

Open Digital Framework Open Digital Architecture

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VP Architecture and APIs

15 Apr 2021

Introducing TM Forum: The Global Association for Digital Business



TM Forum is the member-led global industry association transforming business agility through expert-led collaboration and co-innovation

- 30 years accelerating transformation through worldwide collaboration
- Neutral, not-for-profit, led by the world's leading service providers



90,000+
member
professionals



850+
member
companies




**Global
Presence**

Mission: To enable the service provider businesses of tomorrow

Core Themes



Cloud Native IT & Agility



AI, Data & Analytics



Autonomous Networks & the Edge



Beyond Connectivity



Digital Experience & Trust



Human Factor

Digital Business Transformation

Unlock **Growth** and **Societal Impact**

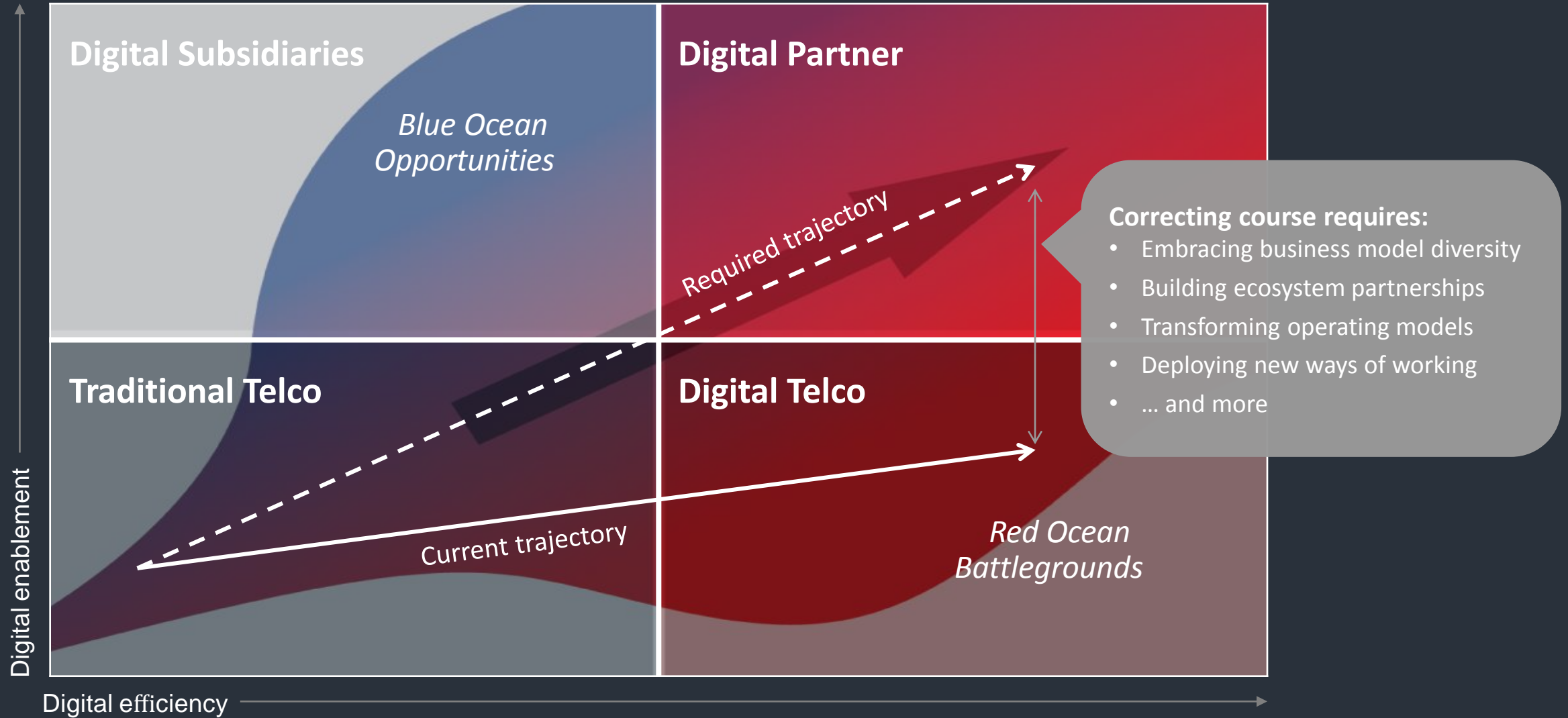


North America	Europe, Middle East & Africa	Latin America	Asia Pacific	China






10/10 of the world's largest CSPs are now TM Forum members



The industry wants to go 'beyond connectivity', but most transformation efforts fall short of the change required



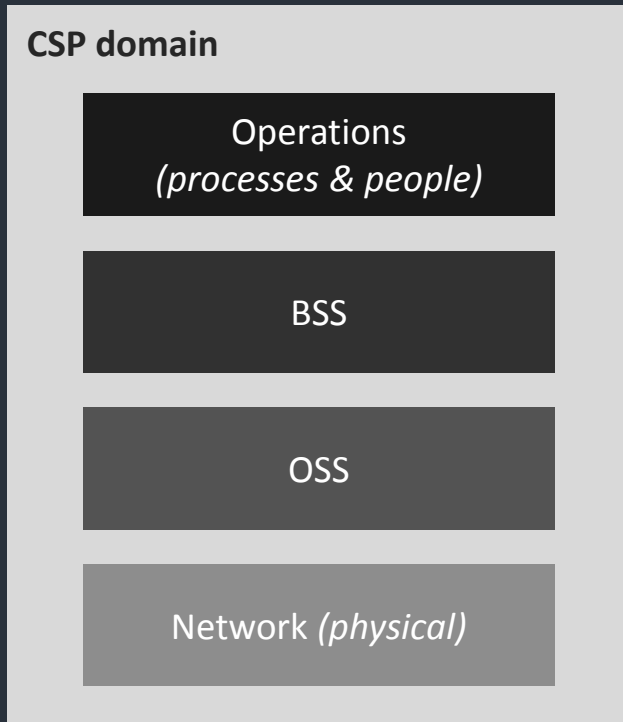
Addressing the challenge requires a clear ambition at industry level

Industry Challenges	Market Requirements/Ambition	
1. E2E Business Agility <i>How fast? (Concept-to-Cash cycle time)</i>	<ul style="list-style-type: none">▪ <i>Launch new products in days (MVP)</i>▪ <i>Deliver new features in minutes</i>	
2. Cost Optimization <i>At what cost?</i>	<ul style="list-style-type: none">▪ <i>Double OpEx Efficiency</i>▪ <i>Dramatically improve CapEx efficiency</i>	
3. Digital Experience & Trust <i>With what experience?</i>	<ul style="list-style-type: none">▪ <i>100% of interactions through digital</i>▪ <i>Build on reputation for Trust</i>	
4. B2B Growth <i>With what growth from B2B?</i>	<ul style="list-style-type: none">▪ <i>40% growth in wholesale (B2B2x)</i>▪ <i>10% growth in 'pure' B2B</i>	
5. B2C Growth <i>And what growth from B2C?</i>	<ul style="list-style-type: none">▪ <i>3-5% growth in B2C</i>▪ <i>Ability to self-disrupt ('Engine 2.0')</i>	

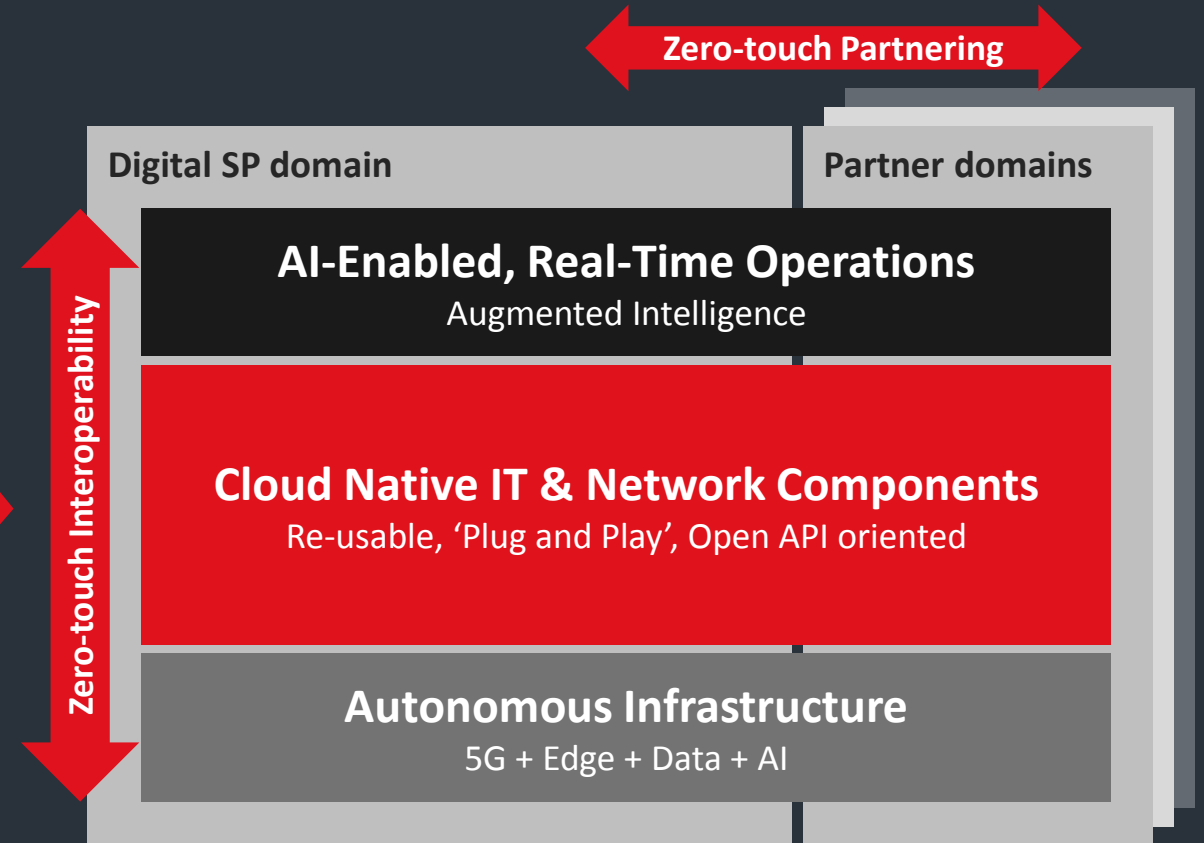
Delivering on the ambition requires change in mindset, end-to-end

Simplification, automation and intelligence are key principles driving the change

Traditional CSP



Digital Service Provider



Open Digital Framework (ODF)

Open Digital Framework (ODF)

A blueprint for intelligent operations fit for the 5G era

- Provides a migration path from legacy systems and processes to modular, cloud native software orchestrated using AI

Practical tools

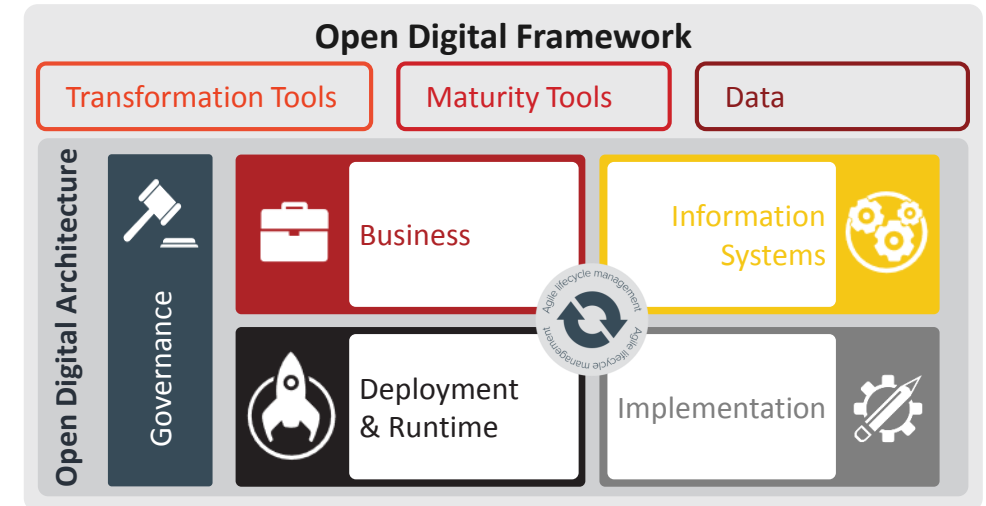
- ODF comprises tools, code, knowledge and standards (machine-readable assets, not just documents)

