# 5G: Accelerating Smart Aviation (Phase IV):

# Intent-driven Business Outcomes for Enterprises

**Catalyst Presentation**

**Catalyst id: C21.0.267**

September 2021

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# Flow

- Catalyst Champions’ Challenges & Context
- 5G Network Slide Design, Ordering & Closed Loop Automation
- Enterprise Controls LCM of 5G Slices & Charging Policies based on Business Intent
- Use Case 1 – Customer Loyalty in Case of Delay
- Use Case 2 – Connectivity Revenue Optimization
- TMF Artefacts & Proposed Contributions
- Summary

# 5G: Accelerating Smart Aviation (Phase IV): Intent-driven Business Outcomes for Enterprises

## Champions

BT

JT IoT

## Participants

mycomOSI

i2i Systems
innovation to integration

ORACLE

# The Challenge laid down by our Champions …

Milind Bhagwat

Principal Enterprise Architect

Platforms, Applications & Software

*"We are exploring how CSPs can offer enterprises configurable 5G connectivity together with the ability to express and modify the business intent that should govern such connectivity.*

*Using their own data and applications, enterprises need to be able to adjust the business intent, manifested perhaps as simple policy parameter changes, that then drives changes to the 5G connectivity for reasons of business optimization, customer experience, regulatory compliance, etc."*

# The Challenge laid down by our Champions …

David Traynor,
Head of Operations

JT IoT

*“Enterprises are seeking guaranteed connectivity services that they can fully control.*

*To capitalize on the 5G enterprise opportunity and to differentiate themselves from private network alternatives, CSPs must empower enterprises with cost-effective 5G propositions in concert with the appropriate level of control over such connectivity.*

*For enterprises it is their data, their applications, their employees and their regulators to whom they are accountable.”*

# A Message from the Aviation Industry

Stuart Birrell

Former CIO
London Heathrow Airport

Heathrow
Making every journey better

*“Service providers must take every measure to ensure the security of data travelling over their 5G (and earlier) networks and further must assure that data stays within agreed jurisdictions.*

*…*

*Perhaps the most important ingredient for success is simply imagination.*

*A massive change is ahead, and service providers have a great weapon in their hands with 5G. They just need the creativity and imagination to use it.”*

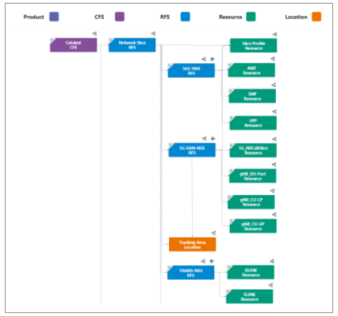
*Moving beyond connectivity with 5G: Lessons from the aviation industry, TMF Inform, 2020*

# Enabling CSPs to Offer Enterprises Differentiated 5G Service Experiences

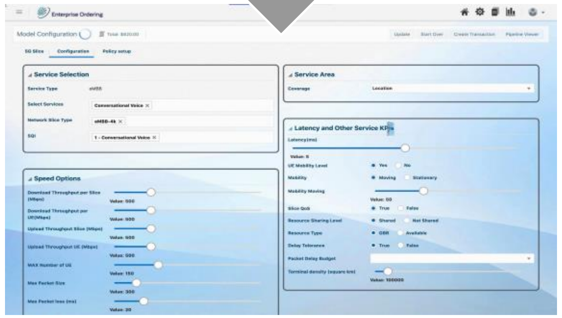
Focus of the catalyst this year

Enterprises

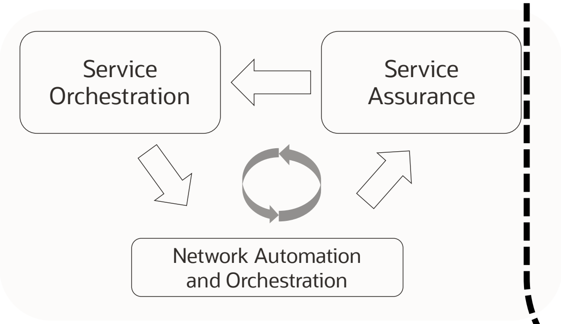
### 5G Network Slice Design



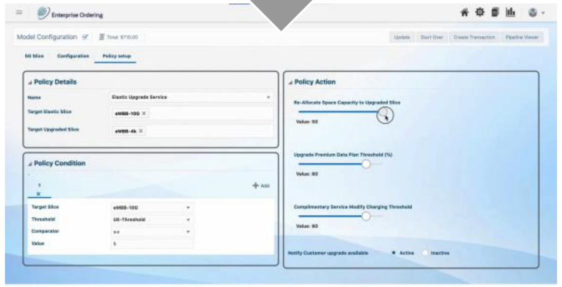
### Enterprise Ordering of 5G Network Slices



### Closed Loop Automation




### Enterprise Controls LCM of 5G Slices & Charging Policies based on Business Intent



CSPs offer 5G network slices to Enterprise customers

# 5G Network Slice Design

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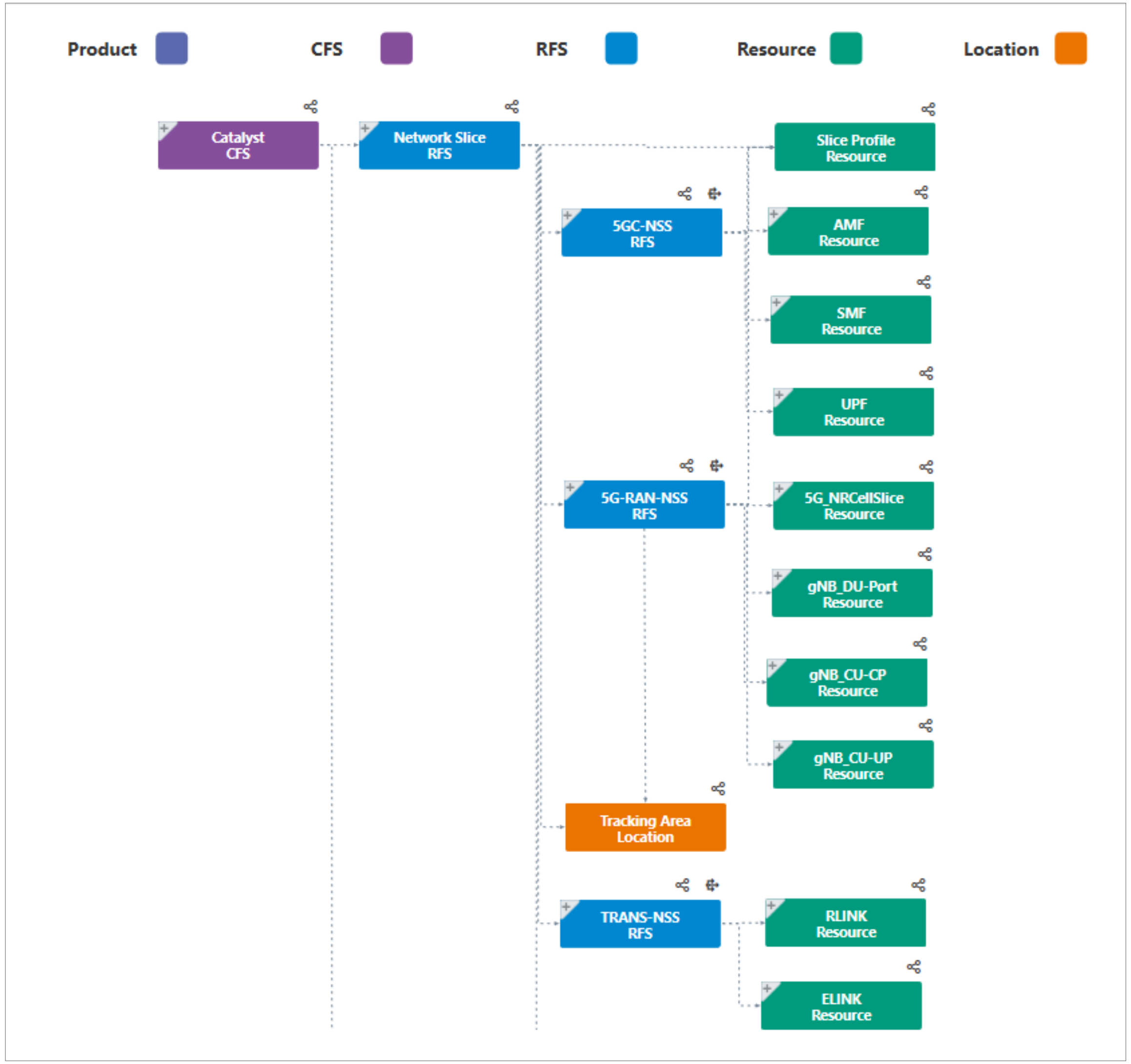
# Designing and Exposing Differentiated 5G services

