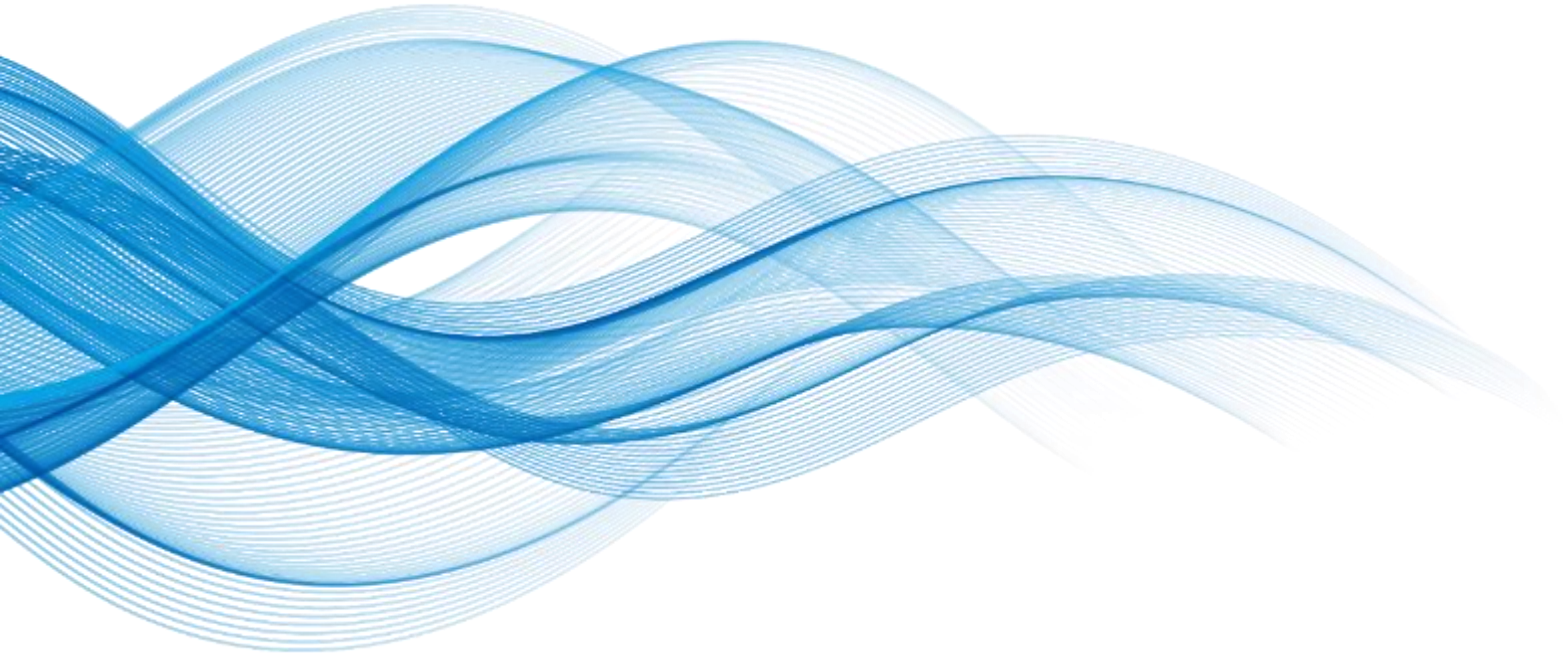
HCLTech Solution Guide

Consultant Services – Enterprise 5G

MS Azure Marketplace Offering

Dec 2022



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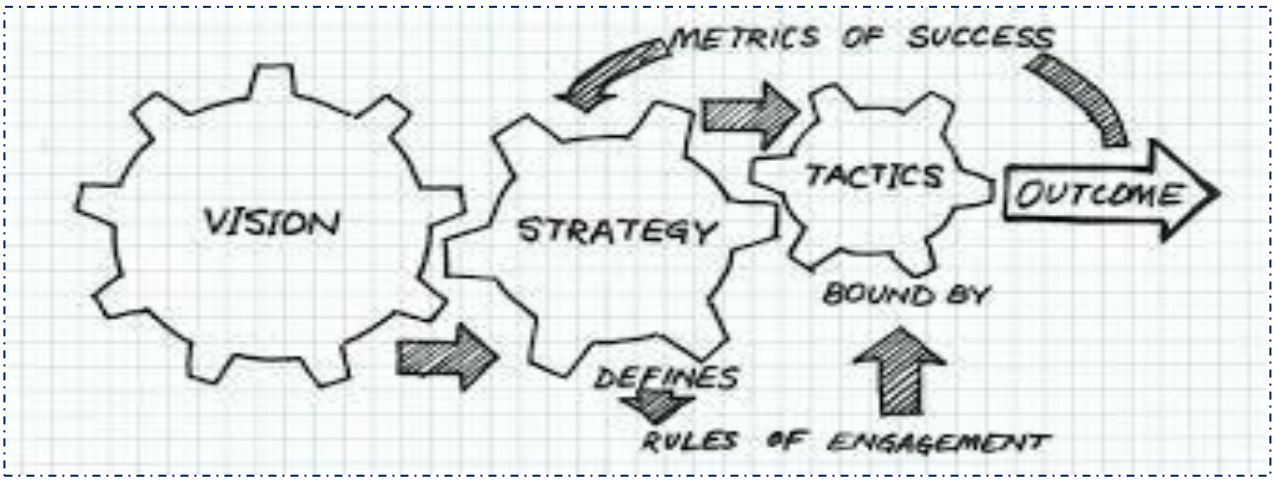
MANAGED SOLUTION OFFER SUMMARY

HCLTech proposes to support the Consultancy Services for Enterprise 5G as the following solution components



This requires a holistic approach across 5G Private Network.

The team of consultants and solution architects (SMEs) need to understand multiple domains and craft an end-to-end solution.

- Initial Requirement Analysis
- Network planning & design - Coverage requirement, capacity requirement
- Network Configuration proposition - Small/Medium/Large
- Network Deployment option analysis – Frequency Band & Bandwidth, Near/Far EDGE, Compute resources
- Network components install/deploy – RAN and Core
- Mobile EDGE Compute deployment – MS Azure
- Industry based Use cases testing
- Monitor, Maintain & LCM of 5G Networks
