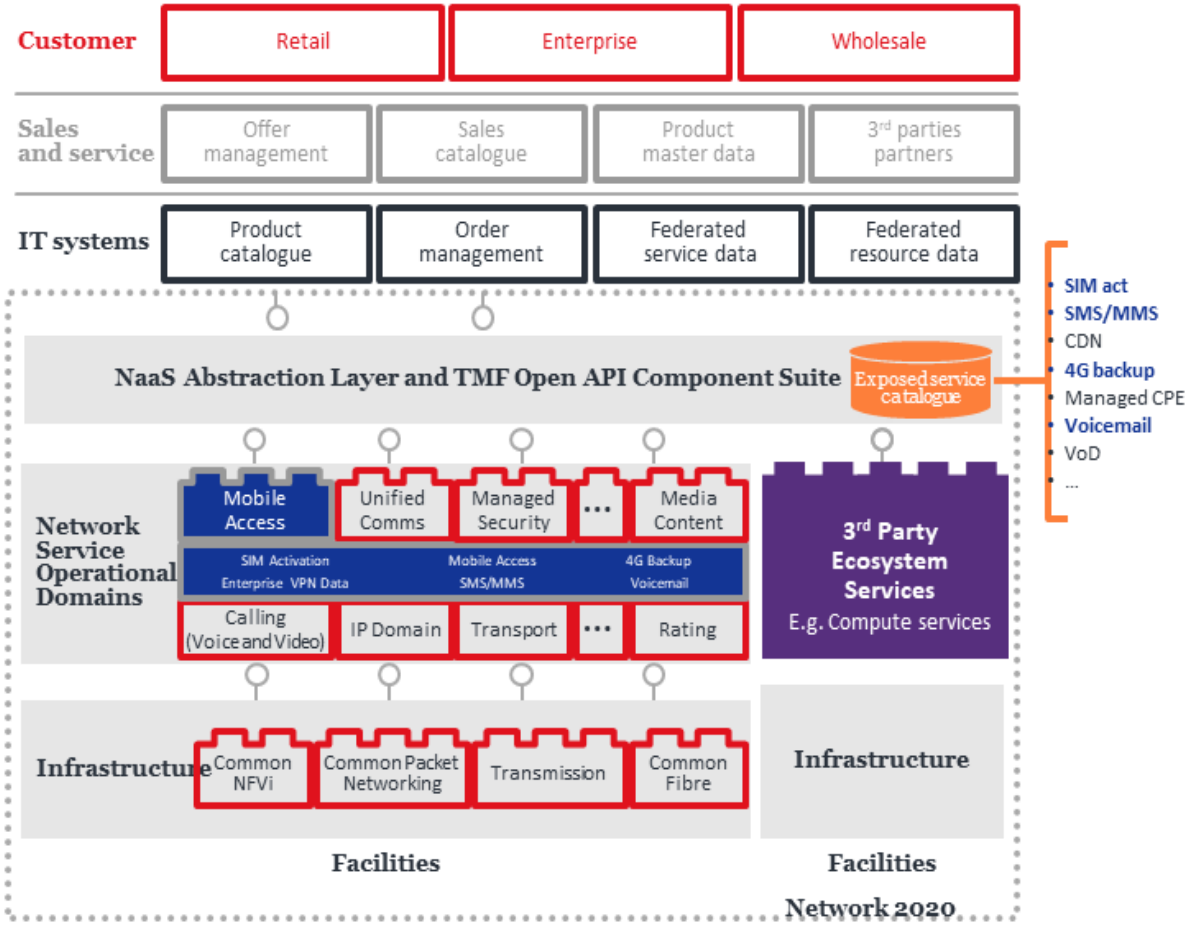
IG1251 v1.0 Autonomous Networks Reference Architecture



Applying ODA principles to the network

A set of autonomous domains that represent networks of the future

- “Softwarization” of the network.
- Transforming the network layer through virtualization.
- Telstra have mapped their entire network to a set of operational **Domains.**
- Each **Domain** has a **Catalog** of the services it supports.
- Each **Domain** exposes a well-defined standard set of services to the order delivery orchestrator so that products and offers can be composed with minimal dependencies on the network resources.
- Telstra will manage the lifecycles of these network services autonomously using the customer’s intent, policy, closed control loops, data analytics and machine learning.



Autonomous networks

Autonomous domain	Identify an industry agreed set of autonomous domains that represent the network of the future
Service exposing	Decouple one domain from another and expose a set of domain-based services via Open APIs to upper layer or other domains
Network element definition	Definition of network elements (or functions) within the various autonomous domains. These network elements or functions will expose a set of standard resource services at the domain level instead of at the element or function level
Network element configuration	Network elements can configure themselves and expose their characteristics to other layers or other domains to allow them to be externally controlled
Network element combination	Support the ability to combine a set of network elements to build or deliver a higher-level network service
Network capability model	Model the exposure of a set of network capabilities as a set of platform services to enable higher level business services to utilize network services
Service delivery ability	Develop the ability to deliver a service using a combination of flexible network services and resources that can be automatically orchestrated, configured, monitored and repaired
Business rule specification	Enable the ability to specify a set of rules at the business level that can be automatically monitored and effected across all domains of the architecture

Self-configuring, self-healing, self-optimizing, self-evolving networks

Customer Experience

tmforum

Digital Experience & Trust

Empowering service providers to deliver deeply rewarding customer experiences across the new landscape of 5G ecosystems

Develop new and existing capabilities for eTOM

Allowing CSPs to "digital, AI-driven customer experiences"

Intent – orientated customer experiences

CSPs can understand the driving force behind customers' behavior and move from delivering reactive experiences to pro-active ones. Functional view of the concept, architecture and applicable use

5G Experience Metrics

Develop new 5G experience metrics so that CSPs can confidently measure the quality and experience of new 5G services

CEM Gamification Journey Tech Spec

Identify the technical specification of gamification concepts

5G Enterprise Customer Experience

- **Objective:** Define what “5G” Customer Experience needs to look like for B2B/B2G/B2x2x customers for connectivity by 2025, and what changes and capabilities are required.

- **Scope:** Define a vision and capability framework for B2x customer experience in 2025, covering:

  - Customer requirements outside-in: based on research from enterprise customers, including:
    - How they will discover/buy/operate connectivity (and other types of digital infrastructure such as cloud, edge, etc.)
    - Expectations for connectivity providers and services including resilience, SLAs, management etc.

  - Identify the requirements of a set of specific use cases, separating requirements into non-negotiables and differentiators, highlighting opportunities for CSPs to differentiate

  - Examine a range of customer sizes e.g. developer, SME and large vertical/multi-national, and GTM scenarios

  - Identify the implications for business and operating model; assess the current level of understanding for

  - Technology expectations: key technology implications and changes needed to satisfy these requirements – and is the change occurring fast enough?

Come and join the fun, make a difference and collaborate

1. Login to https://www.tmforum.org or Register for an account if you don't yet have one.
2. Once logged-in, click on Labs / Member projects
3. Scroll down the 'xxx' project and click on 'JOIN THE PROJECT' accept the IPR Policy and submit the IPR form.
4. Once approved, either automatically or by your IP Manager (depending on your organization's policy) you will see that the text on the Member projects page button will change from 'REQUEST SENT' to 'VIEW PROJECT' and you will be able to access the project space in Confluence by clicking on the button, or by going to: https://projects.tmforum.org/