Federated CSPs Marketplace

White Paper

A DLT-based Data Trust enabling Business Assurance
for CSPs Platforms Federation

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Executive Summary

Internet services are facing an unprecedented growth followed by the generation for their providers of new revenue streams. If Platform and Application Providers are benefitting from the abundance of data that their customers and their devices generate, the Providers of the most important enabler to this innovation, the access to connectivity, still fail to achieve similar growth.

Communication Service Providers (CSPs) need to innovate, in order to capture their part of this market growth. They need to leverage their most important asset, i.e., the access to connectivity infrastructure, which is now achieving unprecedented pervasiveness and flexibility thanks to the integration of 5G, Autonomic Networking, AI and IoT technologies.

Partnerships, Ecosystems and Platforms are thus becoming crucial instruments to drive CSPs competitiveness in a digital market where the value chain is continuously moving and changing. New technologies such as AI and Distributed Ledgers provide the enablers on which these partnerships can flourish and new ecosystems develop.

The TM Forum Catalyst program offers the multi-stakeholders innovation playground that allows ecosystems and digital transformation to flourish. Moreover, TM Forum Frameworks on Partnerships (TR211), Business Models, Business Assurance Ecosystems, Platforms (DPRA /IG1157, DSRA/TR274), and Open APIs for Inter-Carrier use case, CSPs use case utilizing Blockchain (TR 279), Trust Models (TR270), provide the key Building Blocks or Enablers when designing CSPs collaborations.

Leveraging all of these, with this year's iteration of our Catalyst, we developed a CSPs Platforms Federation Framework, which this White Paper describes and was onboarded in a new instrument the TM Forum launched, the "MegaCatalyst".

TM Forum MegaCatalyst builds on the vision of a completely trusted Business Ecosystem where Telcos, together with supply chain actors, can interact together to deliver trusted Zero-Touch Industry 4.0 solutions. Each single Catalyst thus becomes a "Building Block" in this Multi-Layer arrangement of different Catalysts, that forms the MegaCatalyst.

With the access to connectivity being a crucial part of the MegaCatalyst vision, the Catalyst we present here is responsible for the "DLT-based Data Trust", which provides an immutable trusted data record of accesses to the physical connectivity infrastructure and assets. Such layer enables AI-driven Business Assurance for these complex ecosystems. Our Data Trust layer capability is exposed to the "Settlement Layer" (developed by the Digital Business Marketplace Assurance Catalyst**)** through Touch / Control interfaces. With these standardised interfaces in place, the MegaCatalyst can connect the different parts of its solutions ecosystem and collect the value generated from each of them.

Following a "Black Box" approach, the present Catalyst faces the complexity of developing a solution in isolation, while considering the needs for future integration required by the MegaCatalyst. The product of our efforts is the implementation of a DLT-enabled Federated Marketplace for CSPs. Through the implementation of a real use case, we show how it is technically possible to deliver continuous E2E services involving infrastructure available from different existing platforms. Something that will be further leveraged by the MegaCatalyst vision.

The solution presented here thus paves the way for specifying the blueprint of a generic "Federated CSPs Platform" that complements with TM Forum perspective that other SDOs (GSMA, 3GPP SA1/SA2, 5G-ACIA, TIP / O-RAN) are working on for the advancement of the Industry 4.0 vision.

Introduction

Building upon the previous phases of this Catalyst, known as "Blockchain-based Telecom Infrastructure Marketplace[1]" The state of blockchain for CSPs, the core of this new phase is to explore the role of open standards in enabling interaction in a Federated CSPs Marketplace. Validation of results is addressed further through a variety of practical use cases.

The need for connectivity in new Verticals domains, in Industry 4.0 like others (Automotive, Smart Cities etc), opens up new business opportunities that an horizontal collaboration among CSPs can help to capture and accelerate.

Targeting various business opportunities, and exploring and assessing new Business Models within Vertical Industries, our Catalyst targets use cases for 5G Network monetisation. Leveraging DLTs as enablers for trust and transparency, we develop a cross-stakeholders Data Trust Layer that supports the cross-ecosystem Business Assurance Framework developed by the MegaCatalyst.

While enabling the MegaCatalyst vision, the Catalyst presented here tries to address a very concrete industry problem. Now and in future, to fulfill a demand for connectivity that scales across domains and geographic locations, CSPs are called to sustain a huge CAPEX effort to deploy 5G infrastructures. This effort can be reduced, if CSPs are enabled to federate their Network Platforms. This makes them open and accessible to a multiplicity of Applications Providers, and so overcome any existing geographic and vertical domain limitation. As a result, CAPEX and OPEX would decrease while ROI would increase in light of a large scale CSPs' federated infrastructure that is constantly used and generates continuous revenues.

Bearing in mind that most OPEX each CSP has to sustain is due to integration costs (to acquire additional external infrastructure), moving from a "Silo" to a "Federated" model relieves CSPs from those pain points and allows them to focus on developing innovative services at a very large scale.

With a target to deliver a more general Connectivity as a Service, this White Paper explores the opportunities, challenges and technical solutions that allows an ecosystem of CSPs, Asset and Application Providers to leverage a federate marketplace for designing, deploying and assuring new digital infrastructure access and services (i.e., Network Slices provisioning with different network domains from different providers) in an agile, cost effective and profitable manner.

Leveraging Distributed Ledger Technologies, this federated marketplace achieves the ambition to ensure increased trust, reduced settlement time, risks and frauds when CSPs collaborate, federate and share their assets. The developed data trust infrastructure becomes then available for the MegaCatalyst integration.

With this in mind, the White Paper covers the following topics:

- Challenges and opportunities (for CPSs innovation)
- From Ecosystem Development to Innovation Creation (the Catalyst role)
- The Federated CSPs Marketplace (the problem, the vision, the Minimum Viable Ecosystem, the solution)
- The benefits of a generic blueprint architecture
- From innovation to market maturity (Marketplace governance and revenues sharing)
- Opportunities for future Federated Platforms

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[1] Firstly presented at the Telco Blockchain Forum in 2019, London https://blockchainconferences.io/conferences/telco-blockchain-forum

Challenges and opportunities

The market opportunity

With the availability and expansion of 5G technologies, the Telecom industry is expected to increase its revenue to $4.7 Trillion by 2025 (Harvard Business School & Keystone research and analysis). Of such, 30% of the revenues will be related to connectivity services, while the rest will come from Business-to-Business (B2B) solutions. These will span differ[2]ent vertical domains, including smart supply chains, smart grid and smart-X in general. Of this, KPMG predicts a $4.3 Trillion[3] value in 5G services for enterprise customers from 5 years and beyond.