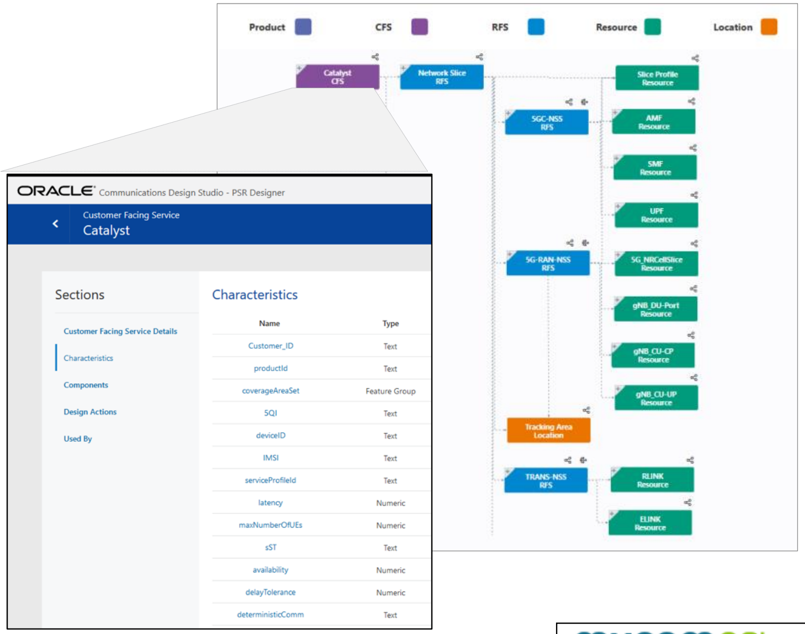
Hierarchical Information Model

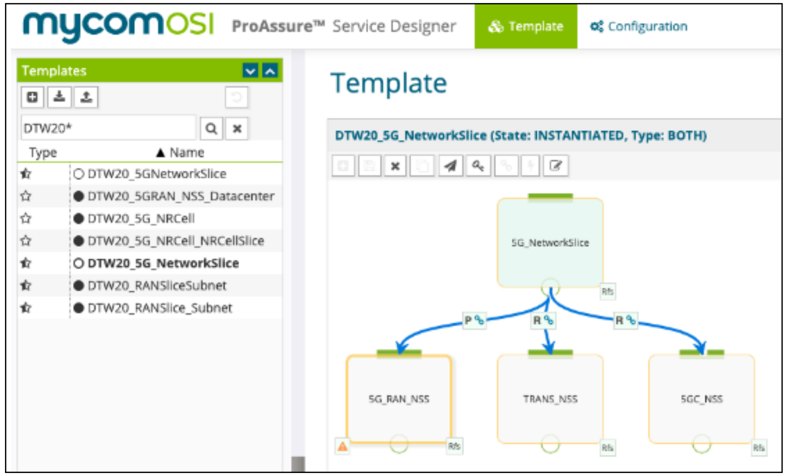
- Catalyst CFS
  - Represents overall service
- Slice RFS
  - Technical implementation
- Slice Subnet RFSes
  - Core Slice Subnets
  - RAN Slice Subnets
  - Transport Slice Subnets
- Resources
  - Slice Subnet VNF Components



# Designing and Exposing Differentiated 5G services

- Model Driven fully automated solution
- Exposing 5G Network Slice as a Service
- Service Orders create slice instances for business verticals
- Assurance of differentiated Services
- Dynamic 5G Charging based on user's actual experience



# Enterprise Ordering of 5G Network Slices

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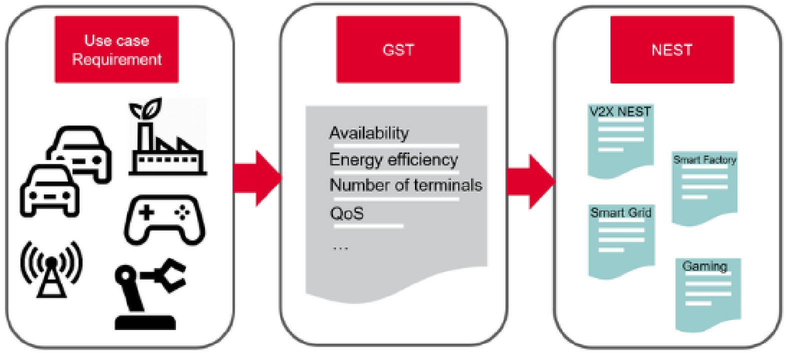
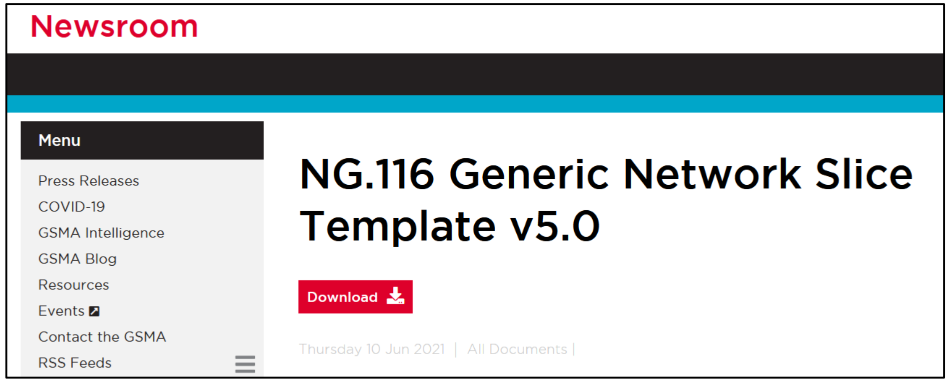
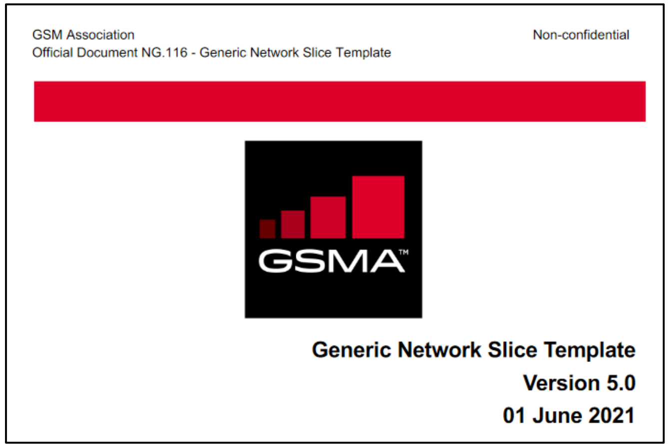
# Leveraging GSMA NEST / GST