Delivering business value for TM Forum members today

- Accelerating concept-to-cash, eliminating IT & network costs, enhancing digital customer experience

Developed through TM Forum's collaboration programs

- Created and used by leading service providers and software companies, building on TM Forum's established standards



Goals of the Open Digital Framework

- Transform business agility (accelerate concept-to-cash from [18 months to 18 days](#))
- Enable simpler IT solutions that are easier and cheaper to deploy, integrate & upgrade
- Establish a standardized software model and market which benefits all parties (service providers, vendors & SIs)

Transformation Tools

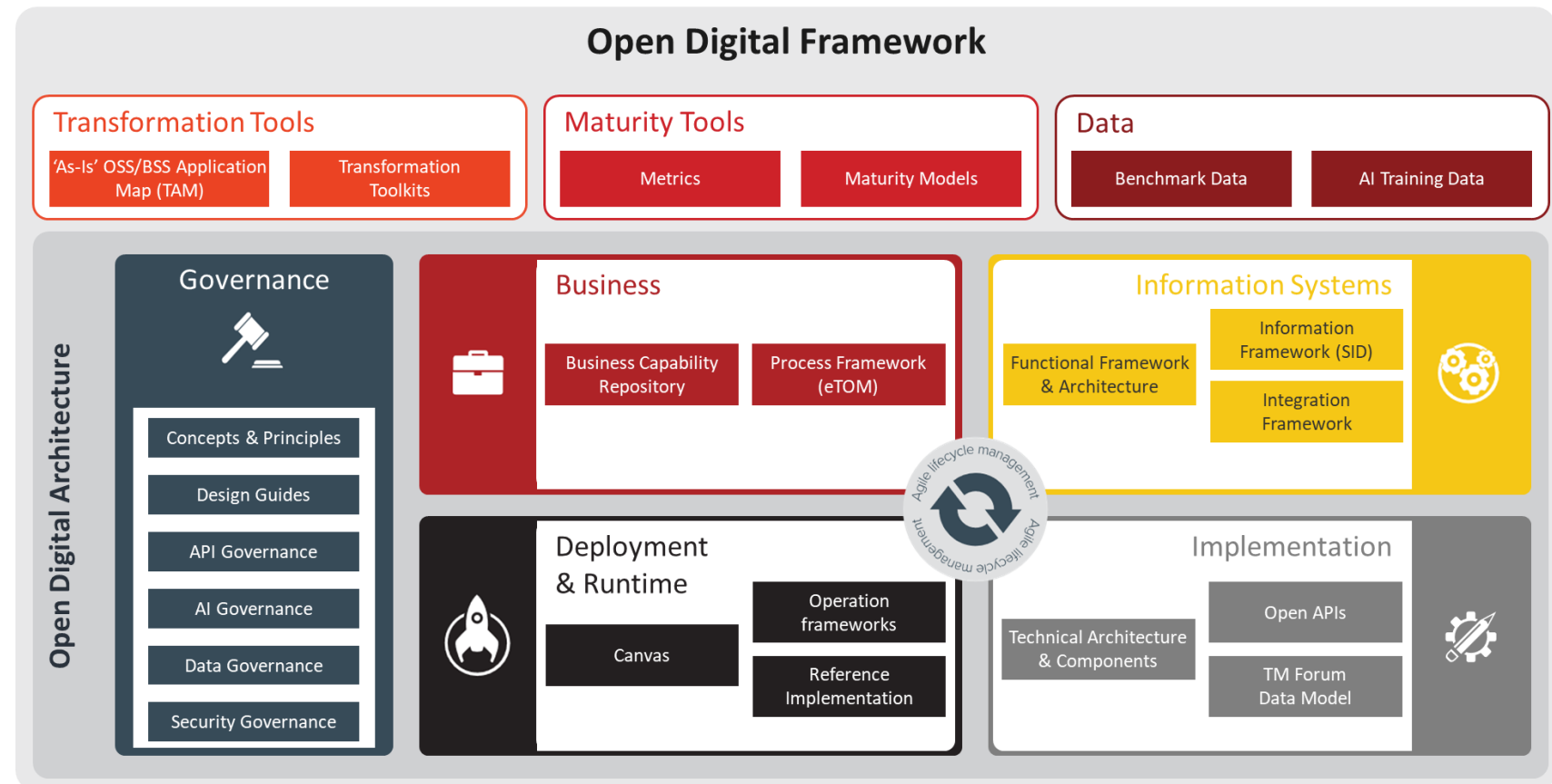
- Guides to navigate digital transformation
- Tools to support the migration from legacy architecture to ODA

Open Digital Architecture

- Architecture framework, common language, design principles
- Open APIs exposing business services
- Software components
- Reference implementation and test environment

Maturity Tools & Data

- Maturity models and readiness checks to baseline digital capabilities
- Data for benchmarking progress and training AI



Open Digital Framework

Transformation Tools

'As-Is' OSS/BSS Application Map (TAM)

Transformation Toolkits

Maturity Tools

Metrics

Maturity Models

Data

Benchmark Data

AI Training Data

Open Digital Architecture

Governance



Concepts & Principles

Design Guides

API Governance

AI Governance

Data Governance

Security Governance

Business



Business Capability Repository

Process Framework (eTOM)

Information Systems

Functional Framework & Architecture

Information Framework (SID)

Integration Framework



Deployment & Runtime



Canvas

Operation frameworks

Reference Implementation

Implementation

Technical Architecture & Components

Open APIs

TM Forum Data Model



Open Digital Architecture (ODA)

Open Digital Architecture (ODA)

- ODA is a complete enterprise architecture blueprint for open digital platforms, replacing traditional operational and business support systems
- Comprises standardized, reusable, cloud native software components organized into loosely coupled domains
- Components connect via standardized Open APIs which:
 - Provide zero-touch interoperability (plug-&-play components)
 - Expose business capabilities for zero-touch partnering
- ODA transforms business agility with simpler IT solutions that are easier and cheaper to deploy, integrate & upgrade
- Built by industry agreement
 - TM Forum members are actively developing the ODA standards, leveraging mature, proven TM Forum assets

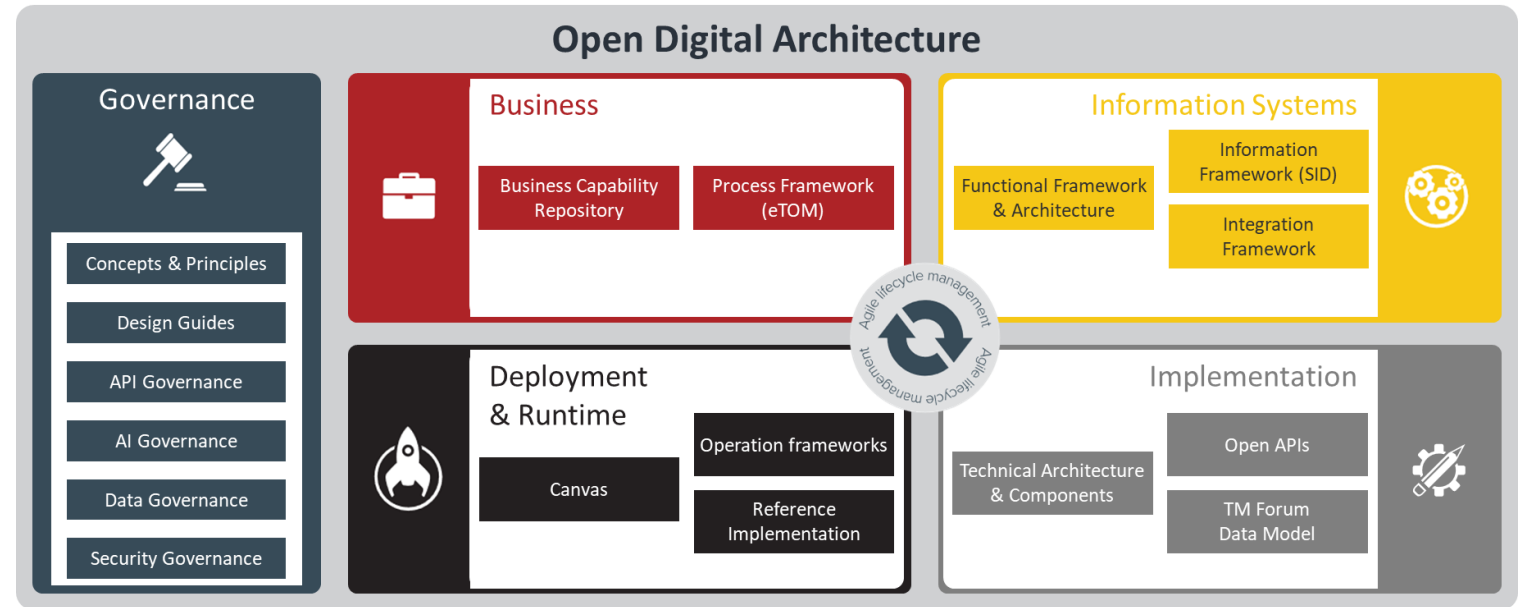
"Open Digital Architecture is a catalyst to cultural change."

Thierry Souche

Group CIO, Orange



Structure of ODA



Business Architecture

- Business capability map & value stream mappings
- Multi-layered model of the key business processes for efficient, agile operations (eTOM)

Information Systems Architecture

- Functional architecture (a set of structured and simplified implementation independent views enforcing decoupling)
- Data architecture, with standard definitions for the information that flows through the enterprise and between service providers & their partners (SID)

Implementation Architecture

- Suite of 50+ REST-based Open APIs for standardized interoperability of IT systems and partner integration
- Standardized data model, enhanced for AI operations
- Definition of the ODA Components for reuse and simple integration

Deployment & Runtime Environment

- Canvas – a standard technical framework and DevOps environment for plug-and-play ODA components
- Lab-deployed reference implementation and test environment

Governance

- Principles, design guides, metamodels
- Tools for agile management of the architecture lifecycle