To capture these revenues, CSPs are required to innovate.
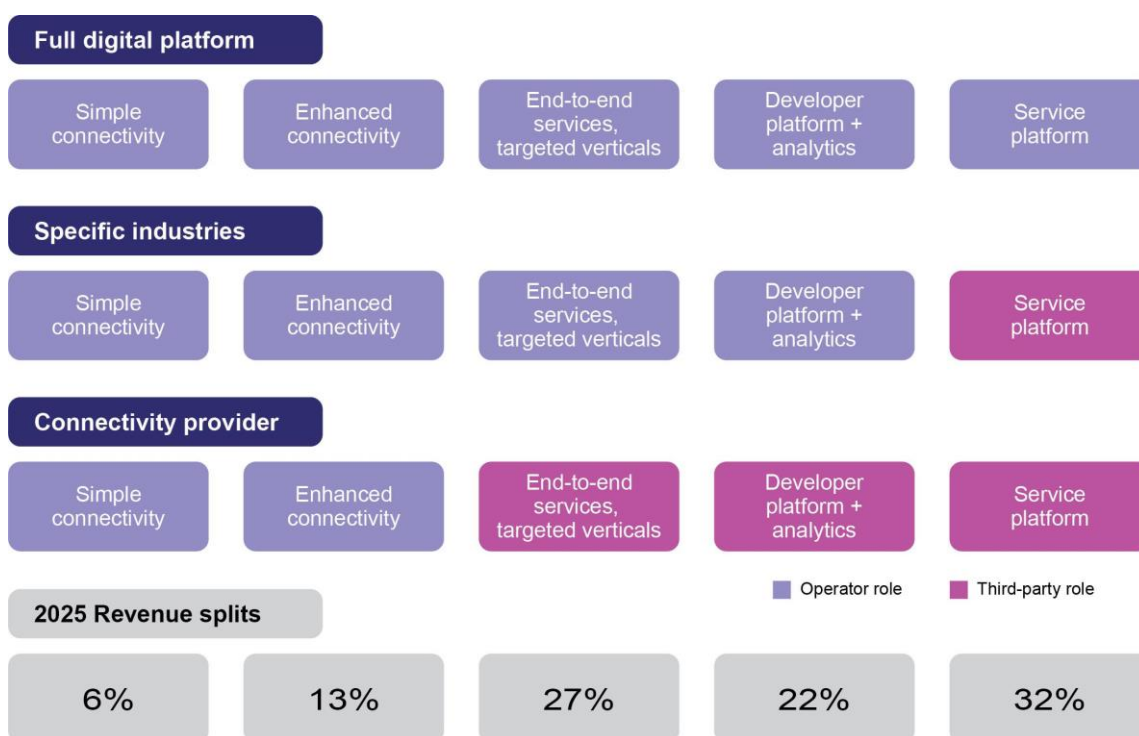
Figure 1: B2B 5G value chain and 2025 revenue split forecasts

However, to be able to move up the value chain and capture the new business opportunities, CSPs are often required to make significant one-time CAPEX investments to improve their networks and support high-capacity, low latency services. While infrastructure CAPEX and OPEX increase quickly, cost of offered services are expected to grow with the risk of churn. With an expected Next Generation connectivity worldwide cost of $1 Trillion, of which only an average 17% can be covered from revenue generated by the sole use of the infrastructure, CPSs needs to be able to capture at least an additional ~5% of non-connectivity related revenues.

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[3] Unlocking the value of 5G for enterprise customers
https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/04/unlocking-the-benefits-of-5g-for-enterprise-customers.pdf
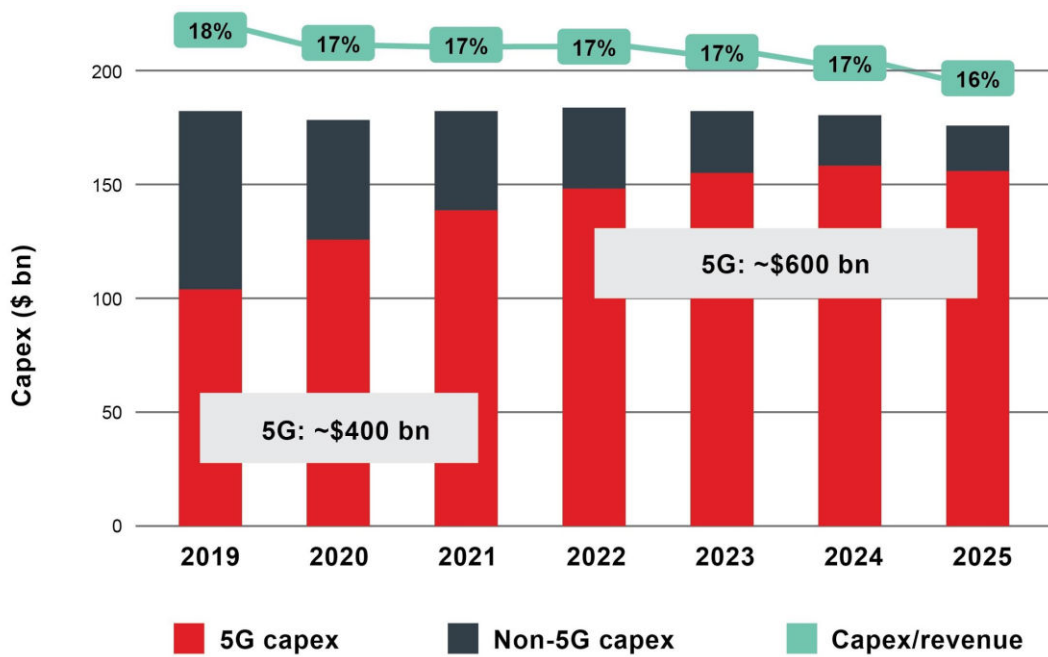
Figure 2: Operators Mobile CAPEX worldwide (Source: GSMA Intelligence)

This requires provisioning of advanced E2E services for targeted verticals, while maximising the use of existing infrastructure. By simply and temporarily federating their infrastructure assets, CSPs can achieve this and reduce their CAPEX, while increasing their margins without exposing themselves to integration risks. Following this, future opportunities might be offered by the deployment and management of service platforms that allows CSPs to monetise not only their infrastructure assets, but also their customers and data while achieving consumer global outreach and cross-vertical presence. Platforms and marketplaces thus become an alternative
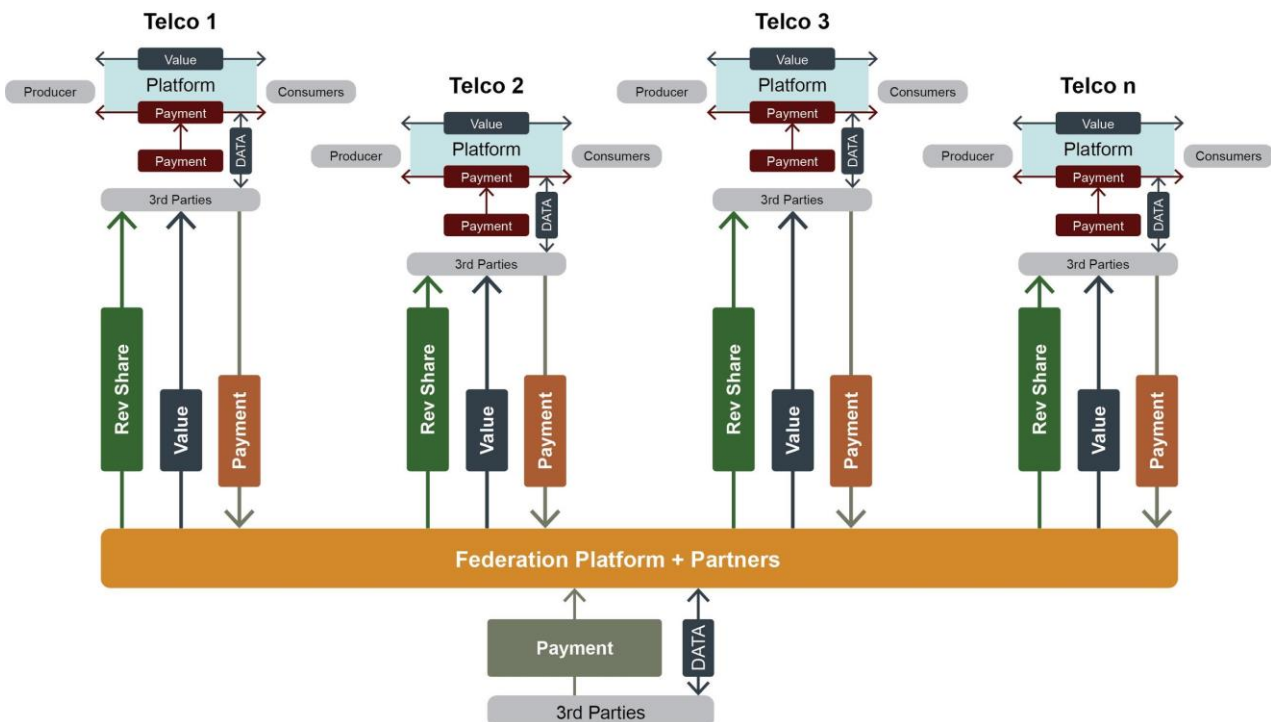
for capturing these opportunities beyond the one-off CAPEX.