- Provide SLA based managed service packages to customers
- Vertical specific Service Delivery & Service Assurance
- Network Management and visibility
- Trouble Ticket Handling & Resolution
- Capacity Planning
- Platform, Software upgrades and Life Cycle Management

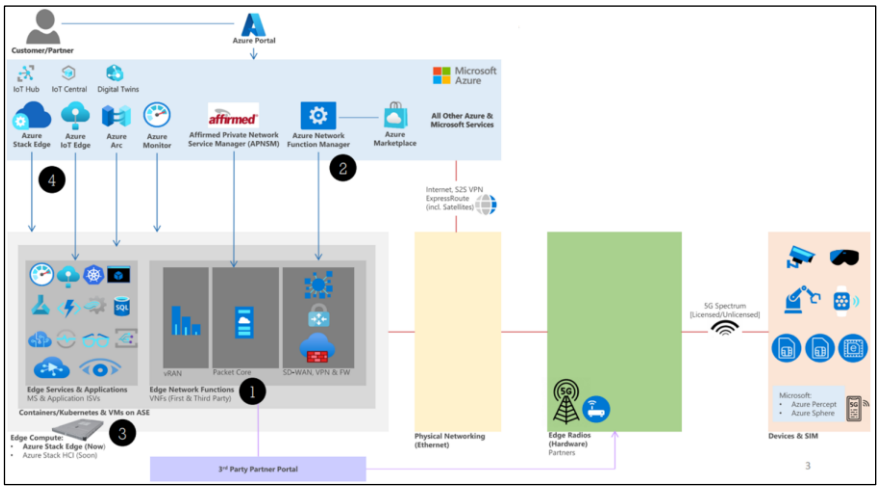
Enabling 5G Ready world : Hybrid EcoSystem Driven, Hyper Automation

- Consulting projects allow us to engage with clients at the early stages of large programs.
- Customer Expectation & Spend: We are seeing a growth in consulting needs from our customers in Enterprise 5G.
- Market Positioning: We continue to grow our Enterprise 5G market leadership position.

Microsoft Azure Edge

Azure private multi-access edge compute (MEC) is a solution that brings together a portfolio of Microsoft compute, networking, and application services managed from the cloud. The solution enables a high performance, low-latency connectivity, and IoT applications at the enterprise edge for the next wave of enterprise digital transformation.

