ACCELERATING 5G JOURNEY WITH CLOUD

Abstract

Cloud native solutions from networks to platforms to applications, microservices based architecture, Open API, power of AI and ML are all contributing towards enabling the business innovations. Cloud computing along with 5G is opening numerous opportunities for enterprises in various sectors such as manufacturing, healthcare, energy and transportation. Disruptive value propositions with relative use cases and solution blueprints are being developed across different market segments. During these developments, for coping up with complex customer demands, cloud native capabilities of auto scaling, load balancing by spinning up elastic compute instances content delivery network services storing cache near to edge location are contributing towards delivering the complex use cases supported by 5G.

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Use cases supported by 5G for various industry applications include:

- Enhanced Mobile broadband - faster speeds and lower latency use cases

- Massive Machine Type Communication - Internet of Things (IoT) services use cases

- Ultra-reliable and low latency communications - Services requiring a very high reliability and a very low latency

The usefulness of these use cases in industry applications depend on their respective requirements. Below table depicts few areas of industry verticals with their application requirements

Autonomous Vehicle	Low Latency, High Mobility
IOT	Low Cost, Low Bandwidth
Factories	High Reliability, Low Mobility
Video Applications	Low Latency, High Bandwidth

To enable these solutions, 5G network slicing architecture is being implemented which allows fulfilment of varied requirements of an application. Along with this, cloud native developments fostering business agility, bounded context concept supporting microservices platform design, domain orchestrations and Open digital architectures are used for leveraging the 5G innovation ecosystem.

The four major pillars to be considered for accelerating the 5G journey with cloud are:

1. **Business Deep Transformation** – of networks, platforms and applications fostering agility and scalability as per the customer needs.

2. **Digital and Domain Centric Innovation** – Microservices based customer platforms enabling real-time service fulfilment, domain orchestration combined with AI and ML powered solutions, enabling customers to have full control of their journey

3. **"Harness" – Platform Based 'Hyper Execution'**– Cloud native solutions with scalable models built on Open Digital Architecture and integrated by Open API, enabling reusability of platforms and rapid innovation

4. **Agile Marketplaces and Ecosystem** – Innovative business models and propositions launched by vertical industries in collaboration with partner ecosystem, built on service provider network
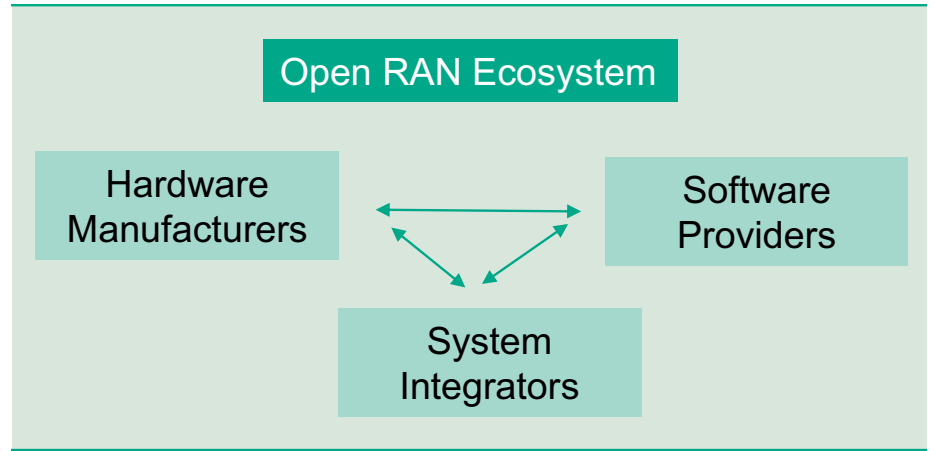
Business Deep Transformation

Cloud business and 5G are entwining each other due to their extensive applications and business innovation solutions possibilities. Business deep transformation of networks, platforms and applications using cloud native solutions would help to manage efficiently the on-demand requirements enabled by 5G network slicing. The 5G data traffic can be handled efficiently using load balancers. The cloud native compute and storage services enable faster AI/ML based analytics and cater to ultralow latency 5G requirements.