A phased approach: From Infrastructure-oriented to Service-centric federation

To best capture the opportunities offered by the B2B, 5G value chain and offer Service Platform with the maximum revenue sharing, CSPs need to collaborate in order to scale across customers, industry and regions.

Platforms federation becomes a key for CSPs to increase infrastructure use, generate new revenues and increase and diversify their service offerings.

While two different federation models can be envisioned, the first and the most immediate one is the federation of infrastructures. MEC, SD-WAN and IoT use cases are paving the way for the need of a global infrastructure and on-demand availability of network resources. Providing access to infrastructure, CSPs platforms federation allows spreading costs among different infrastructure assets providers, to achieve higher return on investment, and more easily comply with local and regional regulations.

Once the value of this collaboration is established, and then service-centric platform federation models will also emerge and build upon these new federated platforms.

However, to create successful infrastructure-based federation a number of technical challenges should be considered:

- How to increase the value that prosumers (consumers/producers) obtain from the federated platform;
- How to reward partners that create new value through the federated platform;
- How to ensure data trust and business assurance rapidly and automatically by resolving conflicts and orchestrating end-to-end services.

Technologies such as AI, ML and DLTs are the enablers for such innovation and the creation of new marketplaces.

From Ecosystem Development to Innovation Creation

To answer the need to innovate, resolve the above challenges and develop a collaborative ecosystem, CSPs and Application Providers need a collaboration and innovation playground. The TM Forum Catalysts offer such environment, for large and small companies to create innovative solutions to common challenges, leveraging key TM Forum best practices and standards to ensure scalability and reuse of solutions while reducing costs and risk.

The 2020 Catalyst

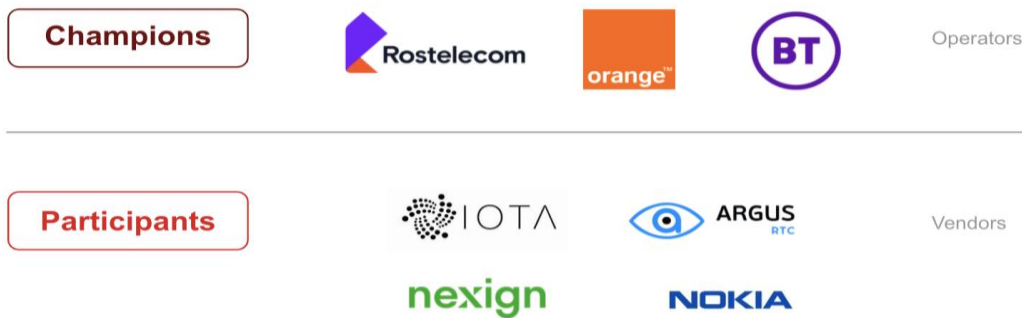As common in any Catalyst, Technology Vendors collaborate with Innovation Champions to develop new solutions.

Figure 4: TM Forum 2020 Catalyst ecosystem

With challenges and technical solutions for creation of an infrastructure marketplace initially addressed in the Blockchain-based Telecom Infrastructure Marketplace Catalyst[4], this 2020 Catalyst now expands the initial foundation created by Orange, IOTA and Nokia. It is enriched by the customer-facing use cases developed by Nexign and Rostelecom, as well as OSS expertise of RTC ARGUS and expands the validation of its ecosystem to a range of end-to-end eSIM-based scenarios.

In order to foster mutually beneficial collaborations, the Catalyst focuses on enabling interoperability of a range of mature ready-to-integrate DLT platforms, using a set of standards accepted by the telco industry.

Interoperability is achieved while utilizing and enriching the relevant TM Forum Open APIs. As a result, the developed solution for data trust and business assurance becomes easily accessible to all the ecosystem parties at any stage of their integration process.

On the top of that, the 2020 Catalyst poses the foundation for the robust and trustworthy data layer to the multilevel data and business assurance structure required by the new MegaCatalyst collaboration.

The Federated CSPs Marketplace

The problem

Network Operators (CSPs) will face a huge CAPEX issue in the coming years (CAPEX will increase 60% [2020-2023] according to McKinsey & Company, White Paper 2018). To answer this CSPs are targeting at reducing dramatically deployment cost (Zero-Capex model), at reducing the energy consumption (expected to be 3 times lower for 5G) and at enabling deployment of new on-demand infrastructure such as PMR (Private Mobile Radio) for Industry 4.0 scenarios. The challenge is thus to define efficient and straightforward solutions for moving away from the traditional costly "Make / Buy / Rent" models for infrastructure access. Instead of the long term commitment and shared procurement rules for infrastructure use, a more agile auction-based / on-demand-based sourcing is needed. This can be achieved with the creation of a federated DLT-based CPSs Marketplace able to ensure trust and confidence, transparency, traceability and compliance with regulation and legislation, alongside with enabling new revenue opportunities.

The vision

Using a platform approach, CSPs should be able to order flexible Telco cloud infrastructure to temporarily increase their infrastructure capacity and in order to deploy VNFs/CNFs such as Fixed Access Network function (vOLT, vCPE), Mobile Access Network function (v-RAN), Mobile Core network functions or Fixed Core network functions. Scenarios like this are particularly common **for emergency services** or for **B2B customers' demands** - such as the ones generated by connectivity requirements in the **Industry 4.0**.

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[4] https://www.tmforum.org/blockchain-based-telecom-infrastructure-marketplace/

Similarly, vertical players such as Industry 4.0, Smart Cities, Autonomous Cars or e-Health, can be enabled to request CSPs to deploy Private Mobile Radio (PMR) networks for their private connectivity needs (i.e. factory connectivity within different regional footprint).