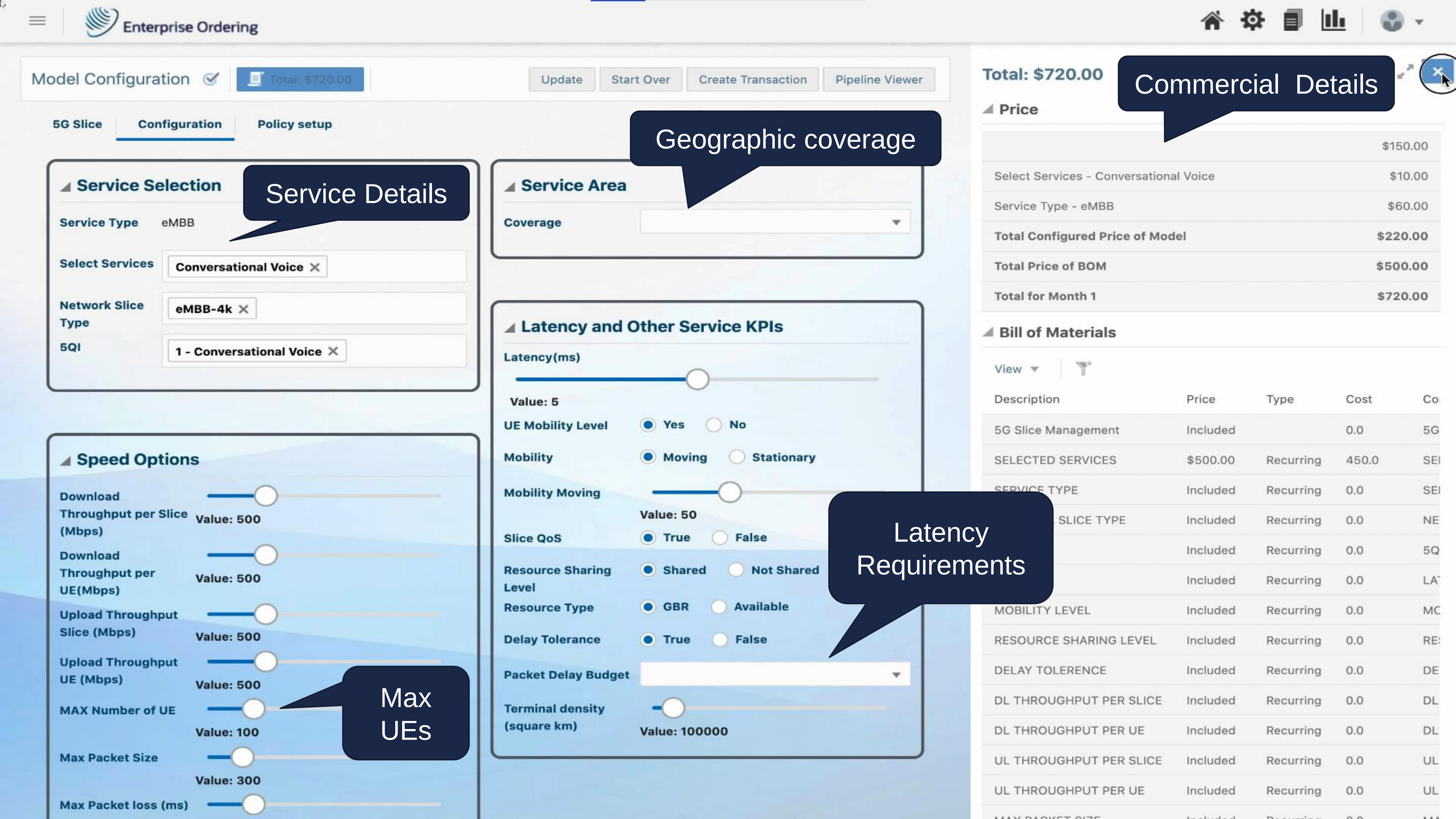
## Building Dedicated Logical Networks on a Shared Infrastructure

- The NEtwork Slice Type (*NEST*) is a *GST* filled with values. The values are assigned to express a given set of requirements to support a network slice customer