Edge Computing

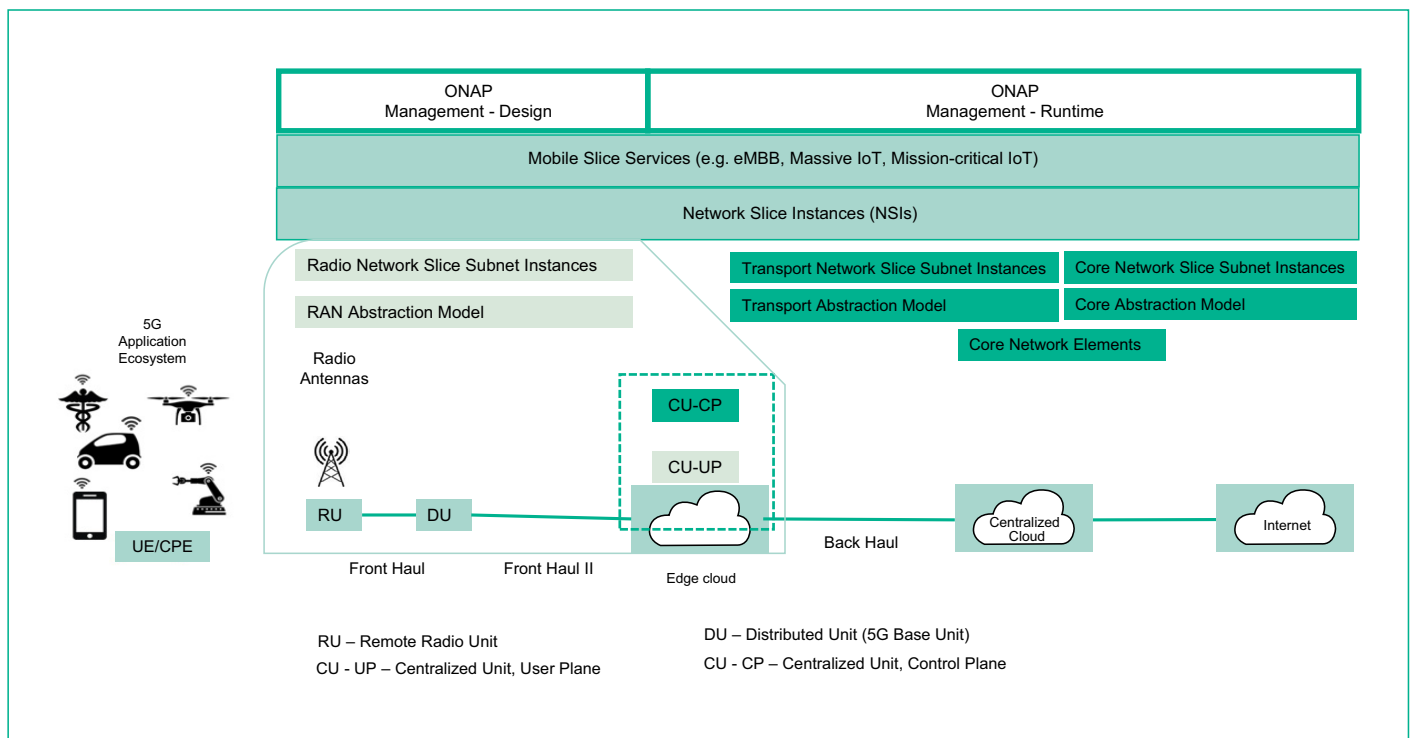Compute power needs to be taken near to edge for improving latency. Open RAN with open interfaces – supports new innovations and opportunities for giving different type of services. Below figure depicts the O-RAN ecosystem, which enables innovative products by using multivendor interoperability.