To answer these needs, a marketplace should exist. Such marketplace should allow access to a variety of resources over a global footprint, including:

- **Infrastructure**: an infrastructure (i.e. TowerCo, covering X square meters) or a spot for deploying network functions such as 5G antennas

- **Cloud**: large cluster of virtual machines

- **MEC (Mobile Edge Computing):** small cluster of servers or a single server located at the network edge

- **Connectivity**: from access to core, but also inter-cloud connectivity

- **VNFs/CNFs** (Virtual Network Functions /Container Network Functions): telco functions or application ensuring network functions

- **App** (non-telco software application) such as application for drone data analytics needs

The Catalyst Minimum Viable ecosystem

A marketplace like the one introduced above requires a Minimum Viable Ecosystem of stakeholders, each one with a specific role:

- **Communications Service Providers (CSPs):** build services based on assets ordered from the marketplace and offered to industry verticals.

- **Asset Provider:** Third-party (including CPSs in this role) providing assets, including infrastructure, MEC, eSIMs, Connectivity and others.

- **Federated CSPs marketplace operator:** manages assets, offers, orders, requests; it provides CSPs orchestration through proxy; it offers SLA, Settlement/Billing and guarantees Business Assurance between stakeholders.

- **Vertical service consumer:** Consumer of services e.g. 5G PMR offered by CSPs

- **Regulator/ Auditor:** Central governing bodies that oversee and audit the transactions that are processed in the marketplace

The Enabled User Flow

An example of the supported marketplace user flow is described below. The scenario is the following. Multiple assets are ordered by a CSP who needs to design and orchestrate **end-to-end services** within an infrastructure on behalf of its vertical customers. To achieve this, the CSP needs to request assets on-demand within a Federated CSPs Marketplace. The infrastructure for flexible access is then composed of different assets owned by different Assets Providers. The complete User flow and functionalities required to the Marketplace are depicted in Figure 5.
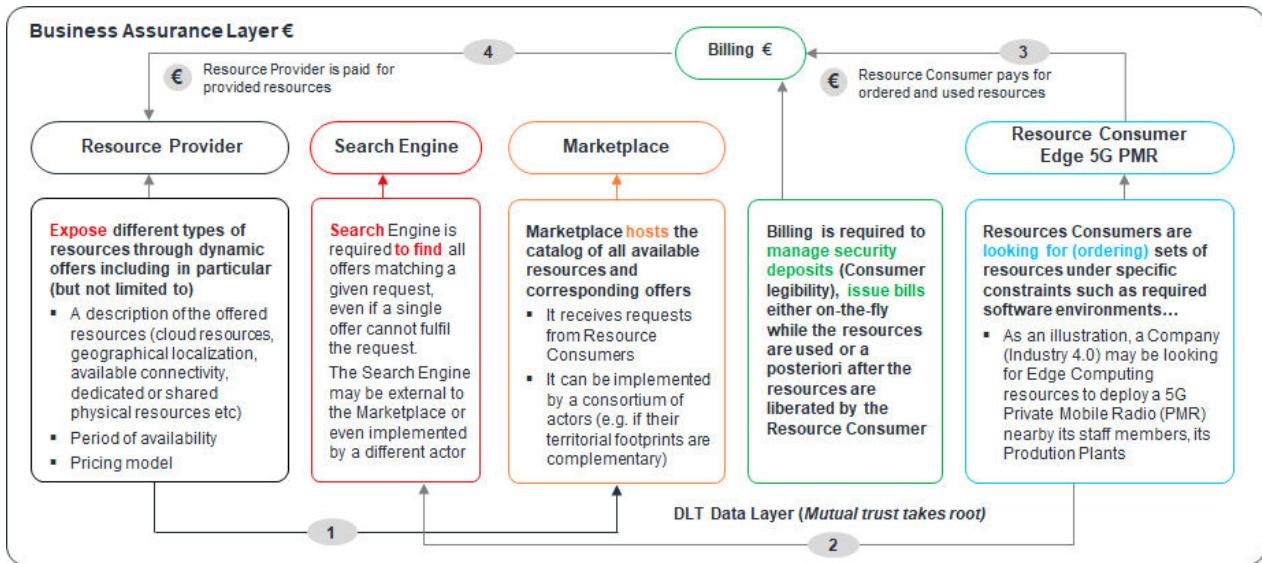
Figure 5: Federated CSPs Marketplace user flow

As a concrete example, a Service provider 'XG Digital' is leveraging the Marketplace to identify assets required to put together a multisite 5G PMR service on edge locations. The 5G PMR can be easily available for 'Intelli Robotics' for XG Digital industrial automation needs.

The Solution

The developed Federated CSPs Marketplace provides the integration of a number of building blocks that enable the functionalities required in the user flow depicted in Figure 5 above.
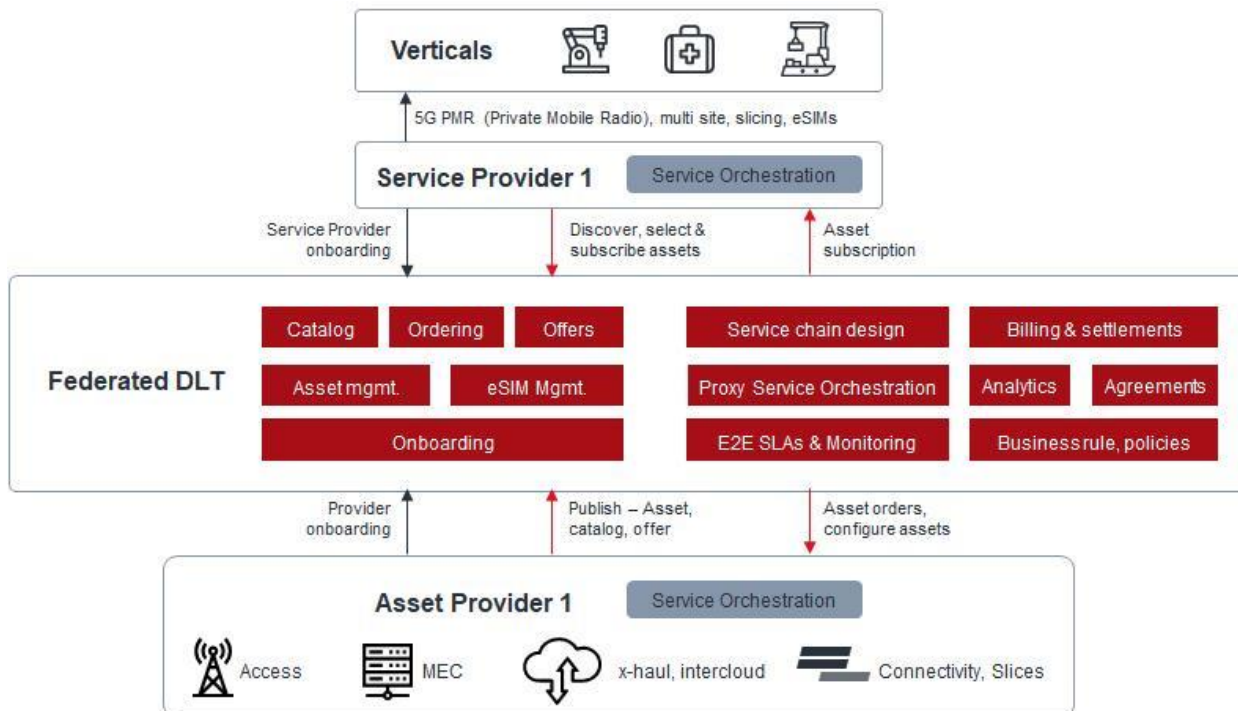

Figure 6: Federated CSPs Marketplace logic architecture

Figure 6 presents a logic view of the marketplace architecture and all its integrated components.