Azure private MEC is an evolution of Private Edge Zone, expanding the scope of possibilities from a single platform and service to a solution that leverages multiple platforms and capabilities. These capabilities include edge services and applications, edge network functions, edge compute options and edge radios and devices. By processing data closer to the end device, these capabilities help improve latency-and throughput-sensitive user scenarios such as video analytics, real-time robotics and mixed IoT use-cases at a global scale. Customers and partners can benefit with a complete set of Azure services and ecosystem technology components to rapidly build, deploy, and manage solutions with simplicity.



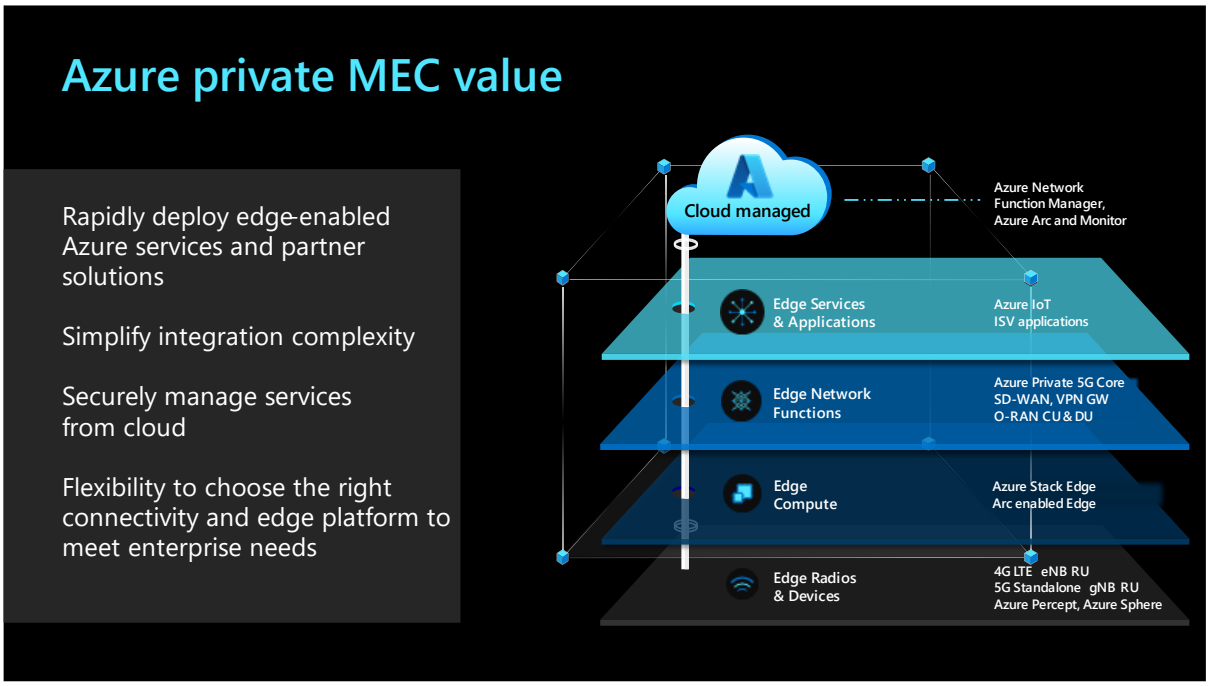
Azure private MEC

[Elevator Pitch – 1 Paragraph]

5G is a key game changer for enterprise digital transformation. Not only does it open up vast opportunities for enterprise but also brings in a great deal of complexity. In order to address this opportunity & complexity, we need a well-defined and organized service introduction pipeline to bring the heterogeneous solutions, the 5G network, the hybrid eco-system in between cloud and smart edge together by bring in best of breed eco-system partners and turn those discrete service enablers into integrated E2E solution.

We are pleased to offer Enterprise 5G Consultancy Services for various industries in order to find a suitable solution to meet the MS Azure Private 5G Network requirements. Our Consultant SMEs will help end-customers decide their network focus and best possible combination of the elements which can be used to construct a Standalone, Private Network solution for hosting wireless network infrastructure, smart services and applications. Together with Microsoft we can address the desired use cases and support our clients build a unique private network solution.

AZURE PRIVATE MEC (PMEC) COMPONENTS



Azure Private MEC

Recognizing that customers are looking for the simplest, lowest-friction deployment experience, the applications, network functions and compute platform (and potentially even the RAN software components) can all be **orchestrated and managed** from a central location using Azure technologies: Azure Network Function Manager, Azure Arc, and Azure Monitor are key elements here.