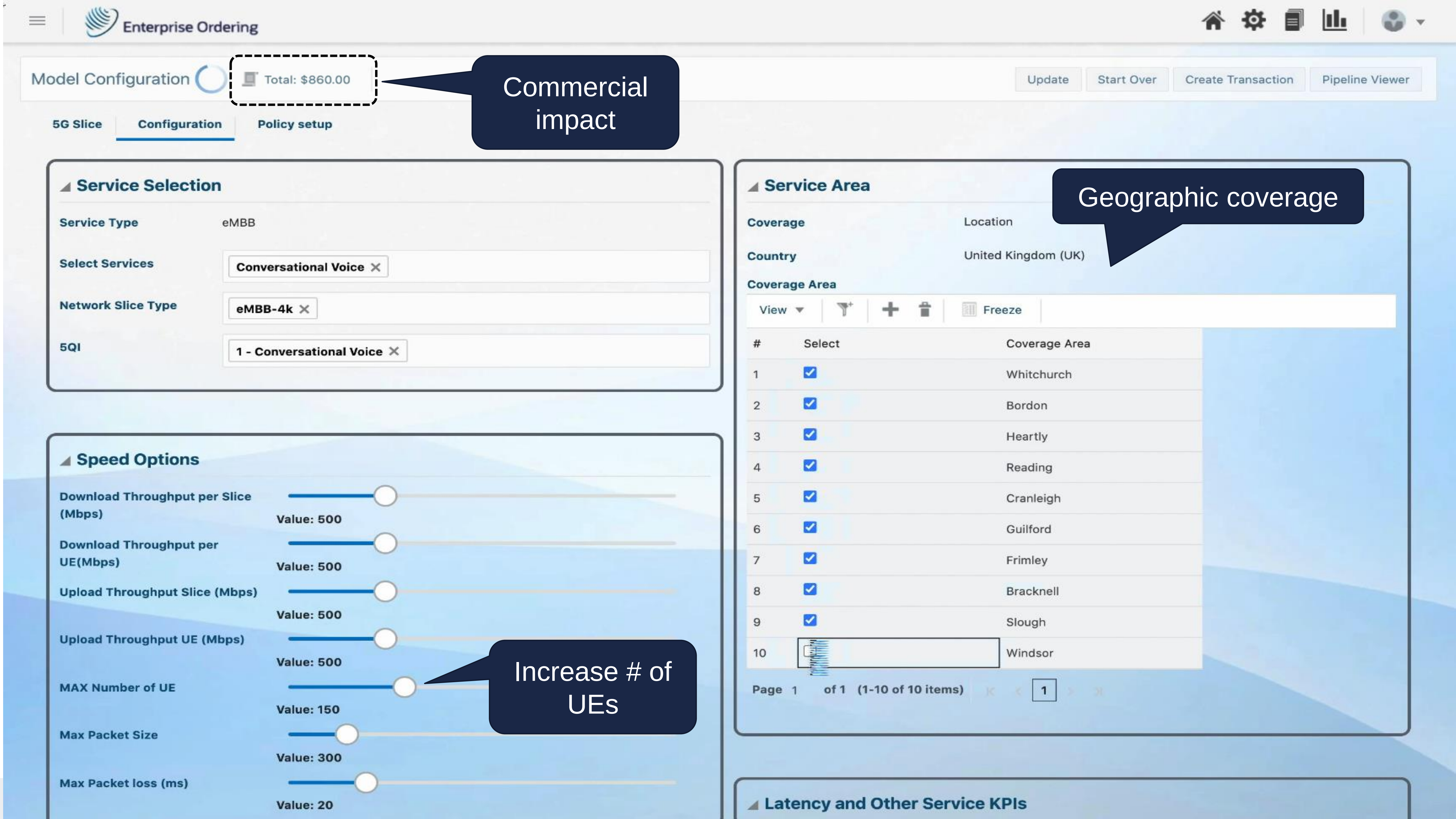




Enterprise Ordering
Model Configuration
Total: $720.00
Update
Start Over
Create Transaction
Pipeline Viewer
5G Slice
Configuration
Policy setup
Service Selection
Service Details
Service Type eMBB
Select Services Conversational Voice
Network Slice Type eMBB-4k
5QI 1 - Conversational Voice
Speed Options
Download Throughput per Slice (Mbps) Value: 500
Download Throughput per UE(Mbps) Value: 500
Upload Throughput Slice (Mbps) Value: 500
Upload Throughput UE (Mbps) Value: 500
MAX Number of UE Value: 100
Max UEs
Max Packet Size Value: 300
Max Packet loss (ms)
Geographic coverage
Service Area
Coverage
Latency and Other Service KPIs
Latency(ms)
Value: 5
UE Mobility Level Yes No
Mobility Moving Stationary
Mobility Moving
Value: 50
Slice QoS True False
Resource Sharing Level Shared Not Shared
Resource Type GBR Available
Delay Tolerance True False
Latency Requirements
Packet Delay Budget
Terminal density (square km)
Value: 100000
Total: $720.00
Commercial Details
Price
$150.00
Select Services - Conversational Voice $10.00
Service Type - eMBB $60.00
Total Configured Price of Model $220.00
Total Price of BOM $500.00
Total for Month 1 $720.00
Bill of Materials
View
Description Price Type Cost
5G Slice Management Included 0.0
SELECTED SERVICES $500.00 Recurring 450.0
SERVICE TYPE Included Recurring 0.0
SLICE TYPE Included Recurring 0.0
Included Recurring 0.0
Included Recurring 0.0
MOBILITY LEVEL Included Recurring 0.0
RESOURCE SHARING LEVEL Included Recurring 0.0
DELAY TOLERENCE Included Recurring 0.0
DL THROUGHPUT PER SLICE Included Recurring 0.0
DL THROUGHPUT PER UE Included Recurring 0.0
UL THROUGHPUT PER SLICE Included Recurring 0.0
UL THROUGHPUT PER UE Included Recurring 0.0



Enterprise Ordering
Model Configuration
Total: $860.00
Commercial impact
Update
Start Over
Create Transaction
Pipeline Viewer
5G Slice
Configuration
Policy setup
Service Selection
Service Type
eMBB
Select Services
Conversational Voice
Network Slice Type
eMBB-4k
5QI
1 - Conversational Voice
Speed Options
Download Throughput per Slice (Mbps)
Value: 500
Download Throughput per UE(Mbps)
Value: 500
Upload Throughput Slice (Mbps)
Value: 500
Upload Throughput UE (Mbps)
Value: 500
MAX Number of UE
Value: 150
Increase # of UEs
Max Packet Size
Value: 300
Max Packet loss (ms)
Value: 20
Service Area
Geographic coverage
Coverage
Location
Country
United Kingdom (UK)
Coverage Area
View
Freeze
# Select Coverage Area
1 Whitchurch
2 Bordon
3 Heartly
4 Reading
5 Cranleigh
6 Guilford
7 Frimley
8 Bracknell
9 Slough
10 Windsor
Page 1 of 1 (1-10 of 10 items)
1
Latency and Other Service KPIs

## Create Enterprise Order for 5G Network Slice

# Transaction

Actions

Transaction Details | Customer Details | Approvals | Order Tasks

**Transaction Info**

| | |
|---|---|
| Transaction Name | 09/15 |
| Transaction ID | CPQ-928 |
| Created Date | 15/09/2021 |
| Revision Number | 1 |
| Buy Side ID | 40937614 |
| Last Updated | 15/09/2021 06:56 |
| Last Updated By | Dhaivat Vyas |
| Order Type | |
| Order Console Visible? | |

**Prepared By**

| | |
|---|---|
| Name | Dhaivat Vyas |
| Title | |
| Office | |
| Mobile | |
| Email | vikas.tyagi@oracle.com |
| Default Request Date | 15/09/2021 |
| Price Score | 9 |
| Opportunity Number | |

Show Columns: Contract Details, Discount, Pricing, Sites, Manager View, Assets Action, Other, Pricing Analysis

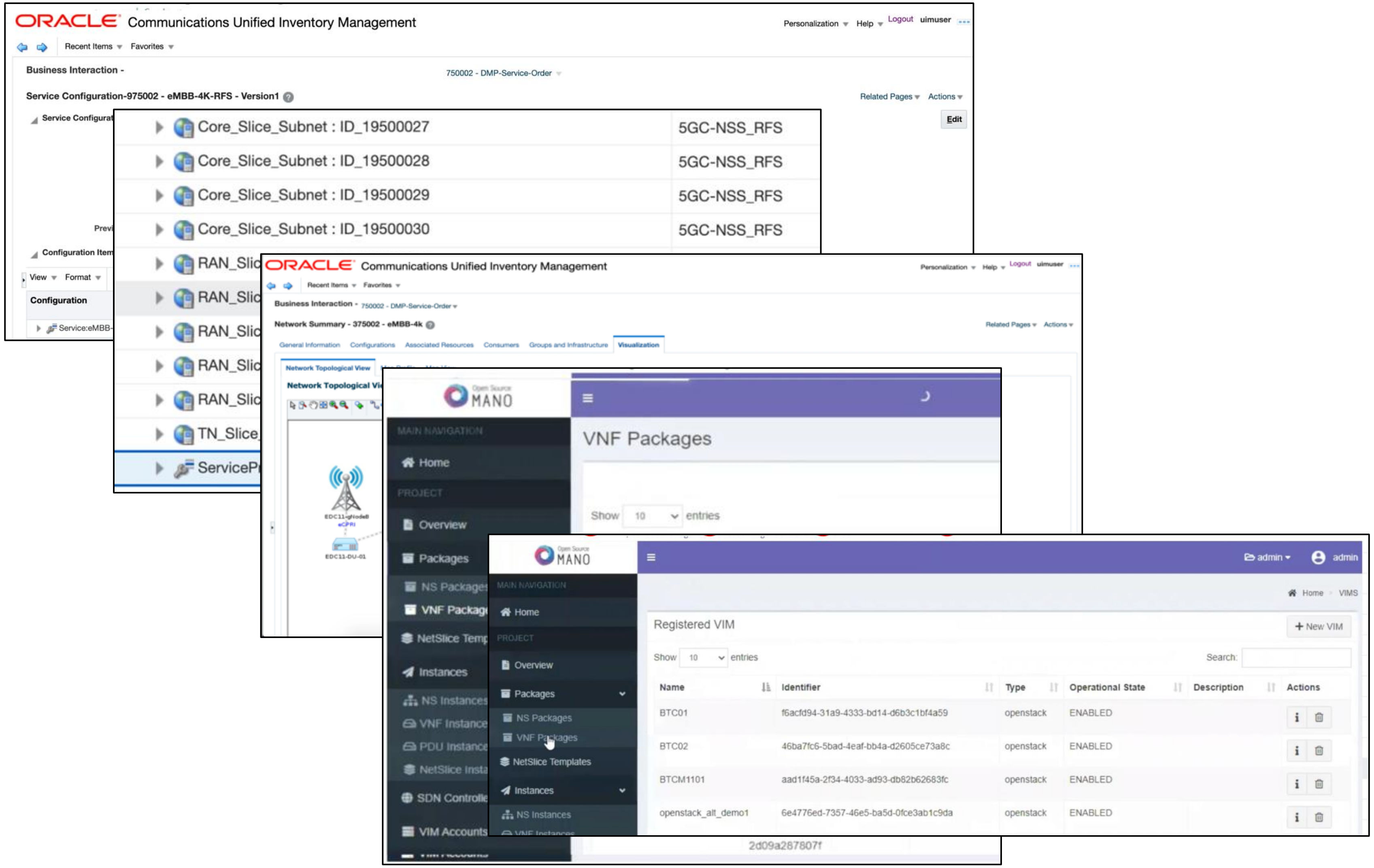
**Line Item Information**

View | Freeze

| Part Number | Description | Currency | Q... | Action | Family | Price (... | Max. Mgr. Disc. | Pric... | Service Id | Fulfillment St... | Annual Value | Contrac |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5G Slice Management | USD | 1 | Add | | | | | abo_c08d5926-87b | Created | | |
| SELECTED SERVICES | SELECTED SERVICI | USD | 1 | Add | Operation | $500.00 | 25.00 | Recurrir | abo_e367c228-4d8 | | | |
| SERVICE TYPE | SERVICE TYPE | USD | 1 | Add | Operation | $0.00 | 25.00 | Recurrir | abo_d9467b86-fbfd | | | |
| NETWORK SLICE TYPE | NETWORK SLICE T | USD | 1 | Add | Operation | $0.00 | 25.00 | Recurrir | abo_7060cae8-7f8a | | | |
| 5QI | 5QI | USD | 1 | Add | Operation | $0.00 | 25.00 | Recurrir | abo_1921dfc9-cd32- | | | |
| LATENCY | LATENCY | USD | 1 | Add | Operation | $0.00 | 25.00 | Recurrir | abo_12359d54-4e0 | | | |