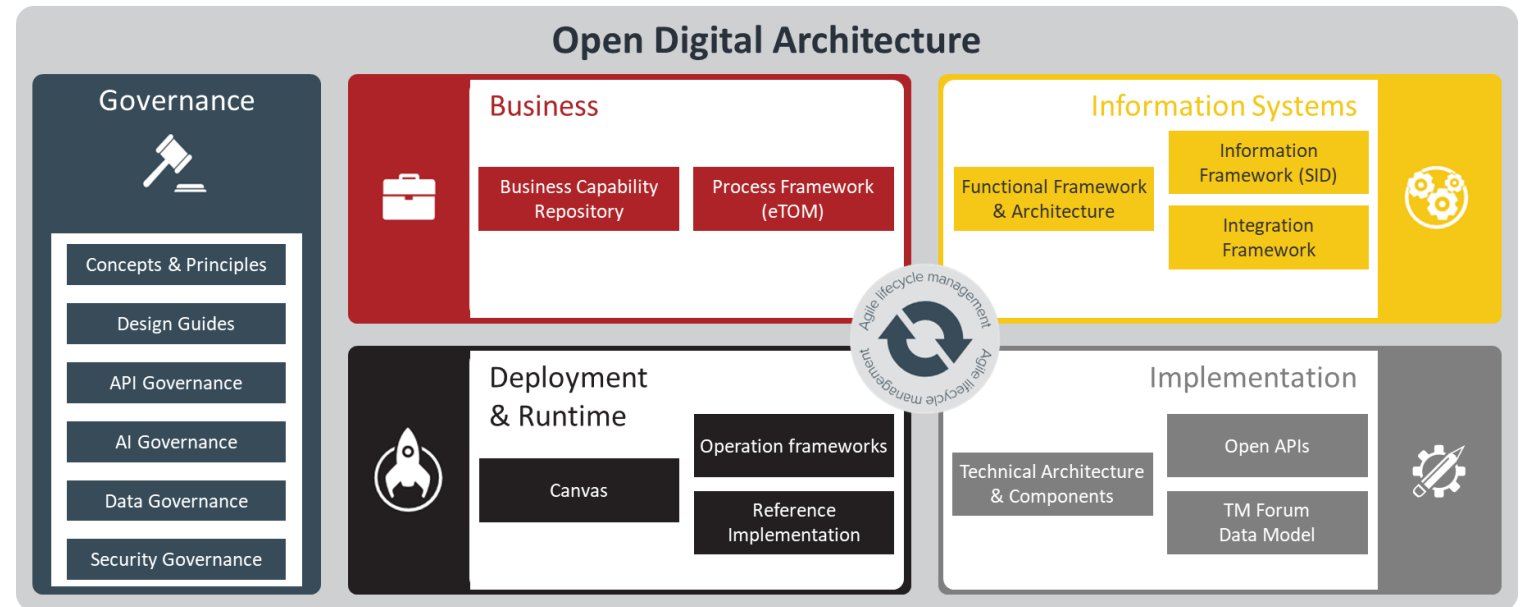
ODA Core Concepts

Capability Driven Transformation

- Business capabilities → functions → components
- Enables business / technical agility
- Common language for Business (requirements) and IT (design)
- Enables the software marketplace

Orchestration of business capabilities to execute value stream workflows (eTOM)

- Supports consistent automation & intelligence



Standard data language (SID) & data model (optimized for AI)

- Supports zero-touch interoperability
- Supports AI training

Functional framework, organized in loosely coupled domains

- Simplifies the architecture and enables pace layering

Standardized components, built for a deployment canvas

- Supports cloud native deployment

Capabilities of components exposed using Open APIs

- Enables zero-touch interoperability and zero-touch partnering

Component capabilities are discoverable (via Catalogs)

- New services can be designed from existing services
- No need for manual configuration of new service chains



















ODA Key Industry Benefits

Ambition	Today's Challenges	ODA Solutions
<p>Accelerate Concept-to-Cash Launch new products in days</p>	<ul style="list-style-type: none"> • Lack of business agility 	<ul style="list-style-type: none"> • Modular, reusable software components • Designed for rapid experimentation and agile ways of working
<p>Monetize 5G in the enterprise 40% growth in B2B2X</p>	<ul style="list-style-type: none"> • Lack of business / technical alignment • Systems & processes designed for traditional telco business 	<ul style="list-style-type: none"> • Common language for business & technology domains • Supports any product via catalog-based data and rules • Zero-Touch Partnering via Open APIs
<p>Eliminate costs Double OpEx efficiency</p>	<ul style="list-style-type: none"> • High IT procurement & integration costs • High maintenance cost of customized IT • High operational cost of complex, manual processes 	<ul style="list-style-type: none"> • Enables a marketplace for standardized software components • Open standards to minimize software customization • Zero-Touch Interoperability via Open APIs • Optimized for cloud native deployment • Zero-Touch Operations via AI-enabled automation
<p>Delight Customers 100% digital interactions</p>	<ul style="list-style-type: none"> • Poor customer experience due to disconnected systems • No single view of the customer 	<ul style="list-style-type: none"> • Pace-layering for rapid evolution of customer-facing systems • 360° customer view built on a common data model • AI-ready for optimizing personalized customer experiences

ODA APIs

TM Forum Open API table (extract)

<https://projects.tmforum.org/wiki/display/API/Open+API+Table>

TM Forum Open APIs Production	Document Number	Swagger (Apache 2.0 or RAND)	API Specification (RAND)	Conformance Profile (RAND)	CTK	Reference Implementation Code	Postman Collection	Release	Lifecycle Status
<p>Account Management API</p> <p>Provides standardized mechanism for the management of billing and settlement accounts, as well as for financial accounting (account receivable) either in B2B or B2B2C contexts</p>	TMF666							19.0.0 (v4.0.0)	Updated
<p>Appointment API</p> <p>The appointment API provides a standardized mechanism to book an appointment with all the necessary appointment characteristics. The API allows searching of free slots based on parameters, as for example a party, then creating the appointment. The appointment has characteristics such as nature of appointment, place of appointment.</p>	TMF646							19.0.0 (4.0.0)	Updated
<p>Customer Management API</p> <p>Provides a standardized mechanism for customer and customer account management, such as creation, update, retrieval, deletion and notification of events.</p>	TMF629							19.0.0 (4.0.0)	Updated



DOWNLOADS

API downloads **11,964**

Unique organizations **431**

Unique individuals **2,578**

TOP DOWNLOADERS

Rank	Change	Organization	Downloads
1	▲	Vodafone Group	762
2	▼	Deutsche Telekom AG	755
3	▲	Accenture	482
4	■	Orange	459
5	▲	Tata Consultancy Services	457
6	▼	Ericsson Inc.	418
7	▲	IBM Corporation	296
8	★	Tecnotree	276
9	★	Tech Mahindra Limited	246
10	▲	NEC Corporation	241
11	▼	Telenor ASA	223
12	▲	Telia Company	217
13	▲	CSG	206
14	★	America Movil	186
15	▼	Oracle Corporation	181
16	▼	Infosys	172
17	★	Dish Network	170
18	▼	TELUS	147
19	▼	Amdocs Management Limited	142
20	▼	BT Group plc	137



CERTIFICATIONS

OPEN API CERTIFICATION LEADERBOARD



TOP CERTIFICATIONS

API	# Certifications
1 TMF629 Customer Management API	11
2 TMF620 Product Catalog Management API	8
3 TMF639 Resource Inventory Management API	7
4 TMF641 Service Ordering Management API	6
5 TMF622 Product Ordering API	5
5 TMF666 Account Management API	5
5 TMF640 Activation and Configuration API	5
5 TMF637 Product Inventory Management API	5

LATEST OPEN API CERTIFICATIONS



WHAT'S NEW

LATEST APIs PUBLISHED

TMF630 API Design Guidelines 4.2.0 | TMF641 Service Ordering 4.1.0 | TMF687 Stock 4.0.0 | TMF704 Test Case 4.0.0 | TMF705 Test Environment 4.0.0 | TMF706 Test Data Management 4.0.0 | TMF707 Test Result 4.0.0 | TMF709 Test Scenario 4.0.0 | TMF710 General Test Artifact 4.0.0

MOST POPULAR APIs

Rank	Change	Organization	Downloads
1	■	TMF666 Account Management API	1183
2	▲	TMF620 Product Catalog Management API	729
3	▼	TMF622 Product Ordering API	698
4	■	TMF637 Product Inventory Management API	582
5	■	TMF629 Customer Management API	562
6	■	TMF632 Party Management API	395
7	■	TMF641 Service Ordering Management API	381
8	▲	TMF621 Trouble Ticket API	379
9	■	TMF639 Resource Inventory Management API	328
10	▼	TMF679 Product Offering Qualification API	313
11	▲	TMF651 Agreement Management API	237
12	▼	TMF678 Customer Bill Management API	217
13	▲	TMF663 Shopping Cart API	216
14	▲	TMF646 Appointment API	212
15	▼	TMF638 Service Inventory Management API	206

NEW API RESEARCH & CASE STUDIES

[What's driving Open API adoption?](#)

[Ericsson makes it easier to implement Open APIs](#)



MY API STORY

[Accelerating the path to digital transformation](#)

Jack Raynor, Senior Director at CommScope

[Empowering agility and flexibility for partnerships](#)

Antonio González Kirchenmayer, CTO at Satec

[Following an API-first strategy](#)

Karthik T S, Head of the CoE for Torry Harris



Useful links

[Open API table](#)

[Early Adoption \(Beta\) Open API table](#)

Latest [Open API Adoption Assessment Report](#)

Open API adoption

2.8X increase

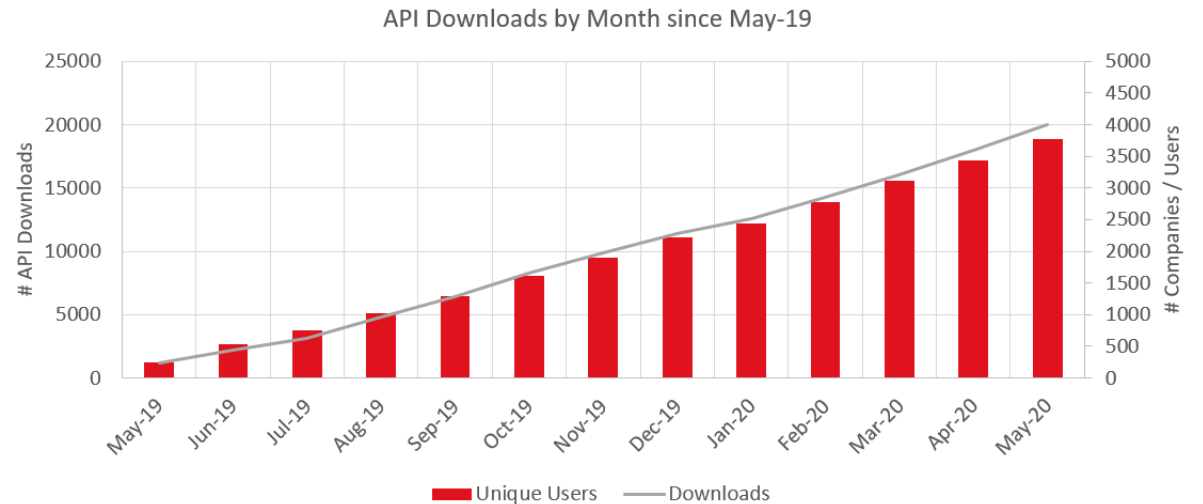
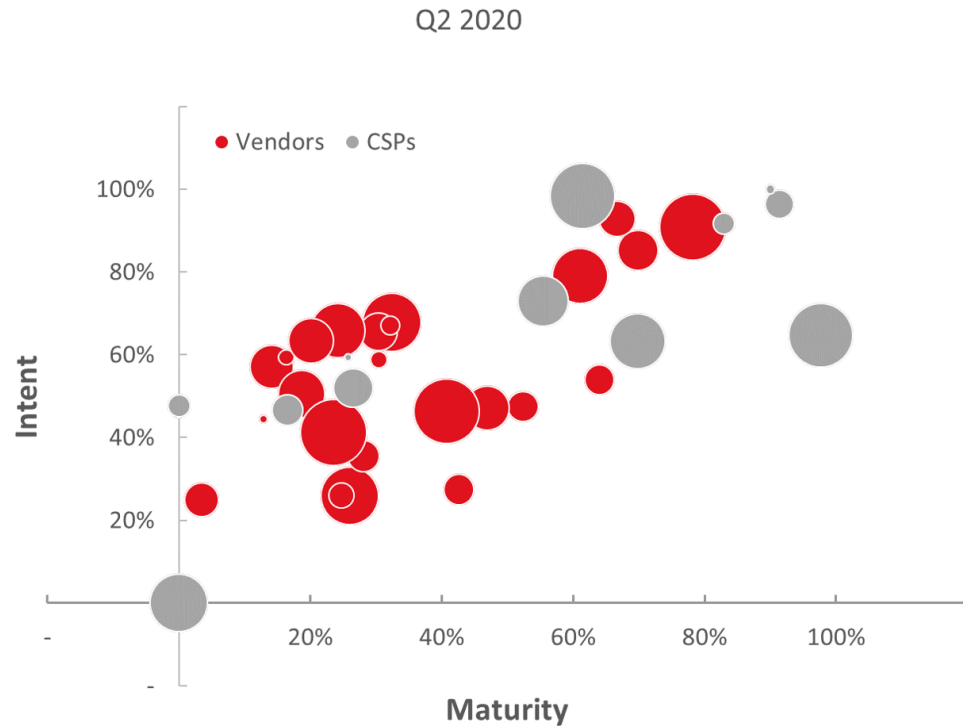
in reported Open API adoption from 2Q19 to 2Q20

20,000 API downloads

by 3,750 users from 185 companies in 12 months to May-20

71

organizations have signed the Open API manifesto



75 Open API Manifesto signatories



“

The Open APIs are fundamental to our API-led connectivity design principle that unlocks data from systems, composes data into processes and delivers them as an experience to the final user.”