Architecture benefits

The logic architecture presented above addresses a number of requirements that identify the innovation potential underpinned by this Catalyst vision.

Requirements and functionalities

The marketplace building blocks are designed to offer the following services:

- Backend Assets and proxy Service orchestration & lifecycle management, which allow to:
  - Simplify the process for procurement/deployment/operations/management for building 5G flexible networks;
  - Enable single point of control to share orchestration transactions used to design, deploy and assure End-to-End (E2E) services in a multi-vendor and multi-domain environment;
  - Manage a portfolio of assets and offers for providers to offer, discover, subscribe and consume.
- DLTs-based Data Trust for Business Assurance, which allows to:
  - Enable implementation of partnership models with a reliable Data Trust layer for Business Assurance Framework;
  - Ensure transparency and trust among the participating stakeholders, and allow to trust the build service chains that extends beyond assets infrastructure boundaries and that are connected across end-to-end services designed by CSPs and co-managed by CSPs and assets providers;
- Interoperable Standard Open APIs that:
  - Support integration with different DLTs platforms through use of standard open APIs to certify transactions between partners;
  - Support integration with different OSS/BSS platforms through use of standard open APIs to offers, requests, orders, search assets within the marketplace and to onboard assets within the E2E infrastructure ordered by CSPs;
  - Finally enable a wide range of use case scenarios that would be applicable to CSPs.

Technical building blocks and providers

The different integrated services build on top of a *data and information assurance trust layer* provided by Distributed Ledger Technologies (DLTs). This data trust layer allows immutability, traceability and accountability of actions thus achieving a trusted collaboration across the different actors and infrastructure providers. Each of the building blocks is provided by one of the Catalyst technology providers listed below:

#	Capability	Description	Provider
1	Federated DLTs-based Data Layer for Business Assurance	It integrates, using standard and open APIs, different modules and services with DLTs platforms for integrity and immutability of exchanged data	IOTA
2	Provider onboarding	It onboards and manages lifecycle of asset providers and service providers	Nexign
3	Asset lifecycle management	It manages onboarded assets and their lifecycle	Nexign

4	Offer catalog	It manages the commercial offers from asset providers and provides a catalog for service providers to search, select and subscribe to assets	Nexign
5	Asset reservation and allocation	It reserves and allocates assets for onboarding to the marketplace	RTC ARGUS
6	Service orchestration	It orchestrates assets based on service provider specific configuration to multi-domain, multi-vendor asset provider orchestrators	Nokia
7	Service chain design	It designs vertical specific service chain and connects them across multi clouds e.g. public cloud and telco clouds	Nokia
8	E2E SLA management	It manages and reports real time and predicted asset performance and recommend for upgrades	Nokia
9	Revenue management	It manages billing, invoicing and settlements	Currently envisioned, it will be developed in later Catalyst phases
10	Agreement management	It manages commercial agreements between providers engaged in the marketplace in support of the marketplace governance	Currently envisioned, it will be developed in later Catalyst phases
11	Business analytics	It identifies optimisation of the marketplace and its offerings and provides overall business performance	Currently envisioned, it will be developed in later Catalyst phases

Table 1: Federated Marketplace requirements

The above-described architecture building blocks leverage a mix of existing solutions and the deployment of new components (Federated DLTs and Open APIs) that help to connect different CSPs backends (OSSs).

These components are described in detail.

The role of OSS

OSS - NRI and OMS allow asset managements and cover the following application functions (represented on the TMF Telecom Applications Map (TAM)):
- Resource Inventory Management
- Location Management
- Capability Specification Management
- Service Inventory Management
- Resource Process Management
- Resource Order Management
- Network number inventory management

To implement the business process "end-to-end", all stakeholders will need integrations for OSS with API TMF 639, в BSS TMF620, OMS - TMF 637, TMF639, TMF640 provided by Federated CSPs Marketplace. The Assets Providers will just need to have access to the Marketplace.

The need for Federated DLTs

The Federated CSPs Marketplace is operationalized as a Federated platform to assess the profitability of new business models for CSPs and their partners. Multi-party transactions need an efficient and secure Settlement and Payment layer.

DLTs capabilities map well to enable a Data Trust for Ecosystem Business Assurance. In particular, they allow to:

1. Reduce risks and frauds, and are auditable

2. Save time, avoid disputes and reduce settlement time,

3. Reduce cost, and support new revenue streams

4. Increase trust

Using DLTs, responsibilities and revenue sharing can be tracked in a transparent and immutable way and require minimum integration time (when using standard APIs) thus making them capable to support rapidly evolving marketplace ecosystems[5].
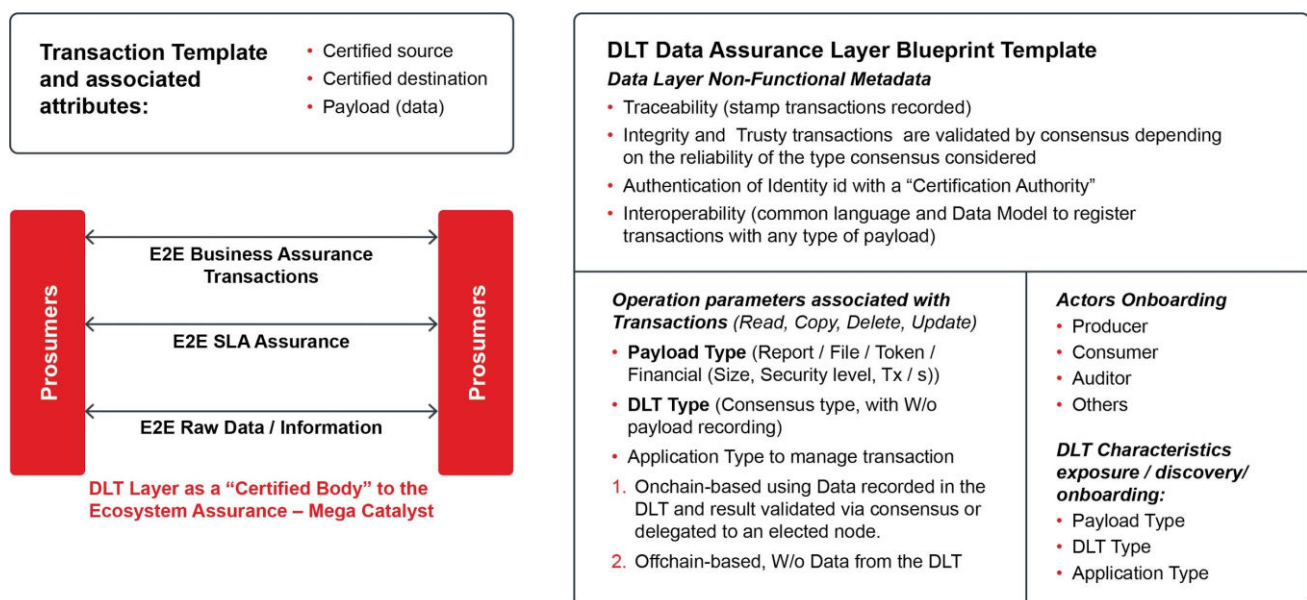
Figure 8 below summarises these needs and benefits.