End customers are seeking the ability to deploy a multi service private network to create enhanced value across multiple use cases. 5G allows customers to embrace open ecosystem of applications and capabilities for different slices by keeping their network open to adopt innovative vendors such as Microsoft who have the flexibility and agility to develop software quickly and cost effectively – while reducing complexity of operations using our long history of global network operation.

The broad range of use cases plus the desire for operational simplicity for massive adoption leads to a diverse and often contradictory set of technology requirements. This can only be realized economically through highly customizable packages of cloud-native network functions providing discrete network slices. This provides an opportunity to re-think how network functions need to be built, deployed, and consumed.

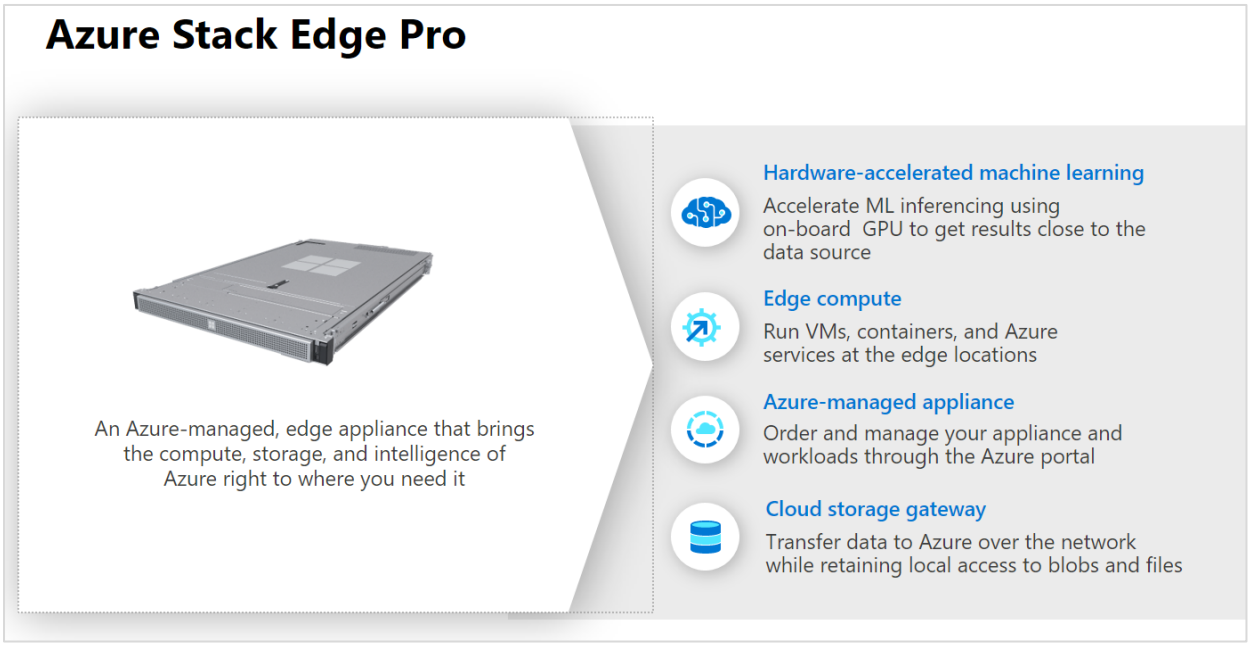
The 5G Core is a mandatory, standards defined set of network function (NF) components, required to aggregate 5G data traffic from all end devices connected over multiple wireless and fixed access technologies. 5G architecture implements a service-based interface, replacing the previous direct peering approach. This interface is used to implement a modular, highly decomposed architecture, which is suitable for deploying in a distributed, cloud-native fashion.

The Microsoft 5G solution builds upon technology strengths and our delivery reputation of on-budget project execution. We strongly believe that these, mixed with our introduction of simplified consumption models, bring a unique capability to leverage 5G as the best platform for network innovation.

The applications rely on the networking delivered by the next layer in the stack, **edge network functions**, most notably the **packet core**. These functions connect the equipment on the cellular wireless radio network to the upstream data network. Additional network functions such as VPN gateways also reside at this level. These functions are designed to speak open, standards-based APIs for maximum interoperability in a multi-vendor network. The **compute platform** that the applications and network functions rely on is next. It provides the processing, networking interfaces and storage required to support the upper layers. In the Microsoft solution, the Azure Stack Edge platform also provides on-board GPU processing designed to speed up the kinds of AI and ML workloads that are expected to be common in private networks.