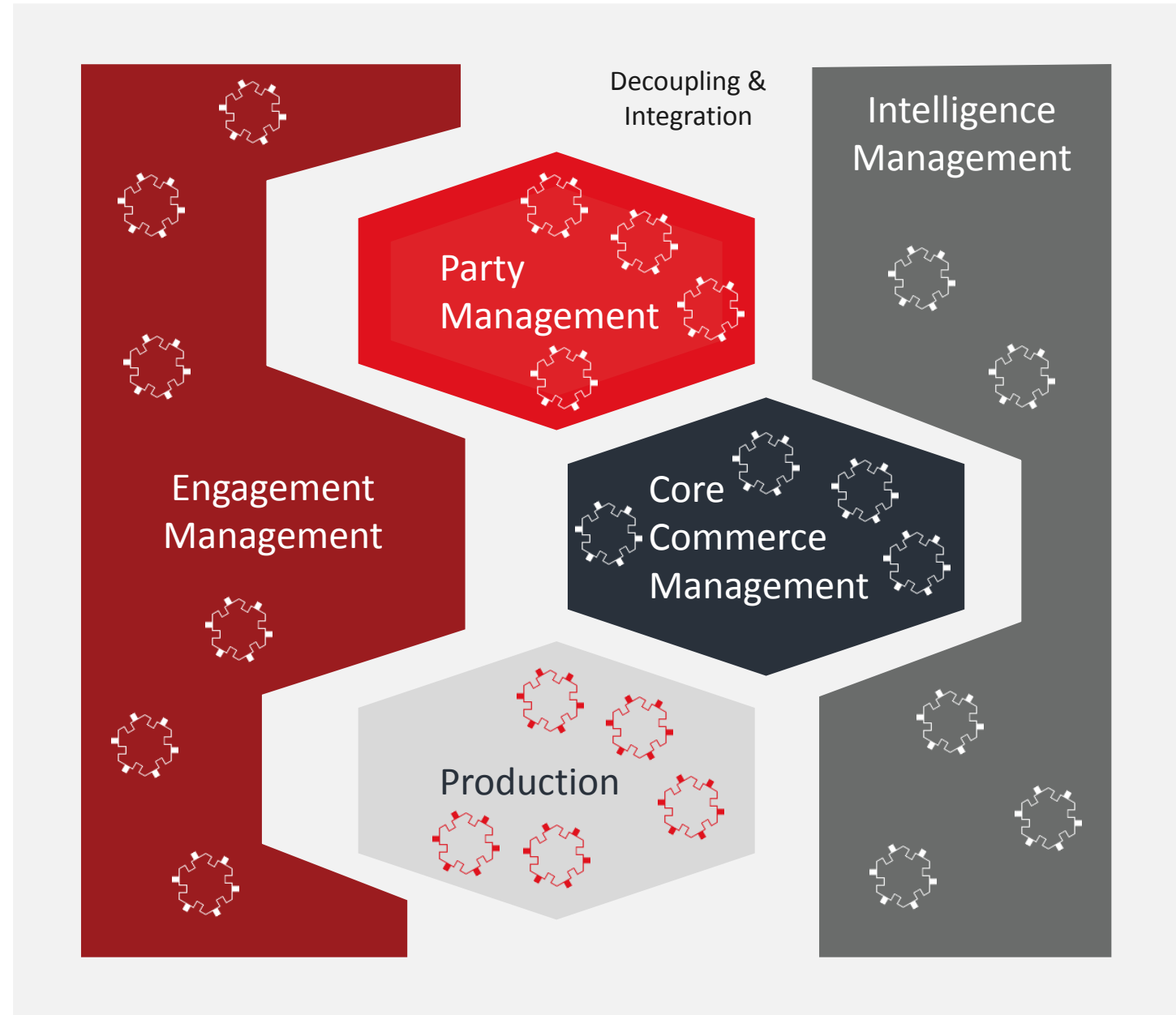
Abhi Sur,
Senior Director, Communications Industry,
Salesforce



ODA Domains

Components are organized into loosely coupled domains

- Decoupling of the domains simplifies the architecture and enables separation of concerns
- Each domain can change at its own pace without affecting other domains (pace-layering)
- Business functions of the domains are exposed via Open APIs



ODA Domains

Engagement Management

- For a single coherent customer experience

Party Management

- Supporting complex business models

Core Commerce Management

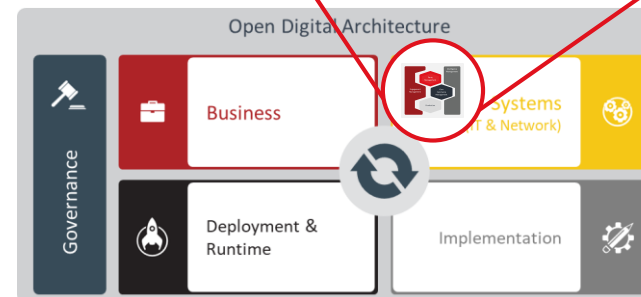
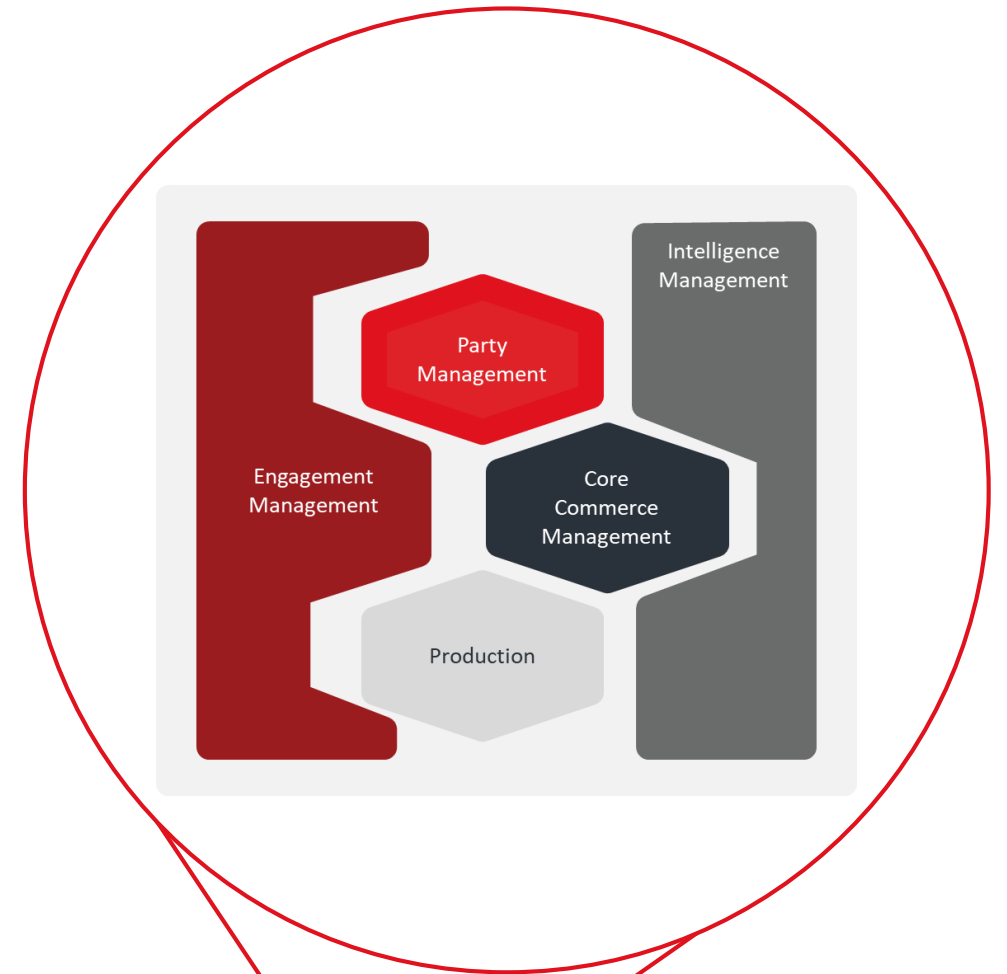
- Supporting third party & marketplace offers, service composition and orchestration