# Orchestrating 5G Network Slice Services

- BSS or Closed Loop: Initiates Service Orders
- Service Orders: Initiate automated Slice Design
- Inventory: Manages Life cycle of the Slice and subnets
    - Synchronizes service topology with ETSI & Assurance
- Orchestration: Directs ETSI MANO to configure virtual network functions



# Closed Loop Automation

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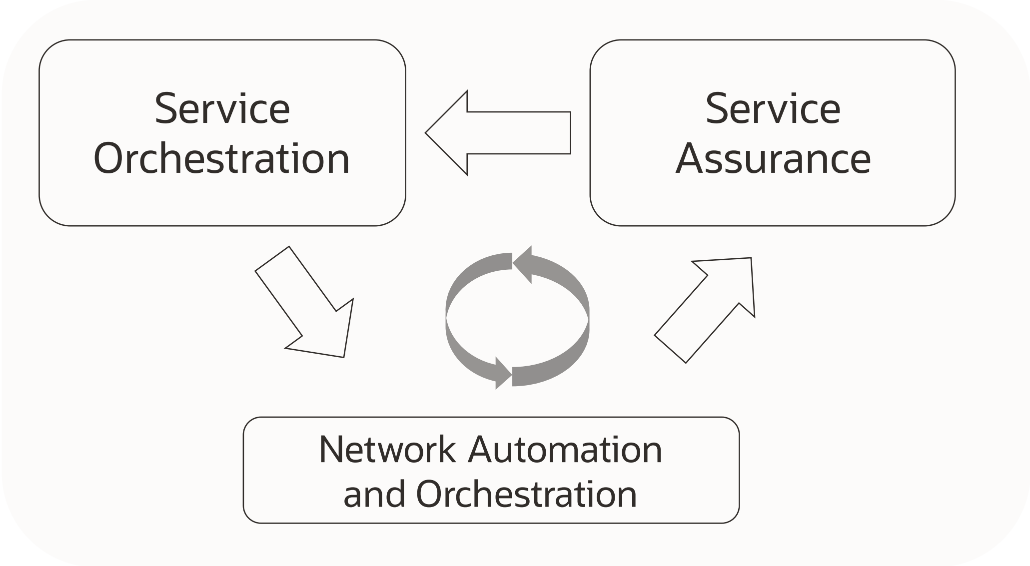
# Closed Loop Automation

- Predictive Closed Loop Orchestration to guarantee SLAs and optimize network resources according to the industry intent
- AI-based predictive assurance triggering remediation automation loops
- Traffic congestion – address through
  - Tactical loop – prescriptive resource re-allocation recommendation
  - Strategic loop – recommends service modification based on business intent



# Enterprise Controls LCM of 5G Slices & Charging Policies based on Business Intent

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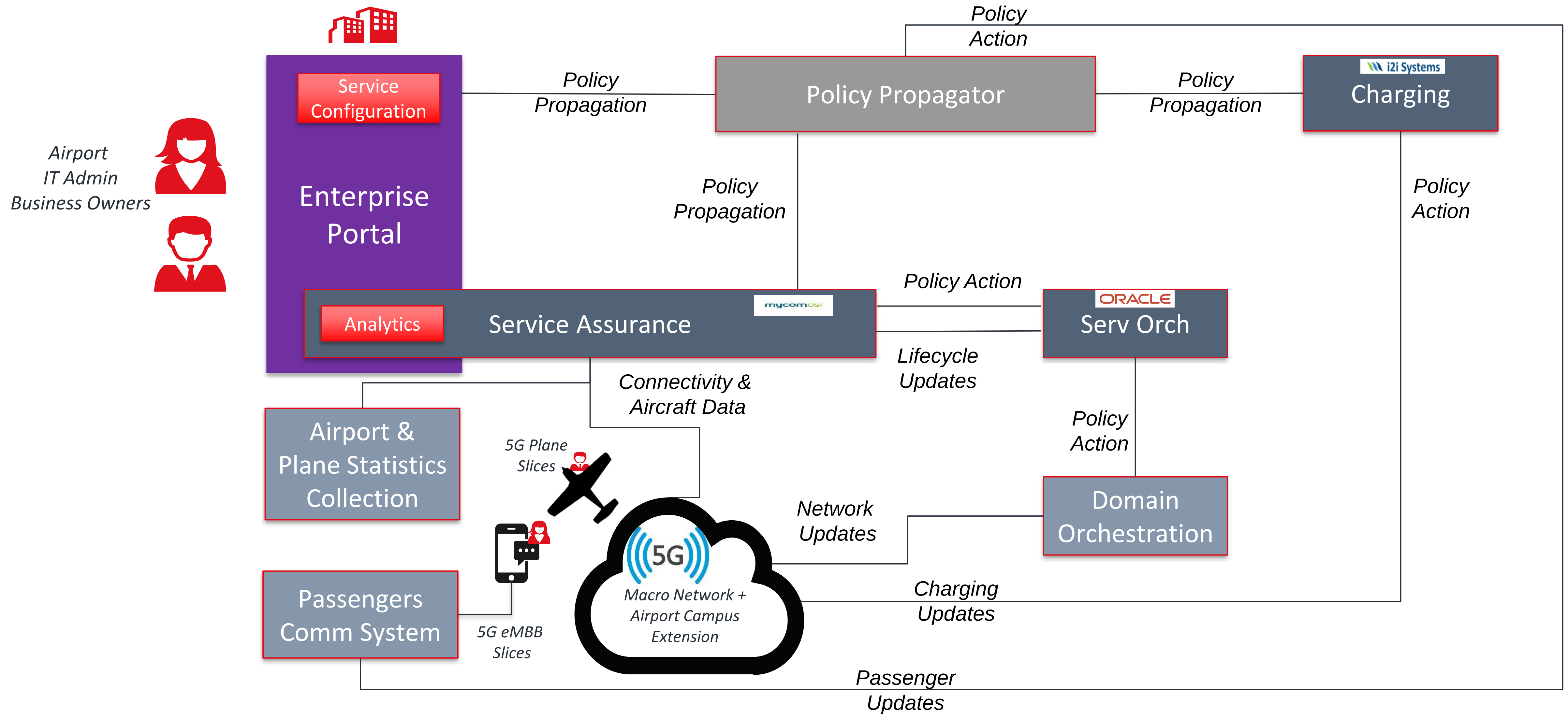
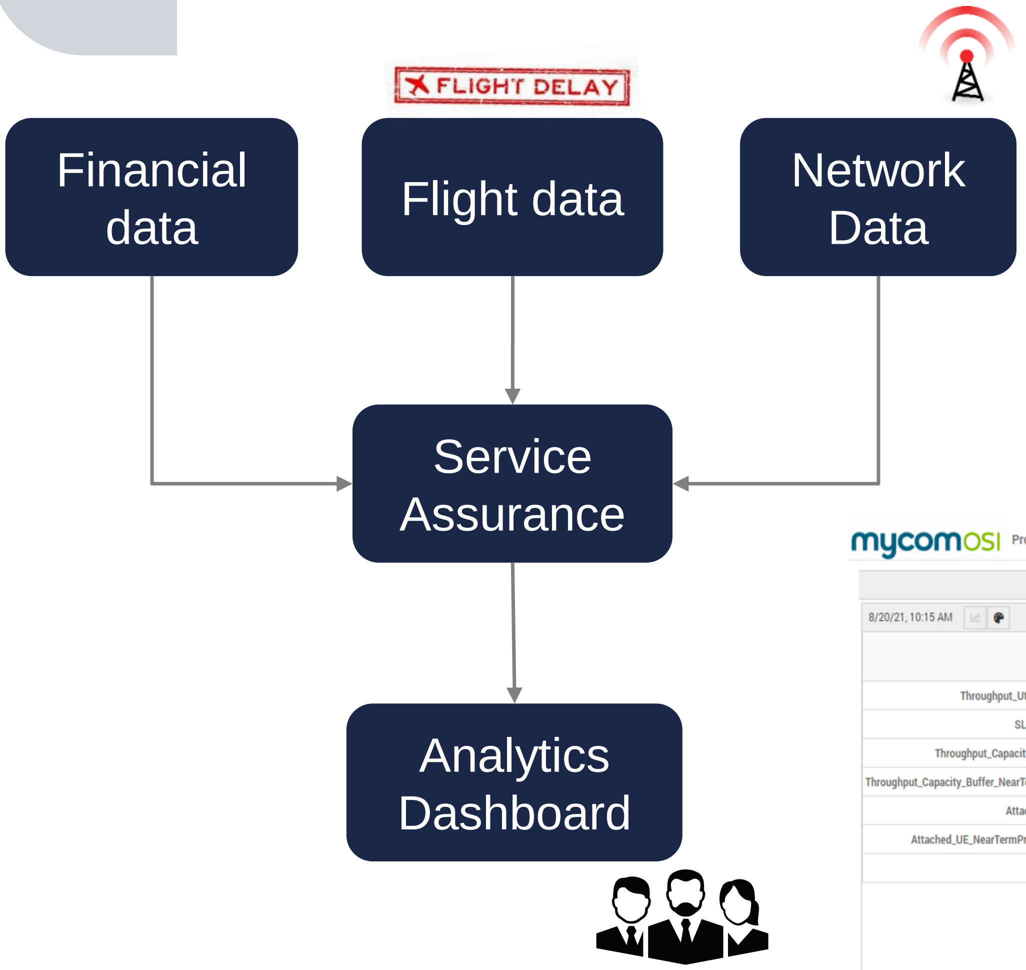
# Enterprise Controls LCM of 5G Slices & Charging Policies based on Business Intent: Key Catalyst Use Cases