AZURE EDGE PLATFORMS

Microsoft utilizes the **Azure Stack Edge** (and in the future, other Azure Arc managed edge compute platforms) to deploy high-powered compute capability at a customer location, acting as the host platform for both the MEC applications and the 5G core networking itself. This allows for simple deployment plus the ability to co-locate SI/MSP value-added applications on the same edge hardware – or to use the power of Azure cloud to create an even richer set of chained services. The edge hardware provides the processing, networking interfaces and storage required to support the upper layers. In the Microsoft solution, the Azure Stack Edge platform also provides on-board GPU processing designed to speed up the kinds of AI and ML workloads that are expected to be common in private networks.



Azure Stack Edge Pro summary

AZURE KUBERNETES SERVICE (AKS)

Azure Kubernetes Service (AKS) offers the quickest way to start developing and deploying cloud-native apps, with built-in code-to-cloud pipelines and guardrails. AKS brings unified management and governance for on-premises, edge, and multicloud Kubernetes clusters. Interoperate with Azure security, identity, cost management, and migration services.

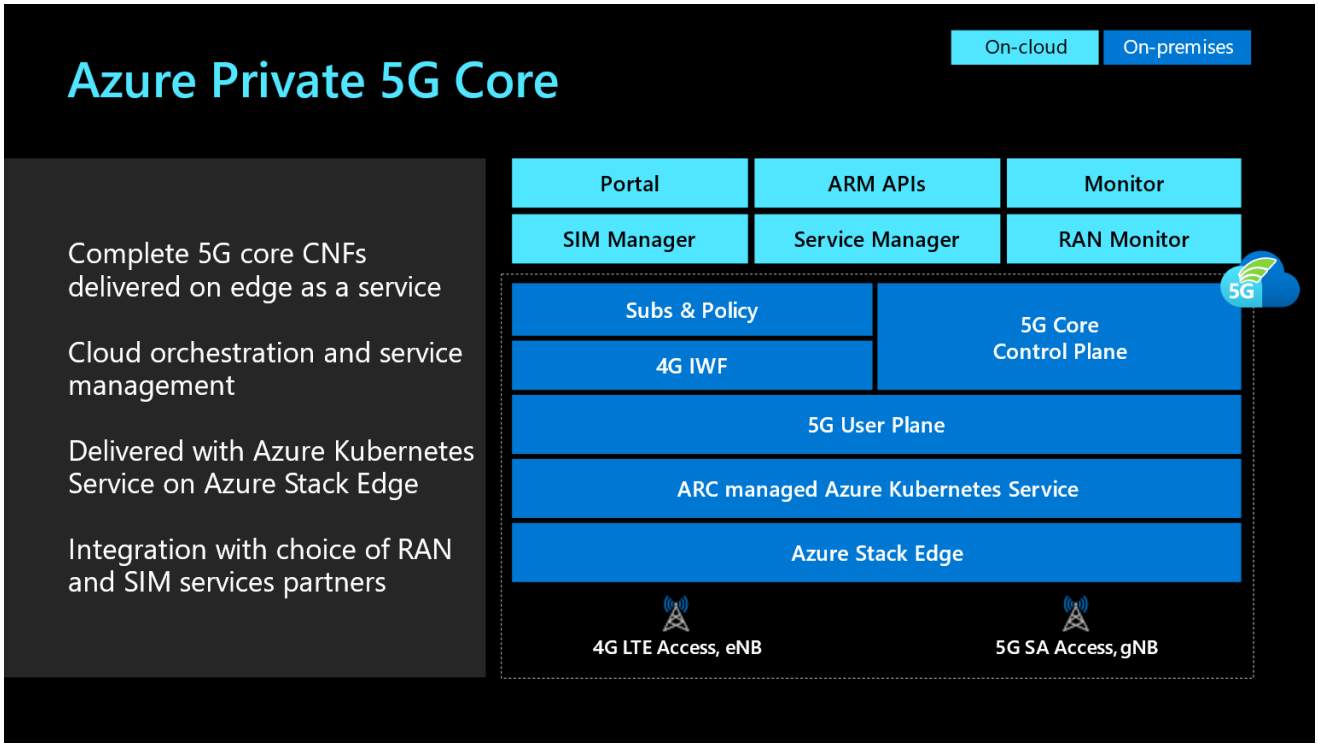
AKS clusters are deployed to the edge platform and utilize Azure NFM and Azure Arc to manage application deployments, GitOps-based configuration, monitoring, threat protection, and governance. AKS on Azure Stack Edge is used to run the containerized P5GC applications on premises.