Intelligence Management

- To support systems of insight, AI, Machine Learning and Cognitive capabilities

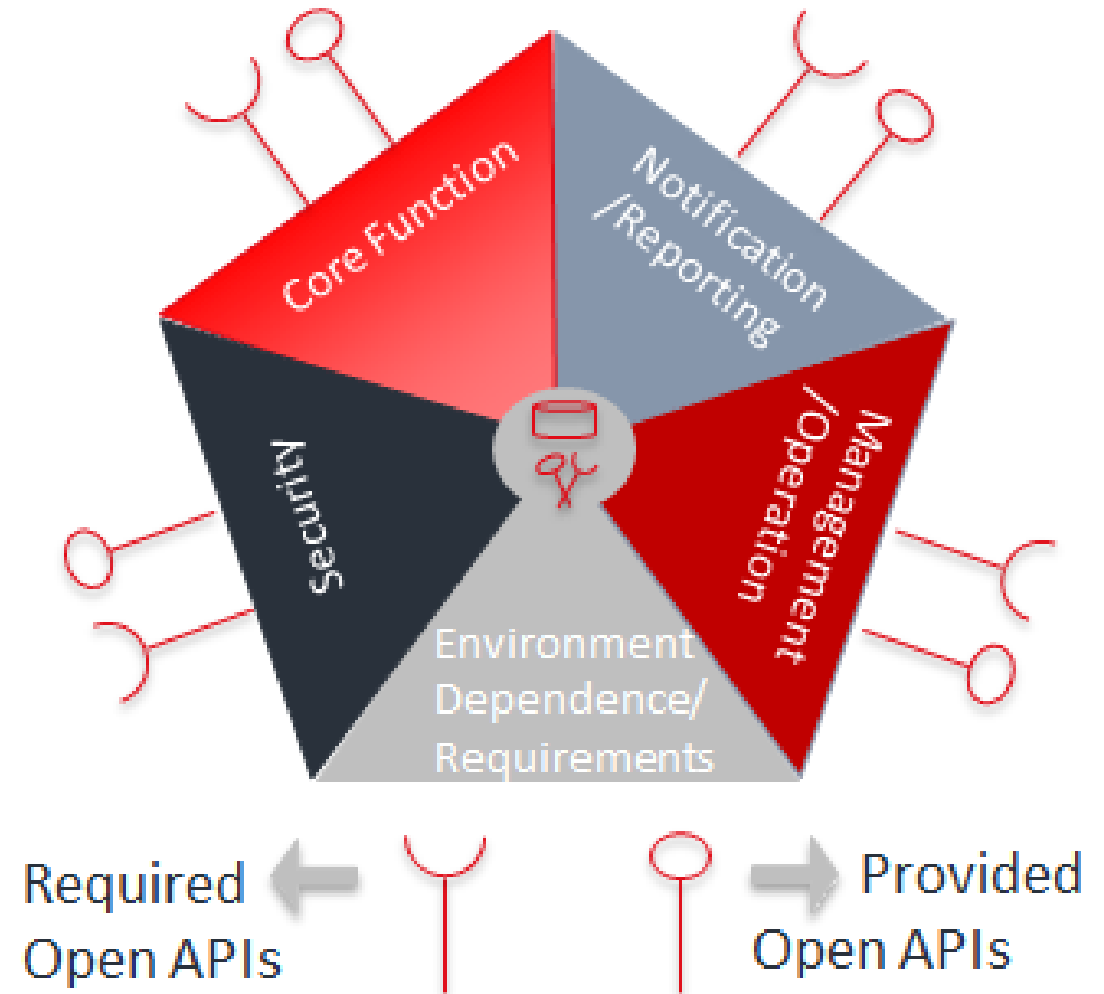
Production

- Abstracting the complexity of infrastructure

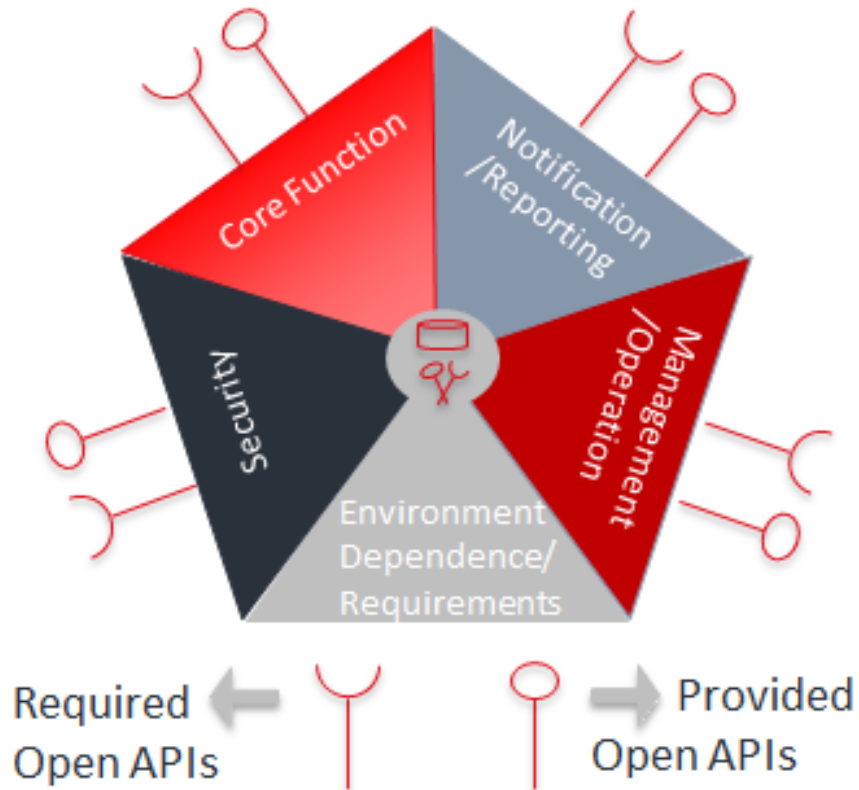


ODA specifies standardized, reusable software-defined components connected via Open APIs

- Support real time, dynamic integration via TM Forum Open APIs (components can be assembled like Lego blocks - Open APIs and a standard data model enable zero-touch interoperability)
- Expose their business capabilities (discoverable via Catalogs) externally through Open APIs, enabling zero-touch partnering
- Support a common data architecture; contain their own data and share it in real-time (AI-ready)
- Components are microservices-based, supporting cloud native deployment (e.g. autonomous, self-healing, self-scaling...)
- Can be automatically deployed and managed in an operational 'Canvas', exposing operational interfaces for management, monitoring, security...



ODA Components are Self-describing



Component YAML definition

```

apiVersion: oda.tmforum.org/v1alpha1
kind: Component
metadata:
  name: productCatalog
spec:
  coreFunction:
    exposedAPIs:
      - name: productCatalog
        specification: https://open-api.tmforum.org/TMF620-ProductCatalog-v4.0.0.swagger.json
        implementation: productCatalog
        scopes:
          - name: admin
          - name: regular
    dependantAPIs:
      - name: party
        specification: https://open-api.tmforum.org/TMF632-Party-v4.0.0.swagger.json
  eventNotification:
    publishedEvents:
      - name: Catalog
        href: https://schema.tmforum.org/Catalog/ProductOffering.schema.json *****FIX
      - name: Category ...
      - name: ProductOffering ...
      - name: ProductOfferingPrice ...
      - name: ProductSpecification ...
      - name: Usage ...
    subscribedEvents:
      - name: ImportJob
        href: https://schema.tmforum.org/Product/ImportJob.schema.json
  management:
    - name: serviceTest
      href: https://manager.local/healthCheck
      specification: https://open-api.tmforum.org/TMF653-ServiceTest-v4.0.0.swagger.json
    - name: alarm ...
    - name: serviceActivationConfiguration ...
  security:
    securitySchemes:
      bearerAuth:
        type: http
  
```

1

2

3

5

4

49 Open API & Open Digital Architecture Manifesto signatories



“Concepts like Open APIs, artificial intelligence, platform business models, and digital ecosystems will help drive agility and innovation. The TM Forum Open Digital Architecture provides a pragmatic way to bring these concepts together and sets the blueprint for digital transformation.” **Lester Thomas**, Chief IT Systems Architect, Vodafone

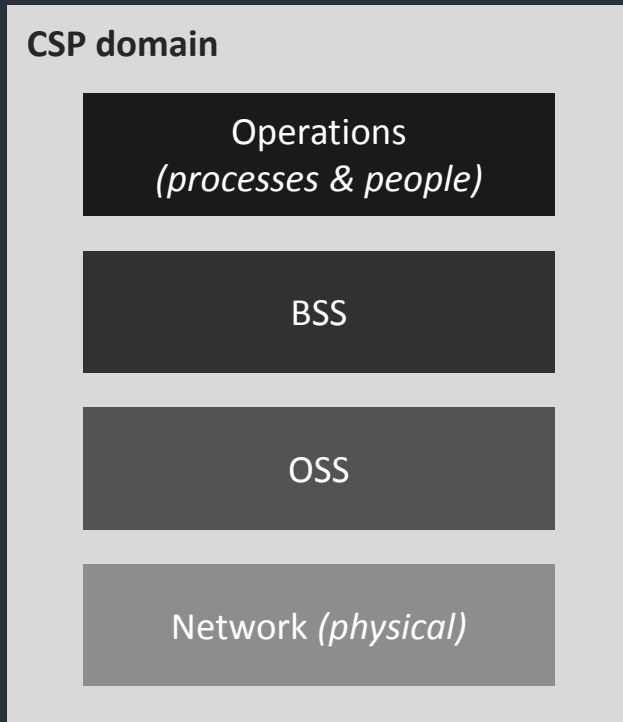


Migration to the Open Digital Architecture (ODA)

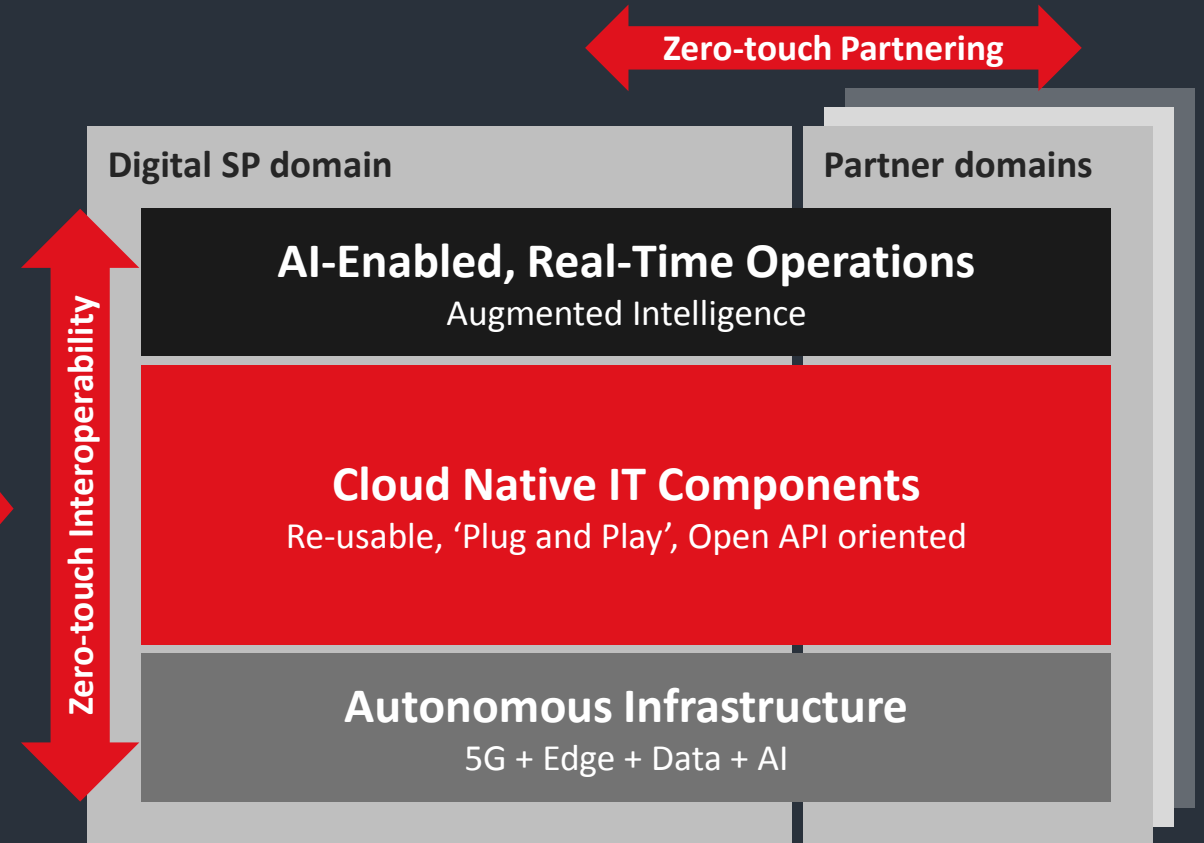
Delivering on the ambition requires change in mindset, end-to-end **tmforum**

How does ODA help this migration?

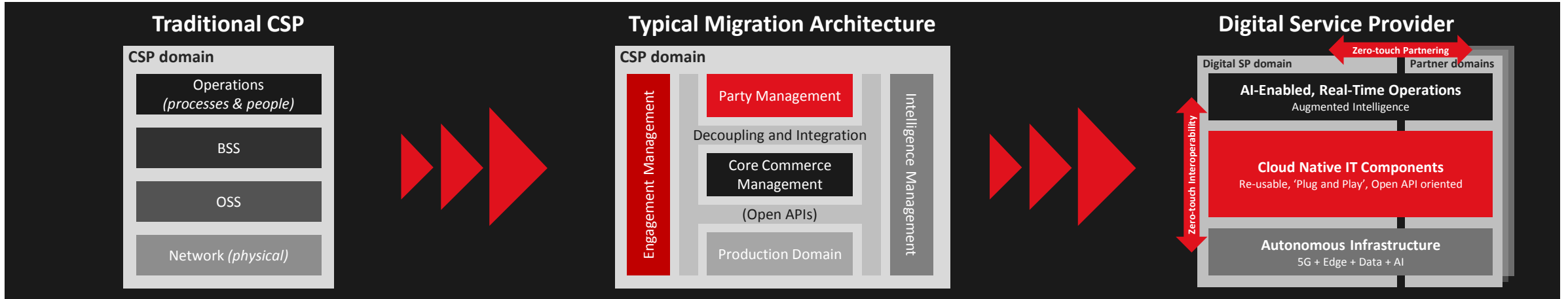
Traditional CSP



Digital Service Provider



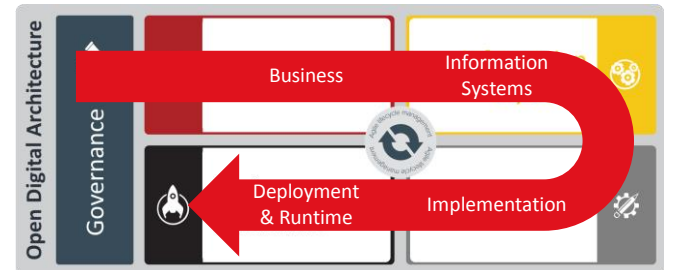
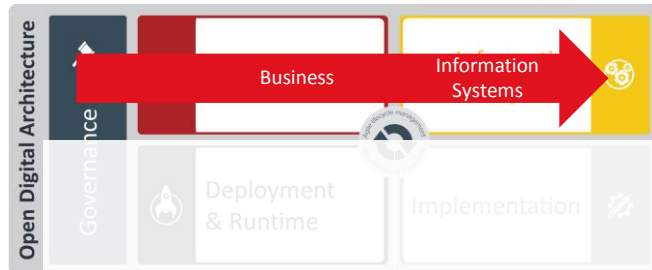
Migration to ODA



This is the starting position for most service providers. At this stage, the business architecture and information systems architecture is most relevant for governing changes to the existing landscape. And the transformation guides can be used to define your transformation strategy.