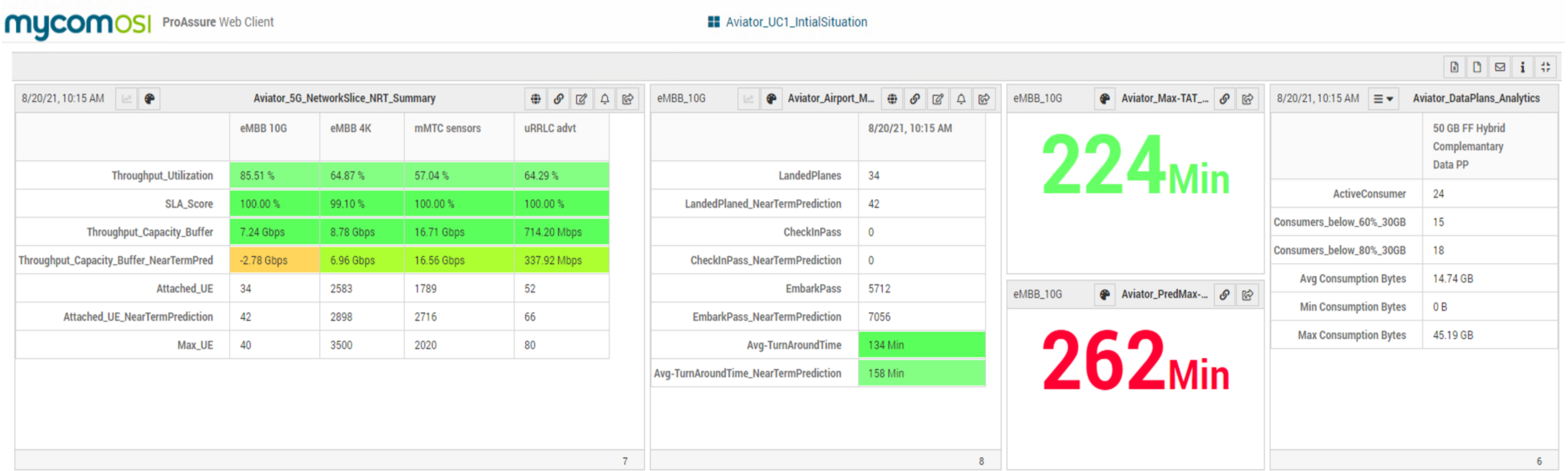
| UC # | Use Case | Airport Business Objective | Airport Business Owner |
|---|---|---|---|
| 1. | Customer Loyalty in Case of Delay | An airport / airline rewards the loyalty of delayed VIP passengers by explicitly adjusting / enhancing their 5G communications experience | VP Passenger Journey, VP Passenger Experience, etc. |
| 2. | Connectivity Revenue Optimization | An airport optimizes revenues and profitability through the network traffic analysis driving the safe and automatic rebalancing of 5G connectivity to slices supporting revenue generating services versus ones supporting internal operations | VP Business Development, VP Commercial Operations, etc. |

# Solution Architecture



# UC1: Customer Loyalty in Case of Delay: Analytics Flow



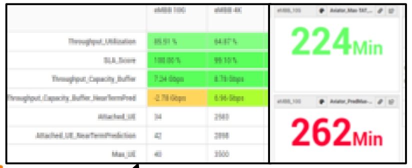

| | eMBB 10G | eMBB 4K | mMTC sensors | uRRLC advt |
|---|---|---|---|---|
| Throughput_Utilization | 85.51 % | 64.87 % | 57.04 % | 64.29 % |
| SLA_Score | 100.00 % | 99.10 % | 100.00 % | 100.00 % |
| Throughput_Capacity_Buffer | 7.24 Gbps | 8.78 Gbps | 16.71 Gbps | 714.20 Mbps |
| Throughput_Capacity_Buffer_NearTermPred | -2.78 Gbps | 6.96 Gbps | 16.56 Gbps | 337.92 Mbps |
| Attached_UE | 34 | 2583 | 1789 | 52 |
| Attached_UE_NearTermPrediction | 42 | 2898 | 2716 | 66 |
| Max_UE | 40 | 3500 | 2020 | 80 |

| | 8/20/21, 10:15 AM |
|---|---|
| LandedPlanes | 34 |
| LandedPlaned_NearTermPrediction | 42 |
| CheckInPass | 0 |
| CheckInPass_NearTermPrediction | 0 |
| EmbarkPass | 5712 |
| EmbarkPass_NearTermPrediction | 7056 |
| Avg-TurnAroundTime | 134 Min |
| Avg-TurnAroundTime_NearTermPrediction | 158 Min |

| | 50 GB FF Hybrid Complemantary Data PP |
|---|---|
| ActiveConsumer | 24 |
| Consumers_below_60%_30GB | 15 |
| Consumers_below_80%_30GB | 18 |
| Avg Consumption Bytes | 14.74 GB |
| Min Consumption Bytes | 0 B |
| Max Consumption Bytes | 45.19 GB |