AZURE P5GC CORE ELEMENTS

The centralized Azure portal deploys the **Microsoft Azure Private 5G Core** to create a private, standalone 5G network on the Stack Edge device, to deliver maximum performance in the smallest footprint. SIM, Policy and Common Network parameters are centrally managed and then synchronized to the edge during deployment and ongoing operation. This provides best of both worlds – edge operation with centralized cloud controls.

The Azure Private MEC offering includes the Azure Private 5G packet Core. The Azure Private 5G Core is specifically built for private networks. It is what the 3GPP standards body defines as a 5G Next Generation Core (5GC), conforming to 5G-SA standards

Azure Private 5G Core authenticates and manages the mobility of subscribers and devices, processes RAN traffic, and applies policy control before routing the traffic to a MEC application, or to another network (for example, an Azure commercial or Government cloud, or a LAN).



Azure Private 5G Core provides a complete 5G Edge solution in one package

In terms of 3GPP-defined functional elements, Azure Private 5G Core provides UPF, AMF, SMF, UDM, AUSF and PCF. In addition, it includes a unique 4G interworking layer (4G IWF), and a local management plane. Together these pieces comprise a complete packet core offering.

- **User Plane Function (UPF):** A high-performance, low-latency containerized packet processing element that is responsible for all the "user plane" – that is, the data flowing from the end-user's equipment (UE) via the RAN to the data network. It combines the flexibility to implement complex packet pipelines with extraordinary performance and efficiency. It provides user plane services including provides packet routing & forwarding, packet inspection, QoS handling and usage reporting.

- **Control Plane Functions (AMF, SMF, UDM, AUSF, PCF):** The elements that handle device attachment, policy, and session control. Like the UPF these are all based on containerized technology designed for high performance in a very small footprint.

- **4G Interworking Function (4G IWF):** To serve devices attached via 4G RAN, a 4G packet core (EPC) is needed. Existing EPCs are large, legacy applications historically intended for cellular operators' networks. However, as the world moves to 5G, it is difficult to justify deploying two different types of packet core to serve 4G and 5G. This problem is compounded in the private networking space where size and efficiency are at a premium. Microsoft's solution to this is the 4G IWF. To 4G RAN, it makes the Azure Private 5G Core look like a 4G EPC: it acts like an MME and HSS, for example, even though internally the Azure Private 5G Core is "natively" a 5G core. This feature allows a customer site to deploy either a 4G LTE or 5G SA network using the same Azure Private 5G Core architecture.

ENTERPRISE 5G CONSULTANCY SERVICES OFFERING

HCLTech offers Consultancy Services for Private 5G Network

- Initial Requirement Analysis
- Network planning & design based on requirements
- Network Configuration proposition
- Deployment option analysis
- Network components install/deploy
- Use cases testing
- Monitor, Maintain & LCM of 5G Networks
- Provide SLA based managed service packages to customers
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HCLTECH CONSULTANCY FEATURES

Flexible design

- Modular design to allow the team to focus on high impact areas
- Set scope according to the business needs

Founded in best practices

- The Core Design Principles, Best Practices and Real- World Examples provide for quick diagnosis
- Data collection is only as detailed as required to understand the issues