A typical first step is to wrap the existing systems in Open APIs to introduce loose coupling and to lay the foundation for agile transformation. In addition to the business architecture and information systems architecture; the Implementation architecture now become relevant for the Open APIs.

The final stage is the introduction of cloud native components. These will include components from partners. The whole of ODA is now relevant to define the business and information systems architecture and also the implementation and deployment architecture.



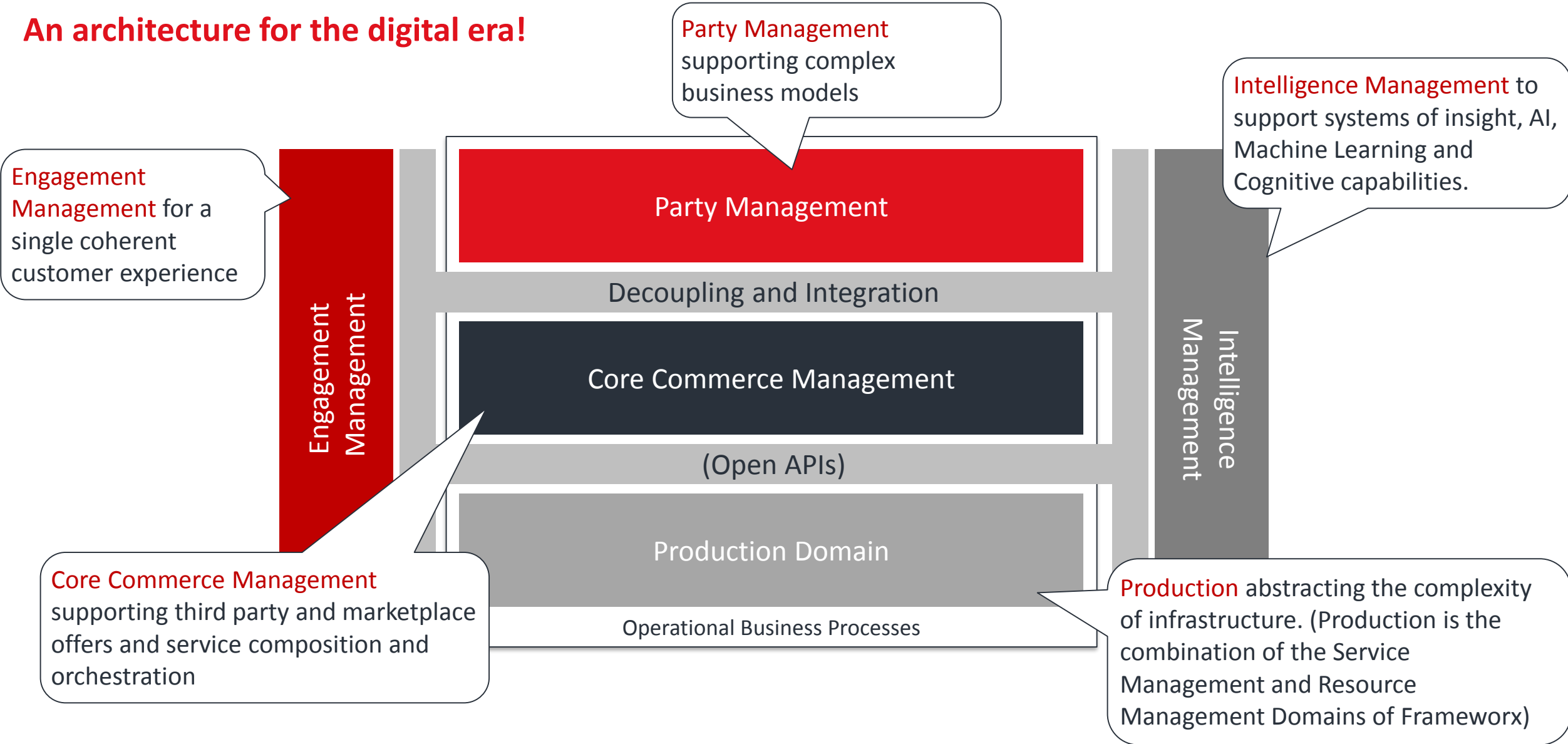
Transformation Continuum

It is important to note that at any point in time some parts of the landscape may be in stage one, while others will be in stage two or even three. Therefore, the appropriate ODA guidelines should be applied to the appropriate parts of the landscape.

ODA – An Example

ODA – Domains

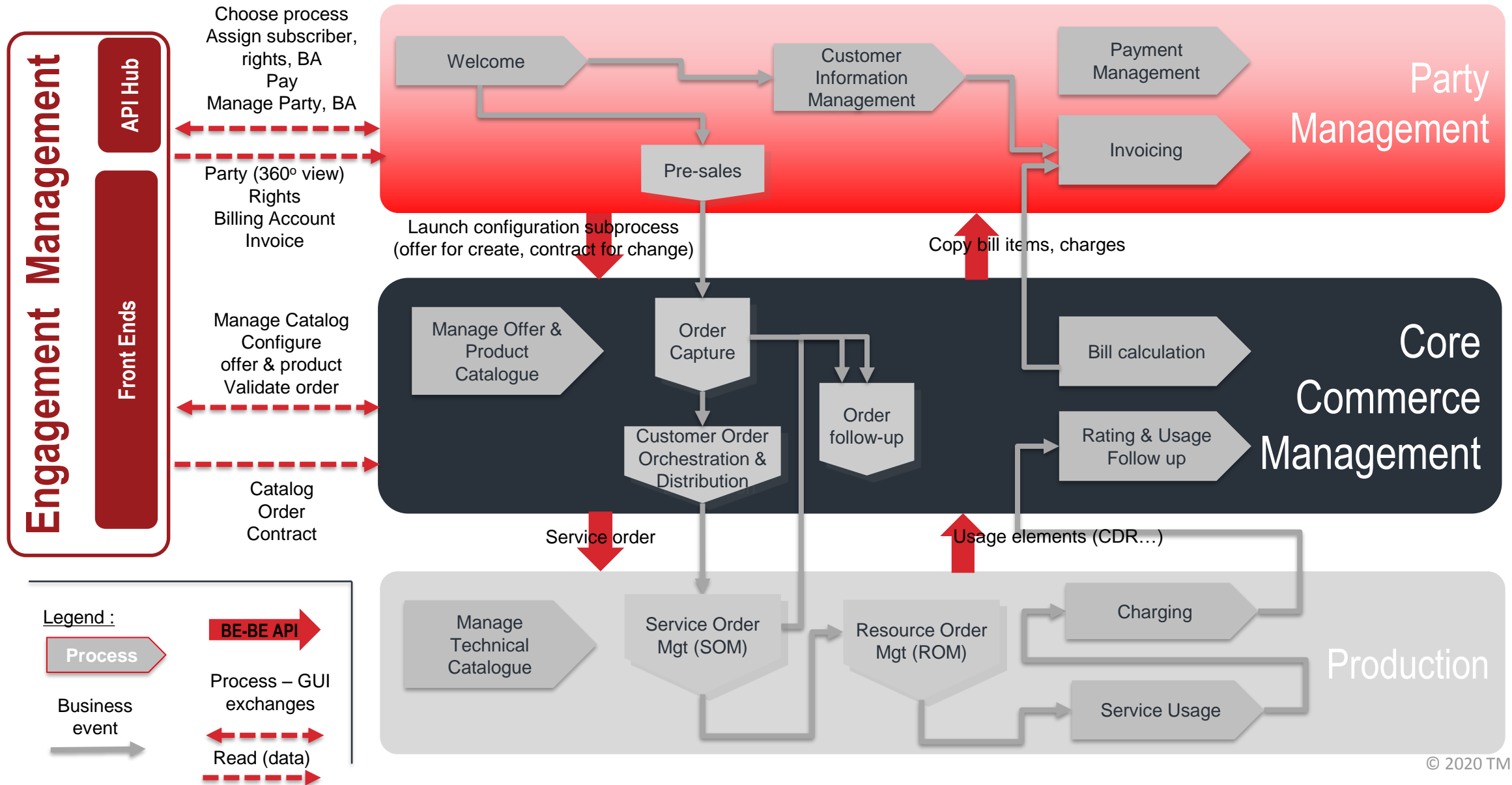
An architecture for the digital era!



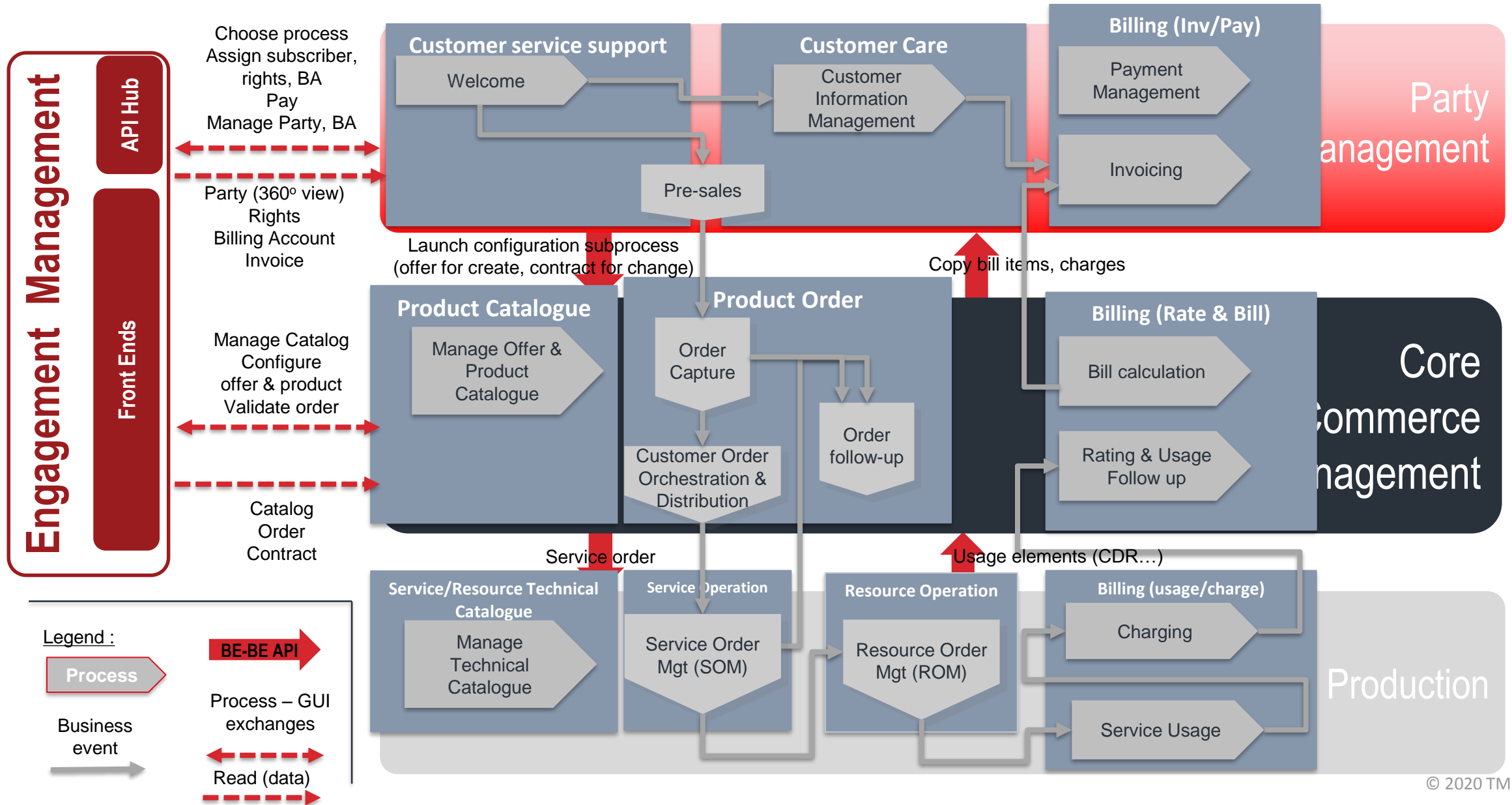
Separation of concerns and simplification through decoupling of the domains