Figure 8: Federated Marketplaces Role and Benefits of DLTs

In order to support the volume of transactions requested by the implemented marketplace, it is of paramount importance that the selected DLT infrastructure remains accessible, easy to use and does not add extra infrastructure costs.

While the designed DLT infrastructure is flexible enough to be integrated with various technologies, for this initial marketplace implementation, the IOTA Tangle ledger was selected.

The Tangle uses a fast and scalable consensus algorithm, with no fees, that can support both data and value transactions. Furthermore, the IOTA Tangle can be deployed not only in a public network for the sharing of assets offer/request transactions but also in a Private Tangle. The latter being more suitable to control the processing of transactions containing confidential information, such as orders and orchestrations, or that providing strategic configuration information to onboard assets within a partner's infrastructure.

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[5] A number of scenarios where Federated Blockchain and DLTs infrastructures like the one proposed has been proposed by TM Forum and confirm the importance of this building block
https://www.tmforum.org/resources/technical-report/tr279-csp-use-cases-utilizing-blockchain-v3-1/

As a result, the underlying DLT infrastructure is not only scalable and secure in terms of data trust capabilities but also ready to support future settlements and revenues sharing through crypto tokens.

Case study[6]

For this catalyst, the scalability of the existing DLT infrastructure and used technology has been evaluated in a real deployment scenario in order to understand the storage requirements for such a Data Trust Layer. It is envisioned that managing the life cycle (Request, Order, Settlement) of 1000 Assets a day over a year will require 10Gb extra information storage. While this is well supported by the IOTA DLT infrastructure, the ability to dynamically scale and adapt this infrastructure according to increasing scalability needs can require combination with other DLT networks and even create hierarchies of them. This is made possible by the implementation of open and standard federation APIs.

The benefit of Open and Standard APIs

To deliver a functional and interoperable Marketplace solution, the Catalyst leveraged industry standards, manly TM Forum Open APIs.

The intent of the implemented API depicted in Figure 7 is to provide a consistent/standardized mechanism for:
- Management of the entire lifecycle of the assets and asset orders;
- Create, query and manipulate the assets;
- Create, manipulate and orchestrate the asset orders.

The standard APIs have been introduced between DLT and the Marketplace platforms, thus providing the ability to integrate the Marketplace with any DLT supporting the same APIs, as well as the ability of a given DLT to interact with any Marketplace. This way full marketplaces interoperability is achieved.
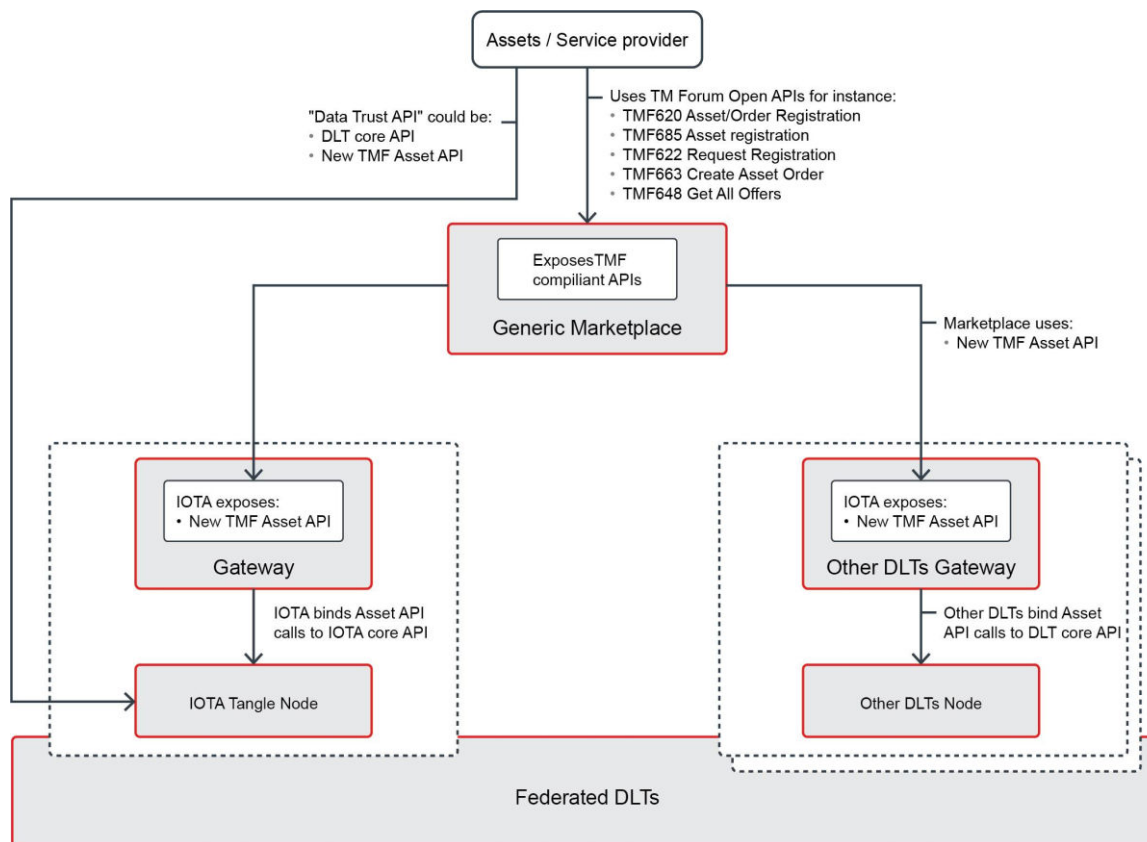

Figure 7: Federated Marketplace APIs

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[6] https://projects.tmforum.org/wiki/download/attachments/128865483/IOTA%20Data%20Volume-v25-20200728_183826.docx?api=v2

Lessons learned and Best practices

The architecture presented above can be seen as an instantiation of a more general high-level Design Blueprint. Such a blueprint should help architects of a DLTs federation to leverage well-defined and reusable templates that allow them to capture all the benefits of this technology. In this regard, our 2020 Catalyst proposes a DLT Design Blueprint that can easily be operationalized (instantiated) in real-time (production environments).