Cloud Native Open RAN solutions include:

- Automated lifecycle management and Orchestration
- DevOps deployment module
- Hybrid Cloud hosted solution
- Distributed and Central units

Open RAN Ecosystem

Hardware Manufacturers

Software Providers

System Integrators

ONAP – Open Network Automation Platform

Disaggregated 5G RAN consists of hybrid network elements (PNF and VNF) and will require a cloud infrastructure deployment at the edge. ONAP defines the management of lifecycle of a network slice from initial creation/activation all the way to deactivation/termination. Also, ONAP provisions the optimization of the network around real time and bulk analytics, place VNFs on the correct edge cloud, scale and heal services, and provide edge automation

ONAP Management - Design

ONAP Management - Runtime

Mobile Slice Services (e.g. eMBB, Massive IoT, Mission-critical IoT)

Network Slice Instances (NSIs)

Radio Network Slice Subnet Instances

RAN Abstraction Model

Transport Network Slice Subnet Instances

Core Network Slice Subnet Instances

Transport Abstraction Model

Core Abstraction Model

Core Network Elements

5G Application Ecosystem

Radio Antennas

CU-CP

CU-UP

UE/CPE

RU

DU

Edge cloud

Centralized Cloud

Internet

Front Haul

Front Haul II

Back Haul

RU – Remote Radio Unit
CU - UP – Centralized Unit, User Plane

DU – Distributed Unit (5G Base Unit)
CU - CP – Centralized Unit, Control Plane

Digital Experience Layer (DXL Architecture)

Application agility is needed for complimenting network automations in 5G. To become digitally agile, service providers are moving towards cloud first solutions. Digital Experience Layer (DXL) architecture enabled by a microservices platform, frameworks using docker container and integrated by Open API's reduces total cost of ownership and allows faster time to market. Below figure shows a Digital Experience layer architecture:
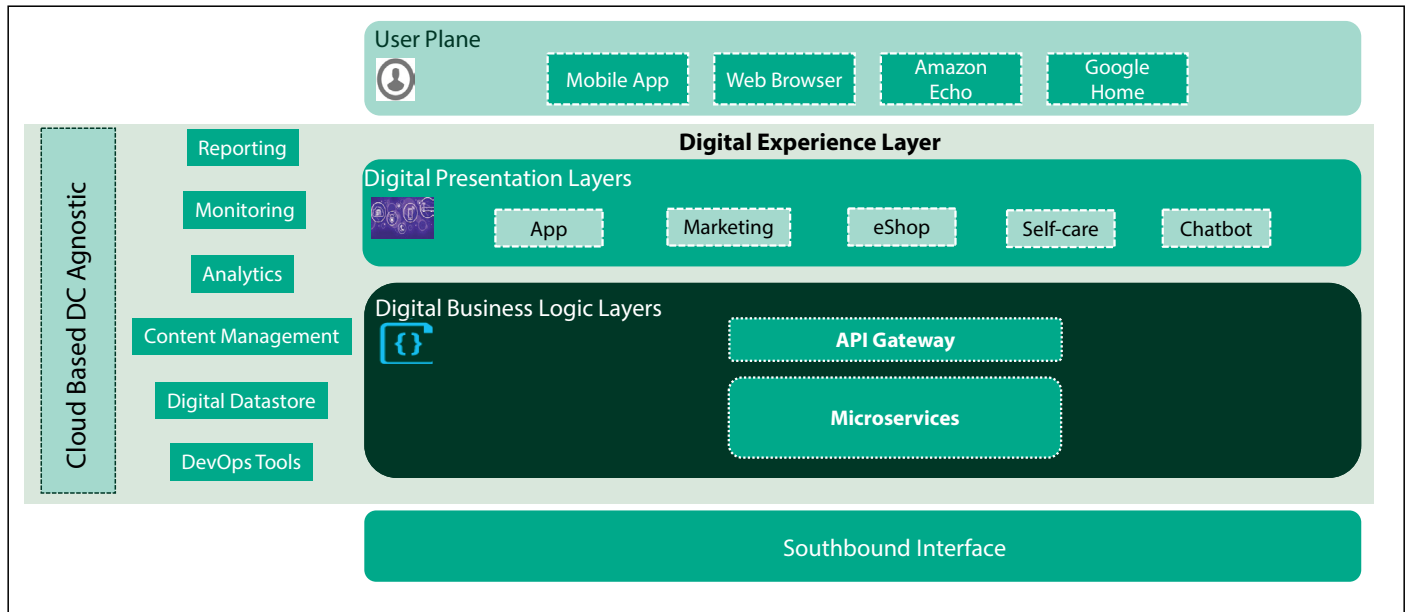
The benefits of DXL implementation:

- Improving Digital Application performance
- Achieve Omnichannel experience across digital channels

- Auto scaling and load balancing
- Achieve Geo resilience
- Independent agile teams working on microservices

- Independent deployments possible
- Optimization of cross channel logic
- Build once, deploy anywhere

Digital and Domain Centric Innovation

In order to cater to on-demand network slice requirement, the business capabilities will need close co-ordination among all the layers in CSP stack. Domain orchestration using SDN and NFV as per ETSI standards (Open Source MANO) play crucial role in delivering on demand connectivity requirement/network slicing for various use cases. The microservice based architecture for processing different events from instantiating a network slice by Service Orchestrator to closed loop service assurance, calling REST API's exposed by various interfaces can be run with cloud native services orchestration capabilities.
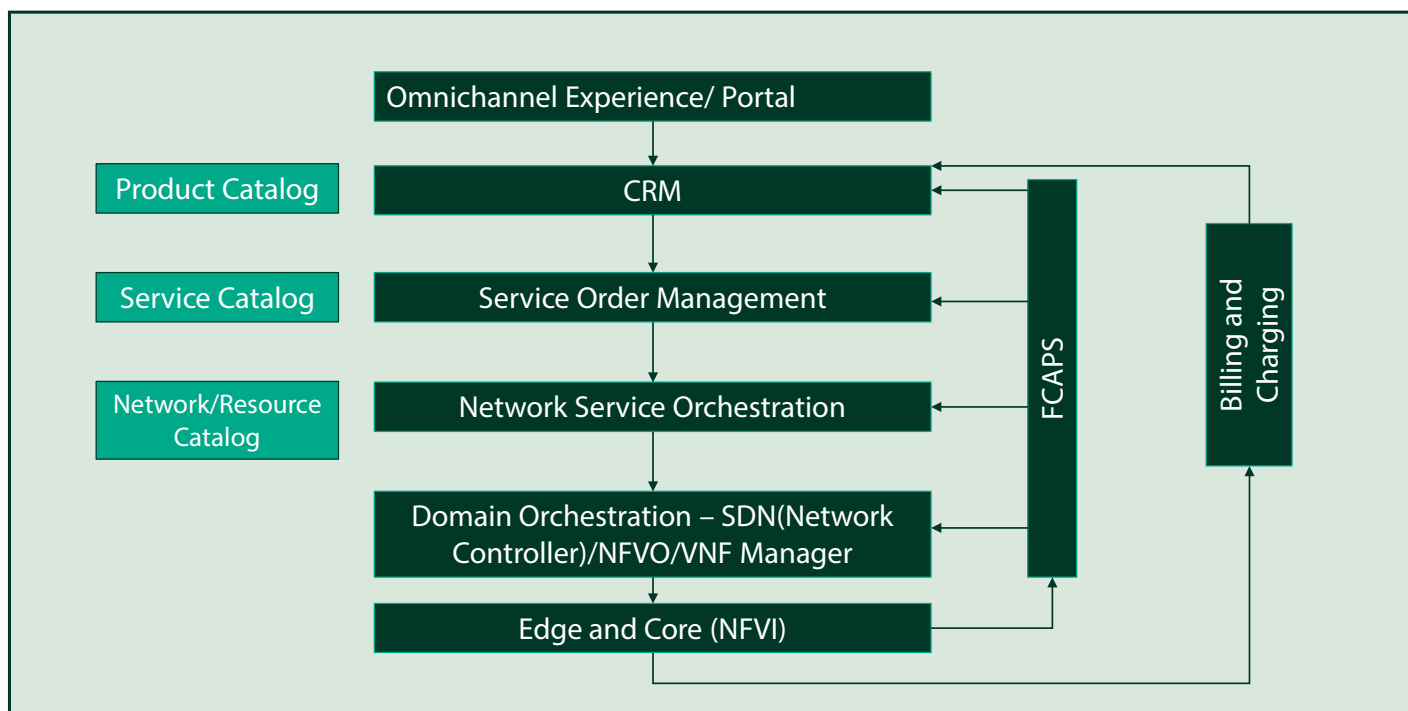
Need of Digital and Domain Centric Innovation:

- New business propositions
- New products addition to catalog – CFS and RFS
- New updates in inventory leading to complex offers
- Complexity in product definition
- Cross selling, upselling all based on cloud native solutions

Below figure gives an overview of functions involved in 5G network slice. Product catalog, service catalog, FCAPS, Domain Orchestration are being built as microservices with functionalities of scaling, self-healing and predictive analytics. Delivery of services being driven by DevOps culture.