ODA simplified e2e order management

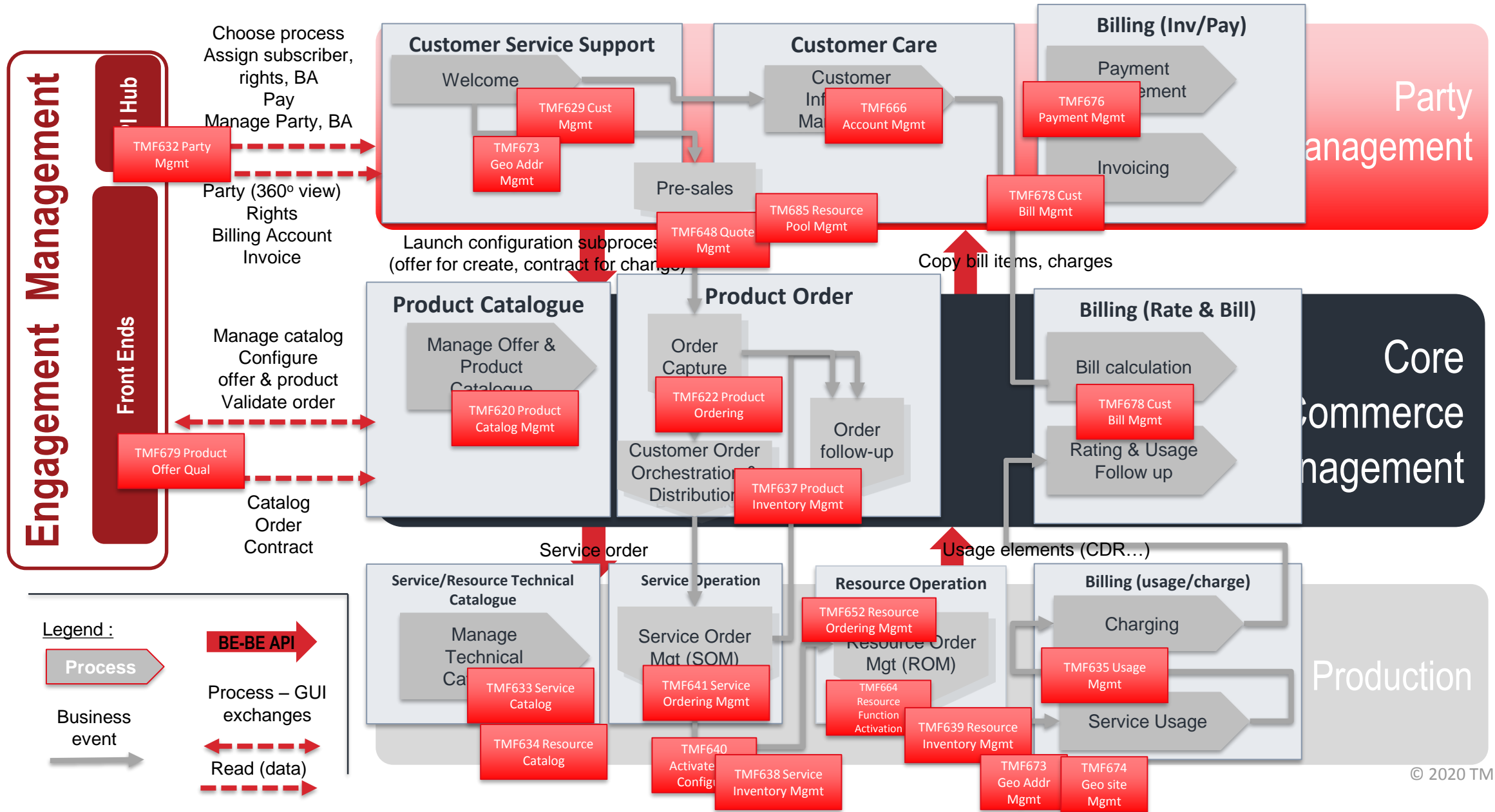
Typical depiction of a telco ordering process (eTOM) within ODA



Component based representation of ODA



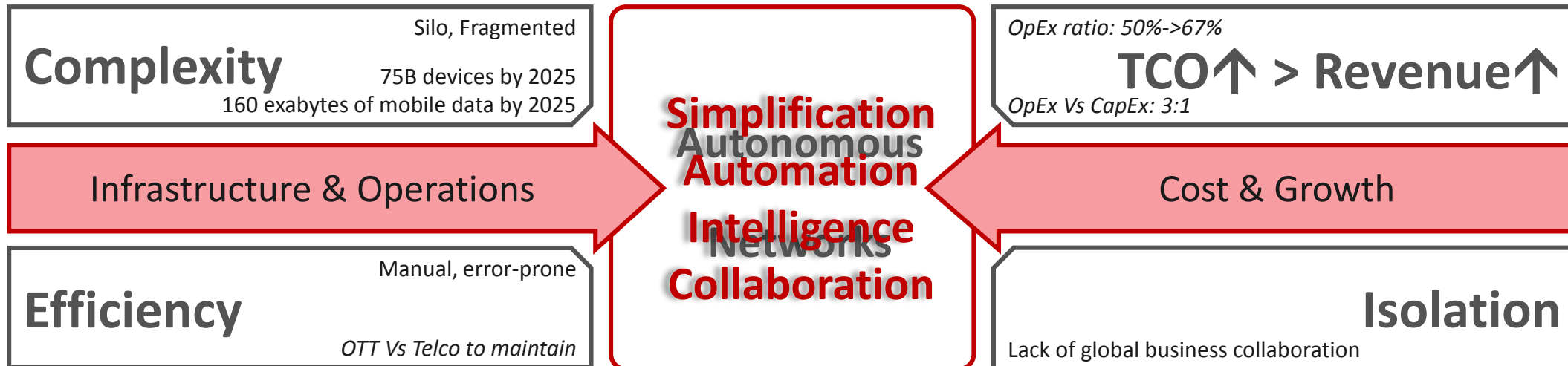
API based representation of ODA



Autonomous Networks

Drivers of Automation

Architectural innovation to solve the structural problems



Networks need the freedom to act independently, to govern themselves and to control their behavior through previously defined policies, it means self-governing, with no external humans or machine are acting upon them.

The Autonomous Networks consist of a simplified network architecture, virtualized components, automating agents, intelligent decision engines and present self dynamic capabilities to create intelligent business and network operations based on closed-loops.

Opportunities to ICT Industry --- “Zero X” Experience

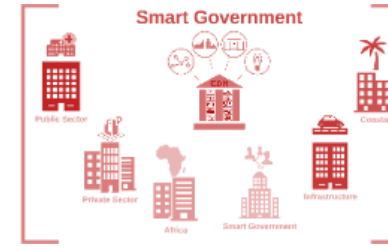
- Autonomous Networks/ICT Services for Intelligent Society



Smart city



Smart industry



Smart government



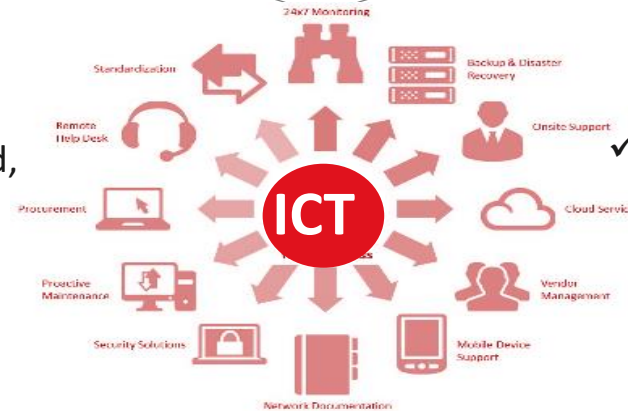
Smart xxx...

“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

Zero Touch

Simplified

- Operating
- Development
- Maintenance

Zero Trouble

Self-healing

- Business
- Services
- Infrastructure



Autonomous

Network



Agile

Operations



All-inclusive

Services

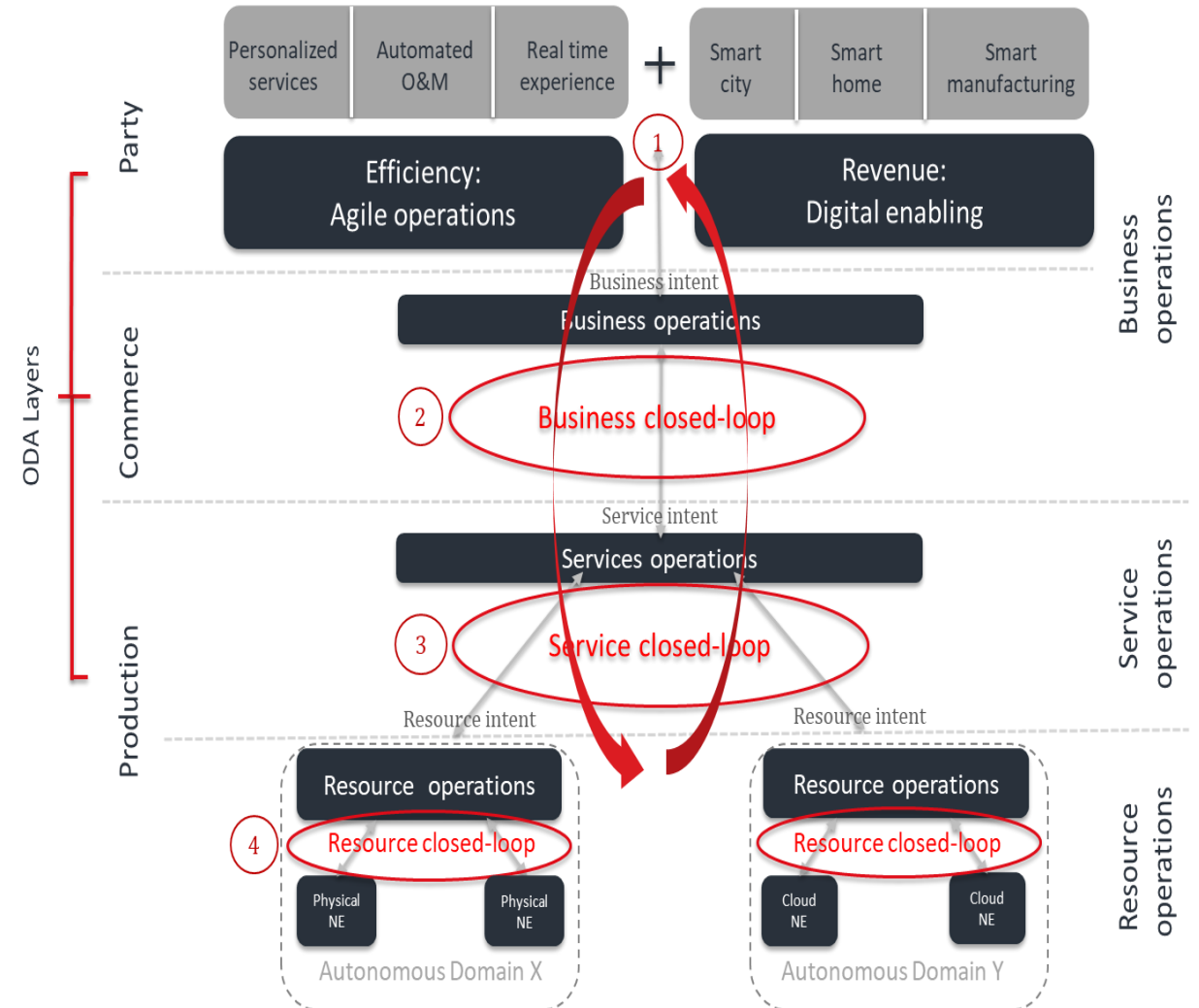


Autonomous Networks

The revolution is happening now!