Figure 9 below illustrates the high-level architecture design principles of federated DLTs Blueprint.
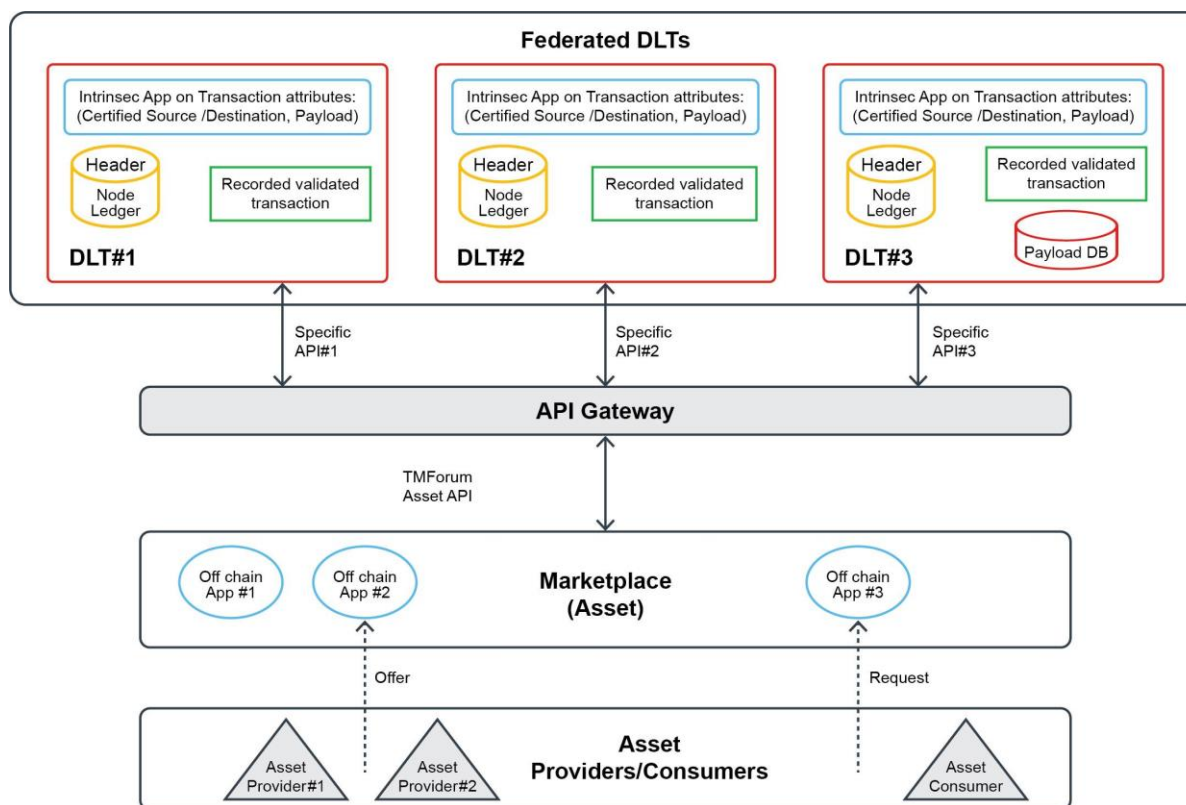

Figure 9: Federated DLTs high level architecture design

It is a multi-Layer Framework composed of the following four layers:

Federated Distributed Ledger Layer

This layer shows three different DLTs (e.g. DLT-Type 1, DLT-Type 2, and DLT-Type 3), differentiated by their respective consensus model, transactions payload and transaction storage mode.

API Gateway Layer

API gateway ensures internetworking and application interoperability among the three different DLT types. In this example, the principle embodied in the model is that each DLT platform in the federation interacts with the API gateway, using its own (specific / proprietary) APIs. Successively, the Gateway translates APIs into standard TM Forum ones.

Marketplace Layer

The marketplace layer embeds a variety of off-chain (outside DLTs) information transactions, such as onboarding, service orchestration, billing reconciliation, settlement etc.

Asset Provider/Consumer Layer

- **Providers of assets** (e.g. MEC networking, computing, and storage resources) expose their assets in the marketplace to be discovered and consumed.
- **Consumers of assets** discover the offered assets in the marketplace and request the selection of an available and requested asset to fulfill their requirement. In this example, the assets are associated with the MEC resources to facilitate a CSP to build and deliver a Multi-site 5G PMR (NPN) to an Industry 4.0.

From innovation to market maturity

In a real-world deployment, the success of the described Federated CSPs Marketplace highly depends on the maturity of its ecosystem, its stakeholders' engagement and the success of their interactions. Figure 10 below shows these interactions.
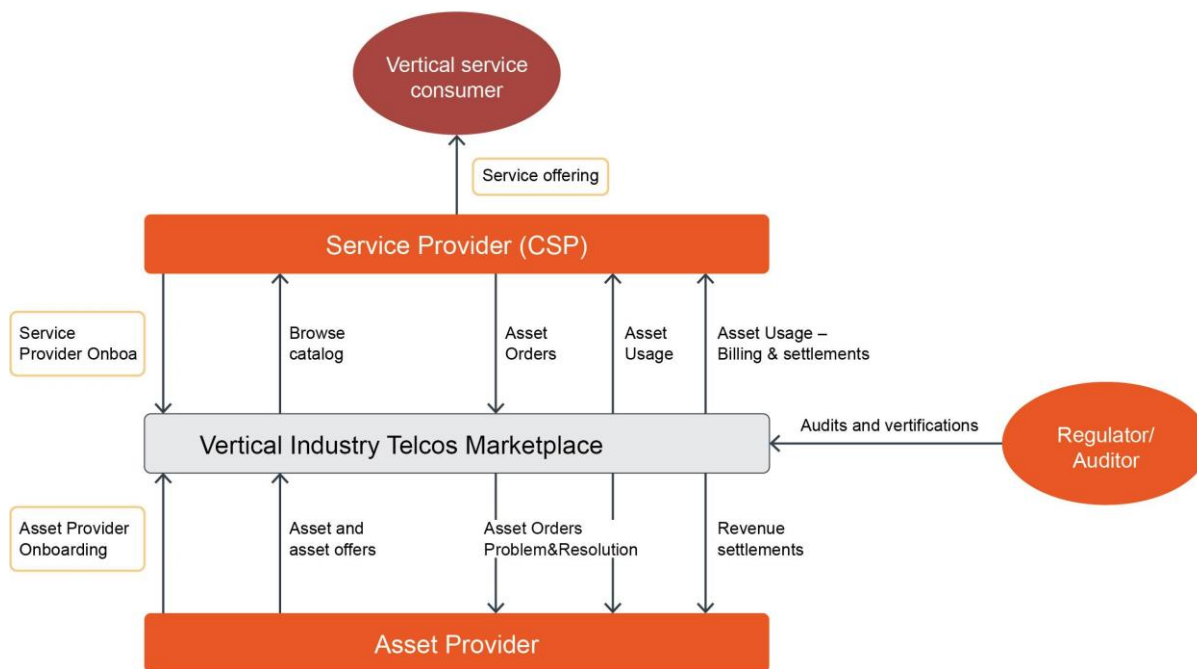

Figure 10: Federated Marketplace ecosystem

The following interactions exist:
- Marketplace Operator operates and governs the marketplace; a consortium of assets providers and CSPs could play this role.
- Asset Providers offer assets to the marketplace and decide on the requested price to offer their assets when they are available (under-used);
- Communication Service Providers (CSPs) access the marketplace, obtain the required network assets and generate revenue for the Asset Providers; the Marketplace operators may also take fees on transaction, but if it is a consortium of CSPs who manage/operate/govern the marketplace it is up to them to decide (with no fees)
- Vertical Service Consumers create markets for new Communication Service Providers (CSPs), Asset Providers and their solution and engage end consumers to pay for provided services;
- Regulators and auditors ensure the correct execution of the federated CSPs Marketplace;
- Sponsors may support the acquisition of assets offered in the Marketplace, and may request transaction fees or data for a given return of investment.