Network Slice Architecture in CSP Stack

Digital and Domain Centric Innovation for enabling 5G on cloud would mean:

- Real time service fulfilment enablement
- Product Catalog management would need to enable ease in product definitions, search and upload functionalities will be needed
- Orchestrator would be playing more flexible and close coordinating role for dynamic requirement changes
- Automated flows for business functions
- Decoupled and loosely integrated functions across business functions
- Managing dynamic customer requests and record customer interactions
- AI and ML power for computing offers management and inventory management based on useful insights

"Harness" – Platform Based 'Hyper Execution'

Cloud native networks (microservices based) deployed in NFV infra - compute, storage and network hardware would help communication providers develop innovative solutions for verticals in a cost-effective way. On demand cloud service benefits customer in terms of installation and operation cost. Rapid innovation is possible due to scalable models. Industry standards like TM Forum Open APIs play an important role for enabling collaboration and integration with new partners in the ecosystem. Domain orchestrators built on open platform with standard open API enables reusability of platform components.

Drivers for cloud native development:

- Predictive maintenance strengthens a distinguished commercial model

- Performance is of importance for network slice that is created and activated on demand using different business rules and constructs

- Billing and charging models defined with different partners in the ecosystem

- On demand service activation

- New Value propositions being launched into market by Service providers

- High co-ordination of Orchestration layer, complex SLA requirements, high and consistent performance needs, operators working in collaboration

- Common platforms that can be used and replicated in different areas of use

ODA –Open Digital Architecture

The ODA project is building on and working with the TM Forum Open API Program, which is designing a common core suite REST based APIs that are service and technology agnostic, enabling the management of services even where components of that service are delivered by other partners in an ecosystem

ODA helps in reimaging the OSS/BSS functionalities. ODA defines the functional architecture in the following way, broadly categorizing the areas as:

- Party Management

- Core Commerce and Management

- Production

- Engagement Management

- Intelligence Management
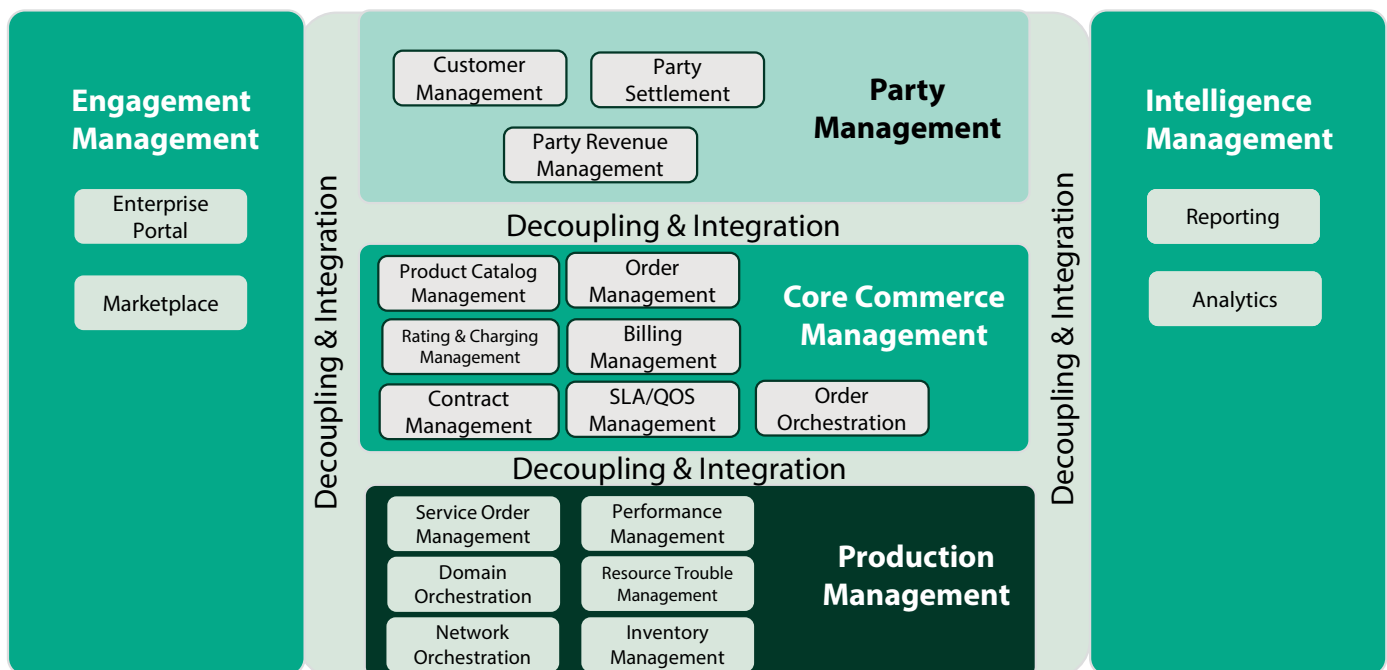
TM Forum Open API's will be used to dynamically configure the elements in the Open Digital Architecture. This would help to run the digital ecosystem more efficiently. Below is the list of open APIs' that are being commonly used in the 5G deployments.