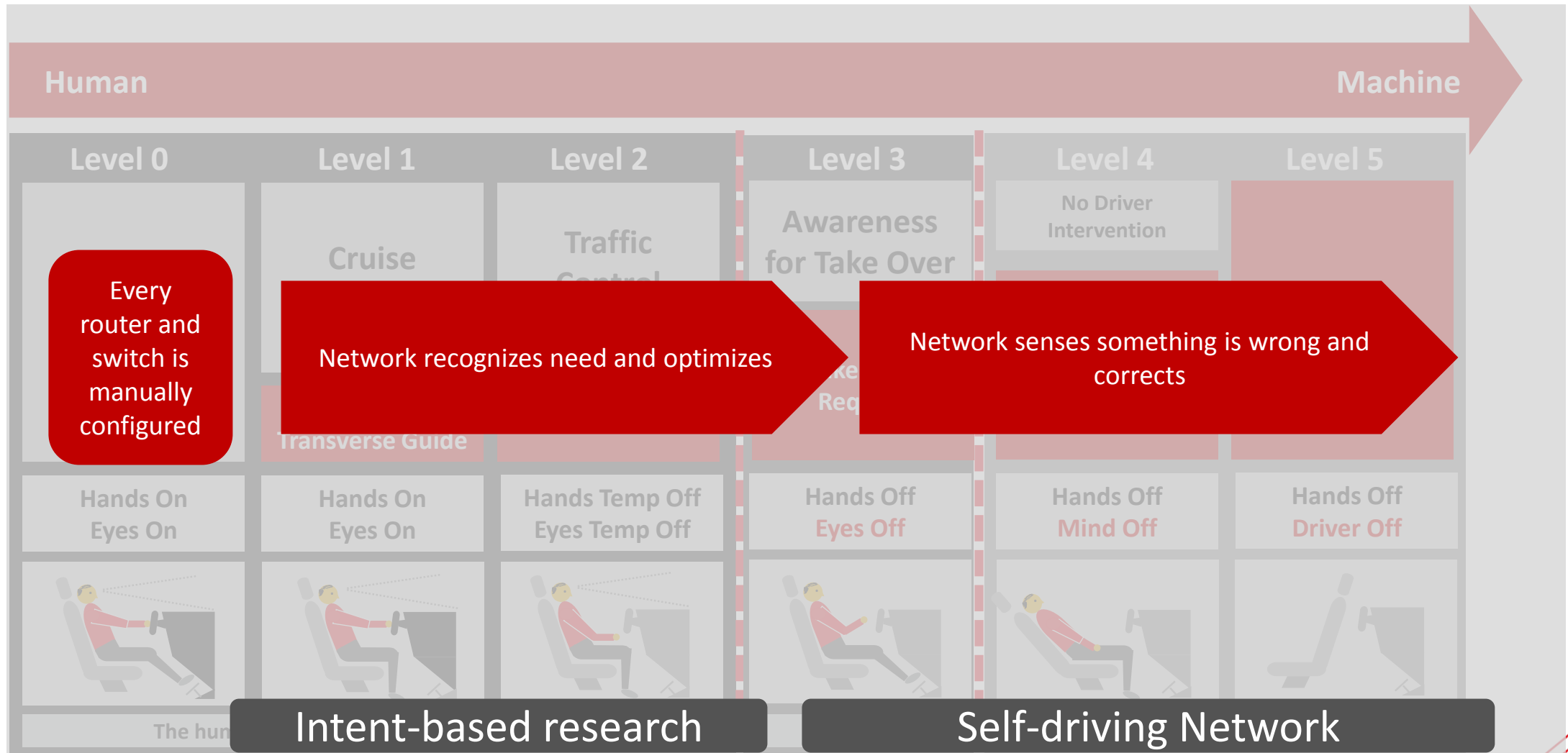
- We will develop the framework/blueprint/architecture for the management of tomorrow's network
- It requires:
 - Fragmentation of the networks into domains
 - Virtualization of the network functions within domains
 - Implementation of the network functions as software components that expose services
 - Encapsulation of the network function complexity within the relevant domains as a set of network services
 - Automation of network function repair within the domain
 - Exposure of the network services from the domains using industry standard Open APIs
- It uses:
 - Automated closed loop control **within** a domain ② ③ & ④
 - Automated closed loop control of the network **across** all domains of the architecture ①
 - AI, big data, cloudification and virtualization
- It delivers:
 - Simplification of the management of the network
 - Agile, flexible delivery of network services and resources
 - Self-optimizing networks
 - Self-healing networks
 - Intent based operations
 - An ecosystem that goes beyond the boundary of Telco and enables digital transformation across many industries

Layers and closed-loops of Autonomous Networks



Revolution through Evolution

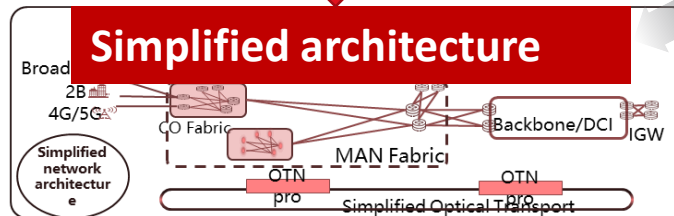
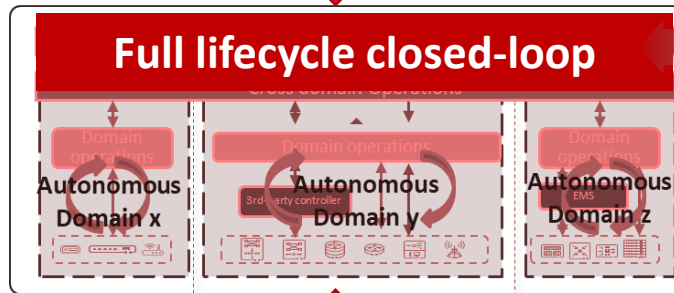
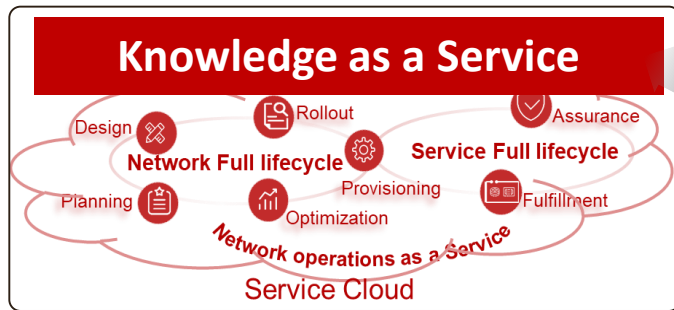
Autonomous Cars vs Autonomous Networks



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

Autonomous Networks: automation levels

Data & knowledge driven intelligent, simplified networks



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

Levels of Autonomous Networks

Definition of automation levels and functionality

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 3 - conditional autonomous network: 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 to enable intent-based closed-loop management.



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Intent/Experience	P	P	P	P	P/S	S
Applicability	N/A		Select scenarios			All scenarios

P: Personnel S: Systems

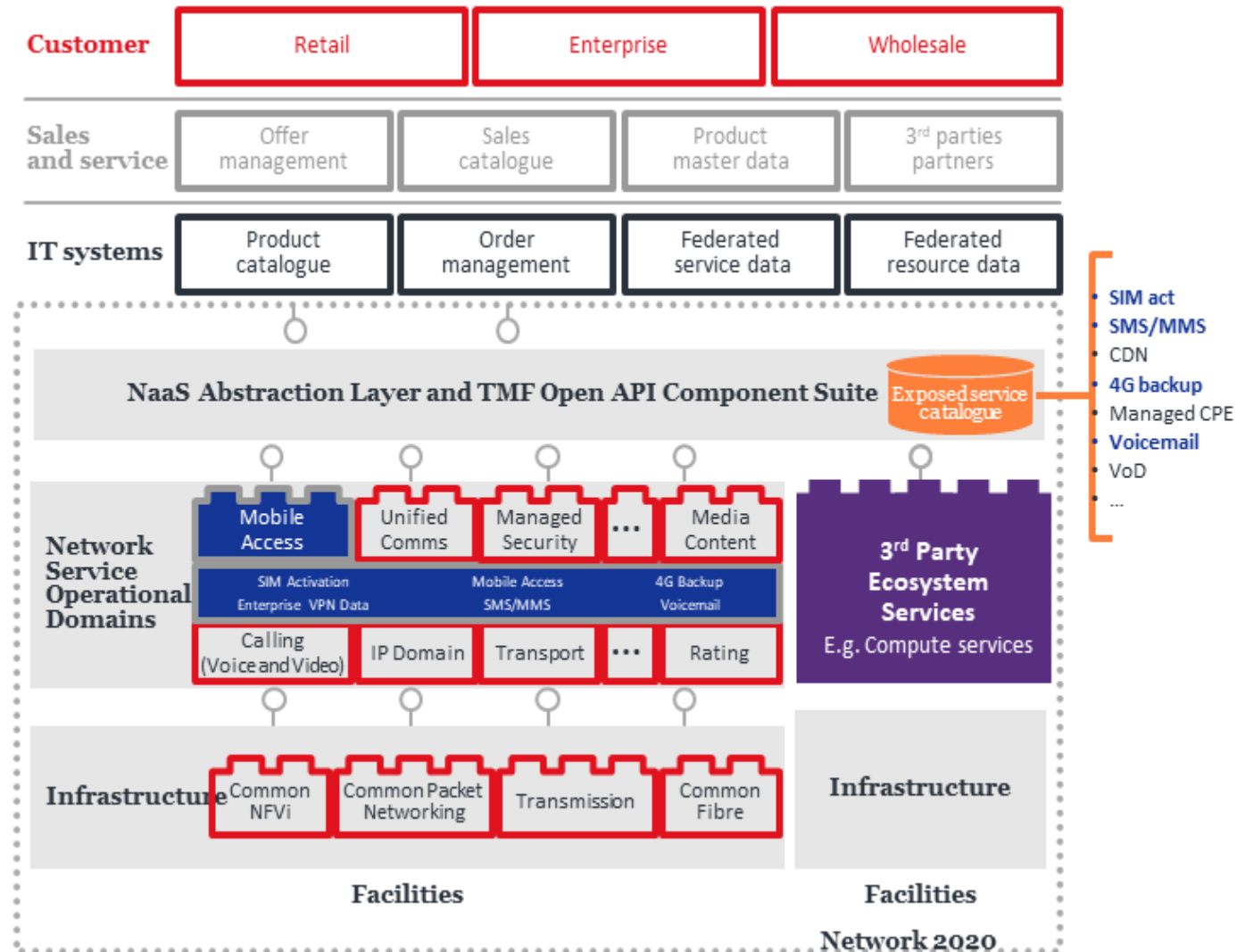
Level 4 - high autonomous network: Building on L3 capabilities, the system enables, in a more complicated cross-domain environment, analyze and make decision based on predictive or active closed-loop management of service and customer experience-driven networks.

Level 5 - full autonomous network: 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.

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