In particular, it is crucial that Asset Providers, CSPs and Vertical Service Consumers (which could be also CSPs in order to temporarily increase their coverage or capacity for their customer's needs) need to be incentivized to

participate. To achieve this and to ensure market maturity to the innovation introduced by the Federated CSPs Marketplace, a set of non-technical but governance principles needs to be guaranteed. In particular:

- How to provide a fair value sharing amongst the federation participants so that to maintain them incentivized to contribute to the platform? (tit-for-tats mechanisms)
- How to enable voting mechanisms and flexibility that allows partners to have a decision-making status in line with their level of membership of the federation?

Marketplace governance and revenues sharing

For the correct functioning of the federate marketplace and collaboration of its ecosystem, a proper governance structure is required and should:

1. Govern the right stakeholders: in this case producers (Asset and Application Providers), consumers (CSPs) and sponsors;
2. Manage their conflicts in case of disputes and claims across the whole set of stakeholders;
3. Define pricing models, orders acquisition (in case different CSPs request the same assets) transparency and when and how to generate incentives for the marketplace utilisation and expansion;
4. Decide the marketplace evolution and when and how new stakeholders can be onboarded, and when and how the marketplace technical development can be performed.

With number 1 being defined as a key principle of any platform governance rule, and number 2 being supported by the use of distributed ledger technology already integrated in the marketplace development to ensure business assurance and traceability of actions and responsibilities, solving number 3 and 4 opens up the opportunity to explore and leverage on new technologies, such as use of crypto tokens[7]. The 2020 Catalyst discusses the following options for future involvement of these solutions in future Catalyst iterations.

The role of tokens

Token and governance	Token and revenue sharing
Each connectivity asset can be digitised and associated with a number of non-fungible tokens, reflecting the tokenized value of the asset. For each asset that CSPs federates in the Marketplace an ownership token is received. For instance, tokens can be distributed based on number of assets, value of assets or other terms. At the same time, tokens can be earned by Assets Providers and new tokens can be generated by those investing in the Marketplace (i.e., CSPs, sponsors) and further distributed to attract new assets providers. In a token based governance, asset providers and other token holders can decide on the platform evolution (4) according to their held tokens, representing their stake in the platform, with each token counting for a vote in the decision process.	Tokens can also be used to define new business models and revenue streams (3). In particular, each revenue settlement can be directly distributed to the asset or set of assets generating it in a way proportional to the token share of each asset. Sponsors can also obtain tokens proportionally to the cash flow injected into the platform and receive payout from the platform revenues based on the number of held tokens. Similar use of tokens for ecosystem participation and incentivisation/revenue sharing does not incur in any taxable income and simplifies their adoption.

Table 2: Role of crypto tokens in the future of Federated Marketplace

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[7] Crypto tokens or crypto assets are a special kind of virtual currency that resides on its own blockchain and can represent an asset or utility.

Leveraging the above opportunities, future marketplace operators can also explore the opportunity to make tokens the 'currency' inside federated CSPs marketplaces. This way any participants and stakeholders will have to buy and exchange FIAT currency towards a predefined amount of tokens. While a solution like this will require to deal with the need to manage token *volatility* and create stable tokens (or new colored tokens), at the same time it will create the opportunity to shift more control towards the CSPs.

All these aspects will be investigated in the future to contribute to the market maturity of the proposed solution.

Future Federated Marketplaces opportunities

With this paper we demonstrate how infrastructure-based federation is the first and the easiest way for CSPs to explore new collaboration opportunities in their attempt to deliver digital innovation, reduce costs and generate new revenues. However, future and innovative service-centric federation models can be explored and built on top of the created infrastructure.

Service-centric federation

Service-centric federation can drive further collaboration among CSPs, helping them to leverage on their customer base, their data, their local and national competencies and presence in different vertical domains, where their infrastructure is being used.

Data oriented services

The creation of data oriented federated-services for consumers and their devices that offer access to worldwide solutions for connected supply chains, smart grids, retails etc can open up additional $3 Trillion revenue streams for the whole telco ecosystem, including CSPs.

In case of data oriented services new governance models will also have to address the new dimension of those who owns the data sources in federated data oriented services, who can access the platform data and for what purposes, thus ensuring GDPR compliance. Being data an asset too, it is expected that with the right adaptation the same and similar solutions tested in this Catalyst can be replicated.

Laying in between infrastructure and service federation, a new opportunity exists, and it is represented by the Identity as a Service.

User and Devices Identities

The creation and provisioning of DLT-based digital identities for users and their devices can empower CSPs with new market opportunities. Horizontal and cross-vertical IoT services are expected to drive this need with a foreseen 24.6 Billion of IoT connections by 2025[8] from devices that will need to be seamlessly verified when roaming across connectivity networks.

Building on the data and eSIM assets that CSPs maintain for their customers and leveraging the same infrastructure blueprint, a new way of monetising them becomes possible.

CSPs will start registering verifiable identities (i.e., a public key) on a Federated Distributed Ledger. When CSPs perform customer/device Know Your Customer (KYC), a signed digital identity credential can be issued and stored eSIM into the device. From there, verification of the customer eSIM or device identity can be easily authenticated by any requesting party and performed directly without any complex integration, simply using the available ledger identity to verify credential signature. At the same time, a fee per transaction can be collected and automatically distributed to the CSP issuer of the identity credential, thus offering additional revenue streams for the offered service.

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[8] GMSA Report: https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/03/GSMA_MobileEconomy2020_Global_Infographic.pdf

A similar "Identity as a Service" infrastructure will well enable use cases like Virtual Identity Supporting Mobility across Vertical Ecosystems" already discussed within the TM Forum and will be explored in the future of this Catalyst.

Conclusions

In this White Paper we explored why CSPs need to collaborate and develop their ecosystem in order to innovate. While offering a new layer of functionalities for the TM Forum MegaCatalyst, we mainly focused on CSPs' innovation. In particular:

- We investigated New Business Models and Value Propositions (including 5G Monetisation) for a Federated CSPs Marketplace
- We proposed a technical architecture that bridges interoperability gaps using standardized APIs
- We showed how Open APIs and SID model from TM Forum Assets can be leveraged
- We used DLTs to provide a "Trusted Data Layer" for Business Assurance, which will be further explored in the TM Forum Mega Catalyst
- We proposed a high level design principle for leveraging Federated DLTs for Data and Business Assurance
- We proposed a Design Blueprint for paving the way for specifying a Generic Marketplace
- We identified a number of challenges and innovation that this Catalyst will explore in the future

If you want to know more or get in touch, please reach out at C20.0.34@tmforum.org

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