TMF 622 – Product Ordering API - identifies the product or set of products that are

available to a customer, and includes characteristics such as pricing, product options and market.

TMF 633 – Service Catalog API - allows the management of the entire lifecycle of the Service Catalog elements and the consultation of service catalog elements during several processes such as ordering process.

TMF 640 - Service Activation and Configuration - allows the user to retrieve, create, update and delete services

TMF 638 – Service Inventory Management API provides a standardized mechanism to query and manipulate the Service inventory

Agile Marketplaces and Ecosystems

5G coupled with cloud computing brings new avenues and services for monetizing. Intelligent solutions for clients – can be built by collaboration of system integrators, network integrators, sensor manufacturers, service providers. Various industry solution blueprints and business models can be developed.

Various aspects to be considered during building the solution blueprint include:

- Business verticals
- Business mandates
- GDPR requirements
- Governing bodies restrictions

- Ownership across collaboration (e.g. service provider ownership, vertical business ownership, any third-party ownership)
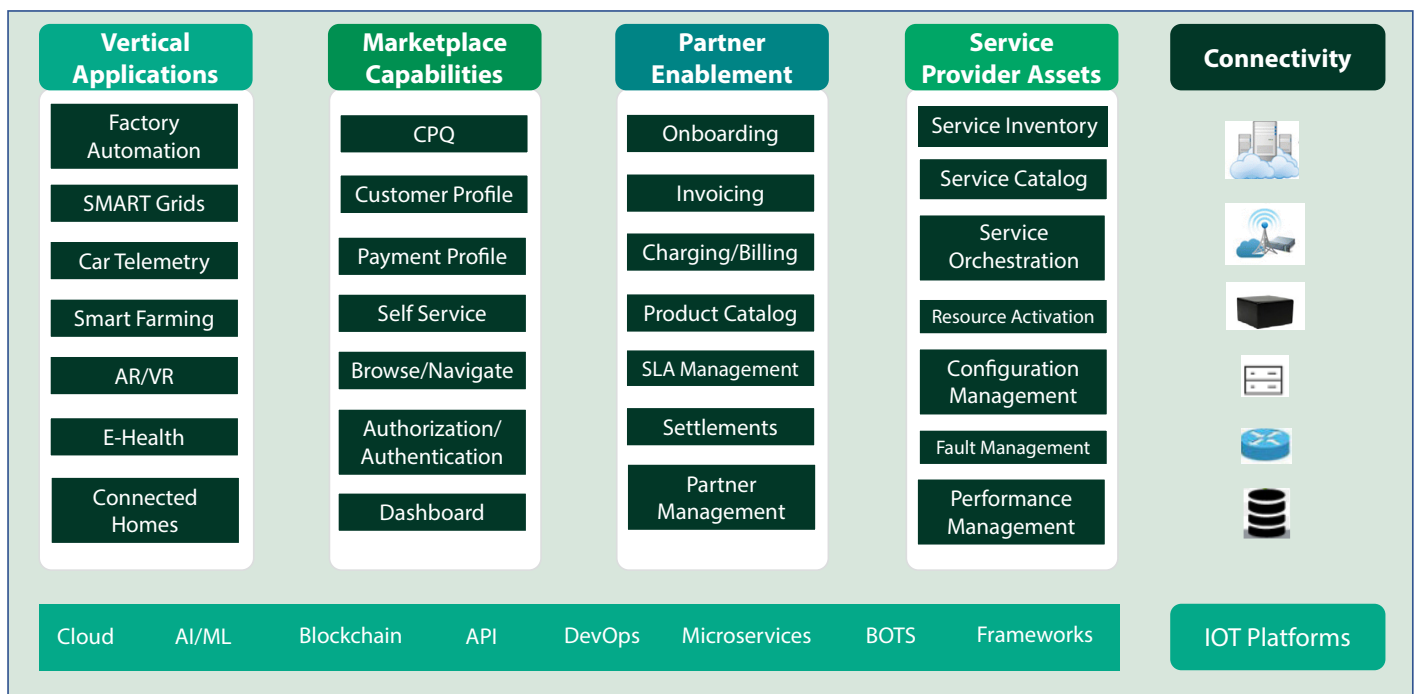
Separate slice requirement may be needed for connecting into the network, leading to different monetization strategies. To understand this better let's look at some examples:

- Auto manufacturers (e.g. Honda, Mercedes) collecting continuous data insights of engine performance enabling predictive maintenance, driver data monitoring for insurance firms (e.g. Allstate, AVIVA, AXA, Nationwide)

- Google nest solutions like Thermostat, Nest Protect, Nest Cam being hosted on service provider marketplace

- Smart farming enabled by video sensors on tractors understanding the health of soil, water needs, GPS guidance, self-driving resulting in autonomous farming

- Conversational user experience e.g. Enabling self-care capabilities via Alexa. With Alexa, developers can build new voice experiences and take advantage of providing unique value-added services to customer

- OTT players (e.g. Netflix, Amazon Prime) provide their own service in entertainment space on top of service provider network

Below figure depicts the ecosystem that can be built for turbocharging business innovation using 5G and cloud

Digital Ecosystem for Business Innovation

Vertical Applications	Marketplace Capabilities	Partner Enablement	Service Provider Assets	Connectivity
Factory Automation	CPQ	Onboarding	Service Inventory	
SMART Grids	Customer Profile	Invoicing	Service Catalog	
Car Telemetry	Payment Profile	Charging/Billing	Service Orchestration	
Smart Farming	Self Service	Product Catalog	Resource Activation	
AR/VR	Browse/Navigate	SLA Management	Configuration Management	
E-Health	Authorization/ Authentication	Settlements	Fault Management	
Connected Homes	Dashboard	Partner Management	Performance Management	

Cloud   AI/ML   Blockchain   API   DevOps   Microservices   BOTS   Frameworks   IOT Platforms

Conclusion:

For enabling 5G use cases using network slice architecture, virtual and disaggregated network deployments are being implemented and cloud first solutions are being embraced. Cloud native solutions built with server less microservices architecture, domain orchestrators and Open API's for interfaces are accelerating the development of 5G solutions. Rapid innovations are demanding Open digital architectures and platform automations. Edge computing and adding Machine learning/AI to digital architectures are becoming inevitable. Digital ecosystem formed by partnering with service provider assets is enabling innovative business offerings.

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Nilesh Shivarajan is working as a Lead Consultant with Infosys. He has over 16 years of working experience in consulting engagements, business and digital transformation programmes, Omnichannel E-commerce platform implementation using microservices and API management, Telecom Domain consulting, operational and customer experience improvements using DPA. He has written number of POV and whitepapers on topics such as eCommerce in Telco Digital Revolution,5G-Revolutionizing the next gen internet, Microservices in Digital Transformation, DPA as Catalyst in 5G Revolution, TM Forum Open API for Telcos.

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