Deliver tangible outcomes and next steps

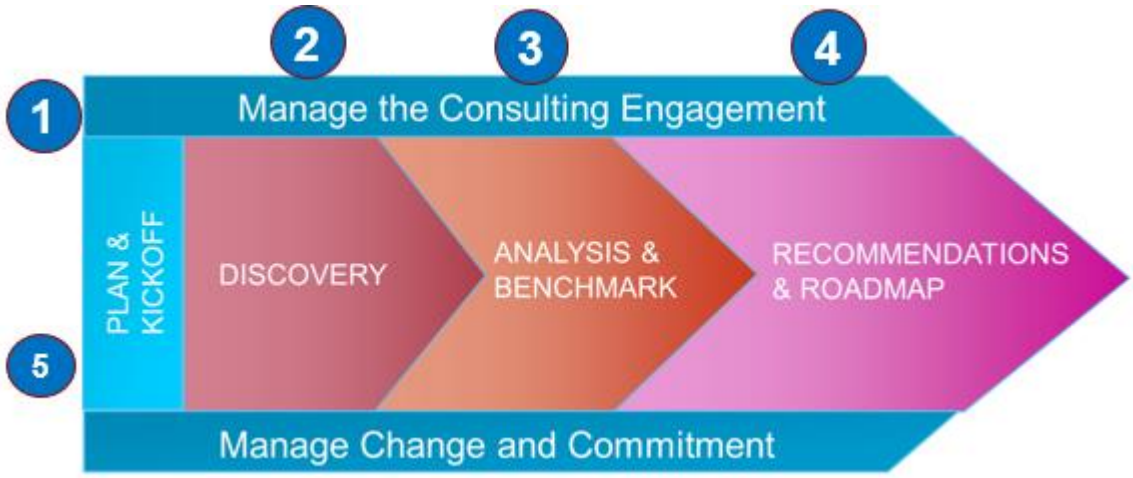
- Draw directionally correct conclusions
- Uncovers gaps at all levels and identifies their drivers

Determine action plans not detailed workplans

- Prioritization and program development exercises provide an achievable set of digital objectives

HCLTECH CONSULTING FRAMEWORK

The Consulting Framework is designed to identify the greatest impacts in the shortest amount of time



1. **MANAGE, PLAN & KICKOFF:**

   - Establish plan & resource requirements
   - Identify scope for strategy & roadmap
   - Define objectives & success factors

2. **ANALYSIS & BENCHMARK:**

   - Digital assessment & blueprint
   - Digital maturity assessment, gap & feasibility analysis
   - Technology, process and risk gap analysis
   - Establish guiding principles
   - Facilitate impact assessment
   - Platform/Technology selection
   - Confirm future-state requirements

3. **CHANGE & COMMITMENT:**

   - Program and change leadership
   - Executive commitment building
   - Knowledge transfer
   - Training development & delivery
   - Communications

4. **DISCOVERY:**

   - Conduct Executive Interviews & Visioning exercises

- Conduct workshops to identify high-level current state, requirements & areas of change
- Gather relevant metrics/KPIs of current state for baselining
- Explore target Functional & Technical solutions

5. RECOMMENDATIONS & ROADMAP:

- Present findings, recommendations, impacts and opportunities to key stakeholders
- Digital Strategic Alignment & Roadmap
- Recommendations and Architecture Blueprint
- Proof-of-concept/Prototype (not fully automated and scaled)
- Solution validation

Telecom Domain Centric Operations

- 5G Network planning & dimensioning
- End to End Business Process management
- Learning Efficiencies leading to Optimized Pyramid

Value Driven Engagement

- As IS Assessment to identify areas of improvement using HCL's solutions
- Shift left for early project execution and incident management
- Shared Services across Operation, Project Support, and Lab management
- Unified Program management

HCLTECH DIFFERENTIATORS

GLOBAL FOOTPRINT

- 20+ years of engineering R&D product development experience with 1500+ patents filed and Subject Matter Experts establishing thought leadership
- 1800+ Trained Practitioners : More than 500 trained on various 4G/5G and enabling technologies like Cloud/NFV, AL/ML
- Strategic Product Units and COEs to focus on developing niche products and IP development

PRODUCTS AND IPS

- Wireless Lan controller: Cloud based offering for management of multi-vendor/multi-technology access points (up to 802.11ax) including support for WiFi SON
- X-haul modem supporting microwave and mmWave bands for high capacity, low latency wireless backhaul/fronthaul needs for 5G
- iCE.X cloud enabled standards bases and extensible device management platform for IOT/5G

STRATEGIC RELATIONSHIPS

- Intel: For NFV hardware acceleration and 4G/5G products co-development and GTM
- Xilinx: Hardware platform for X-haul modem development and GTM
- Tier-1 networking OEM and CSPs as customers across multiple Geos

COMPREHENSIVE EXPERTISE

- Single-stop partner for expertise across various wireless and 5G enabling technologies including multi-technology radio access, 4G/5G core network, VAS, SDN/NFV, device management, validation, and certification
- Cloud Technologies: Containerization, Embedded Tech, Cloud /IoT Platforms, Microservices Development, Container orchestration, DevSecOps