# UC1: Customer Loyalty in Case of Delay: Policy Propagation Flow

Analytics Dashboard



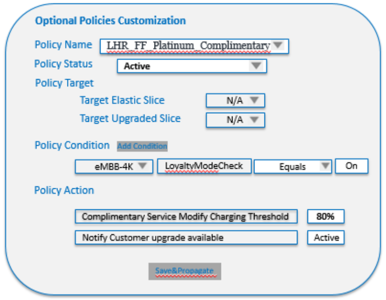

Enterprise Portal

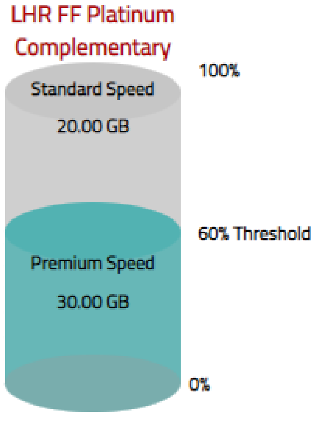
Policy Propagator

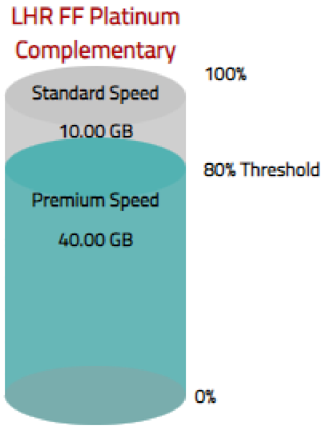
Charging Function

Passenger Comm System

Manual Policy Execution



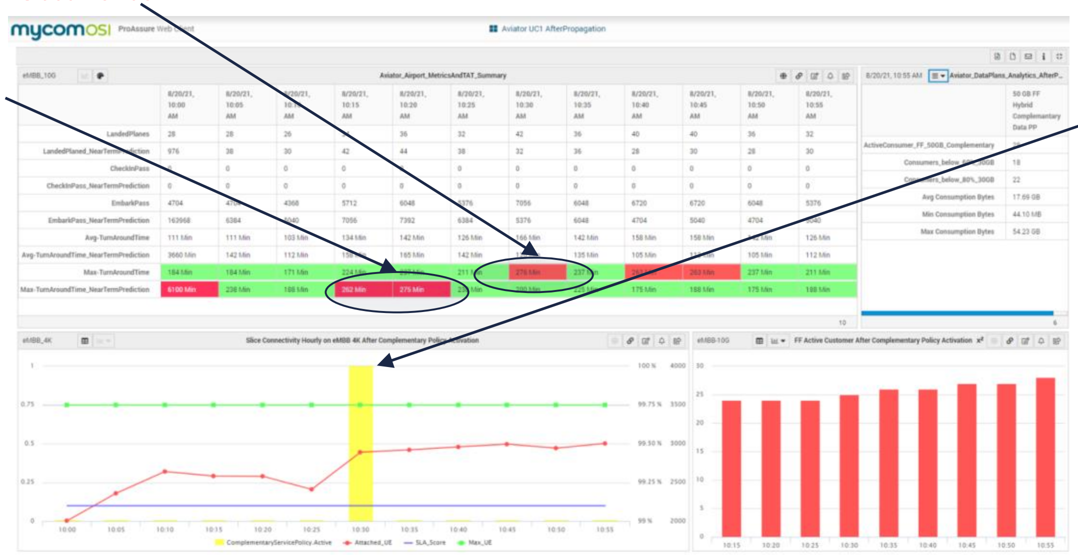



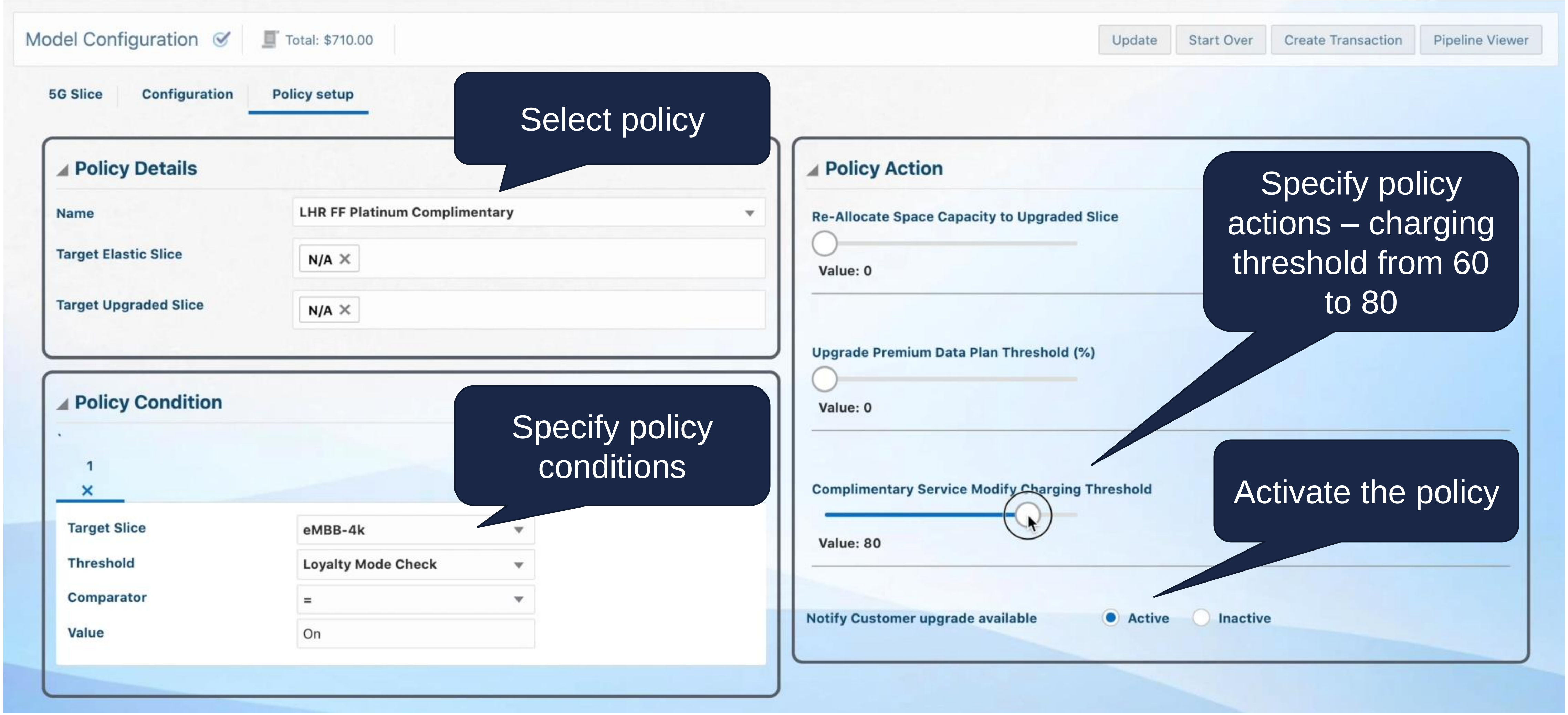

Flight Delay Occurrence

Flight Delay Prediction

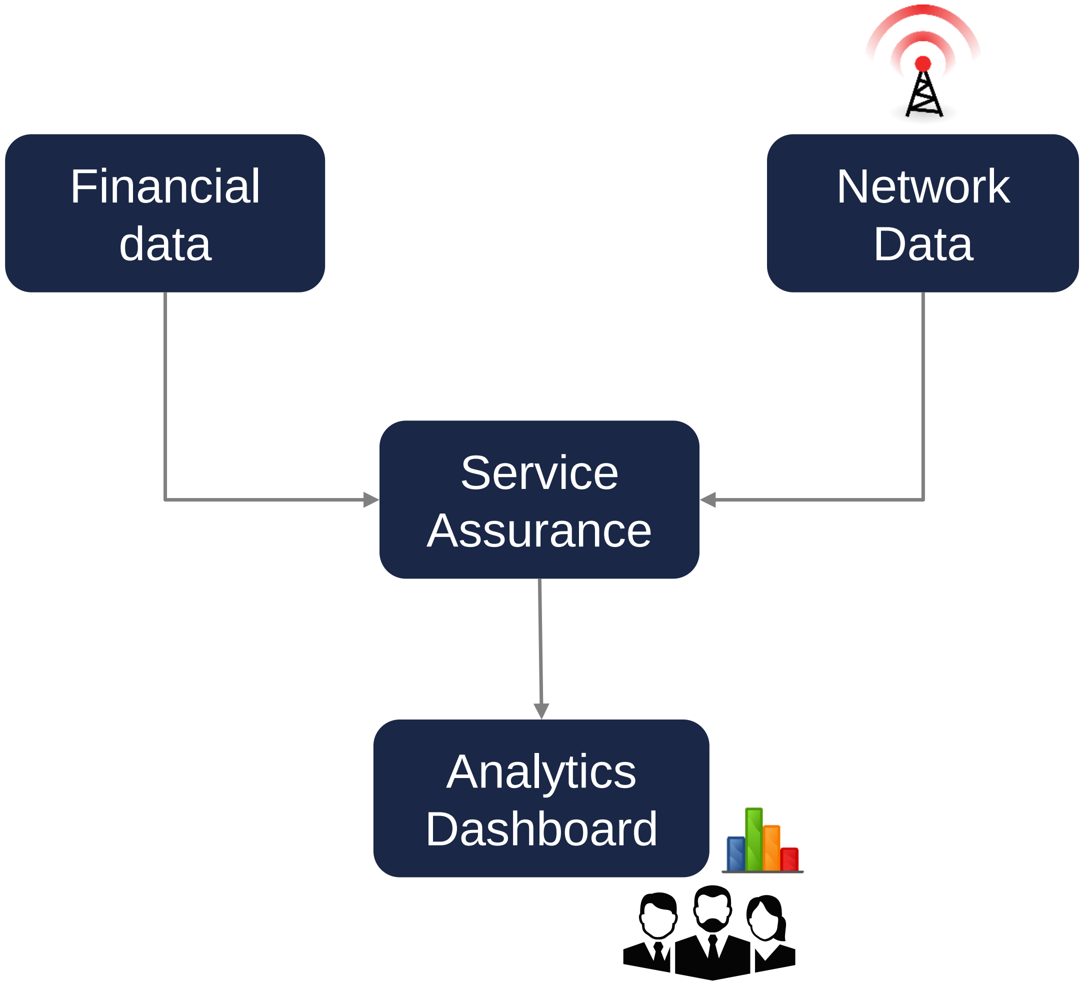
Policy Execution (Activation)

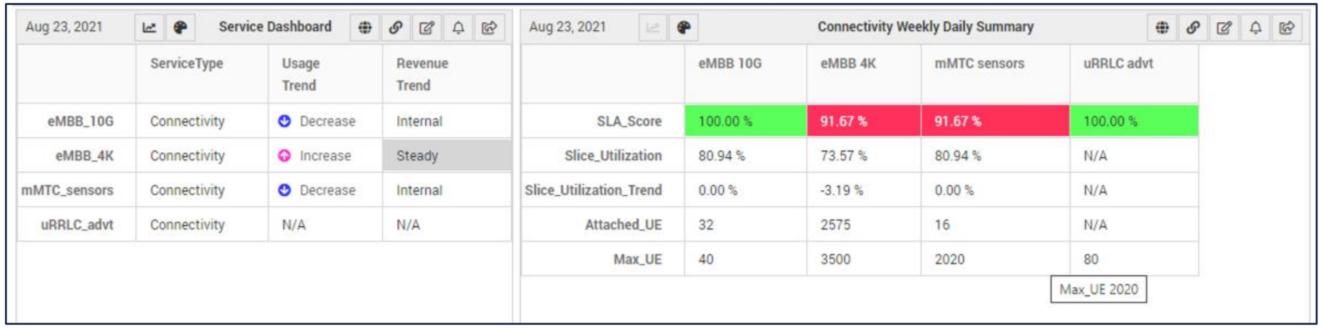


# UC1: Updating Business Intent through change in Policy Parameter



# UC2: Connectivity Revenue Optimization: Analytics Flow

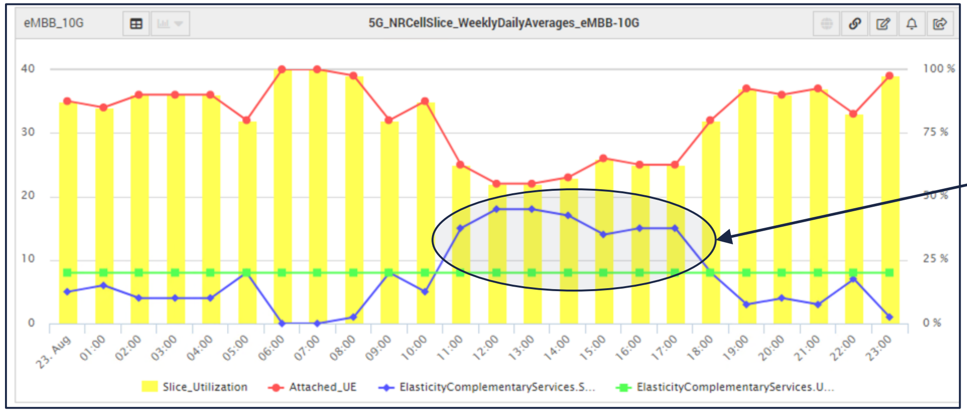


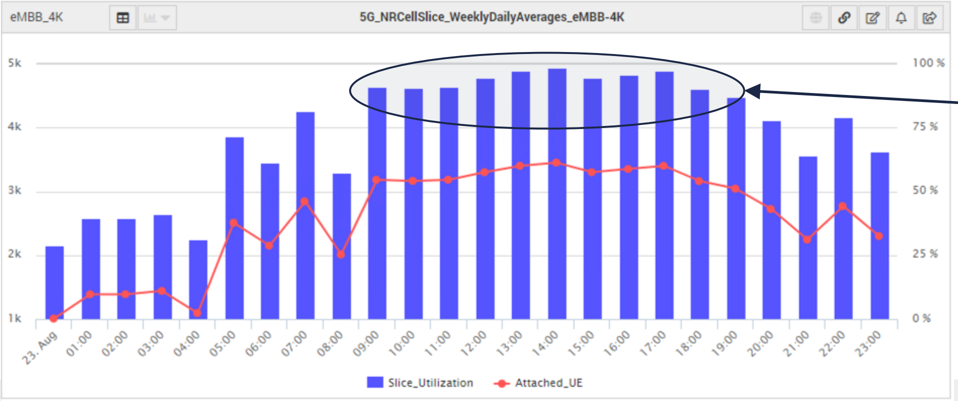
| Aug 23, 2021 | Service Dashboard | | |
|---|---|---|---|
| | ServiceType | Usage Trend | Revenue Trend |
| eMBB_10G | Connectivity | Decrease | Internal |
| eMBB_4K | Connectivity | Increase | Steady |
| mMTC_sensors | Connectivity | Decrease | Internal |
| uRRLC_advt | Connectivity | N/A | N/A |

| Aug 23, 2021 | Connectivity Weekly Daily Summary | | | |
|---|---|---|---|---|
| | eMBB 10G | eMBB 4K | mMTC sensors | uRRLC advt |
| SLA_Score | 100.00 % | 91.67 % | 91.67 % | 100.00 % |
| Slice_Utilization | 80.94 % | 73.57 % | 80.94 % | N/A |
| Slice_Utilization_Trend | 0.00 % | -3.19 % | 0.00 % | N/A |
| Attached_UE | 32 | 2575 | 16 | N/A |
| Max_UE | 40 | 3500 | 2020 | 80 |

Max_UE 2020




Elasticity Opportunity on 10G Slice




Maxed-out Utilization on 4K

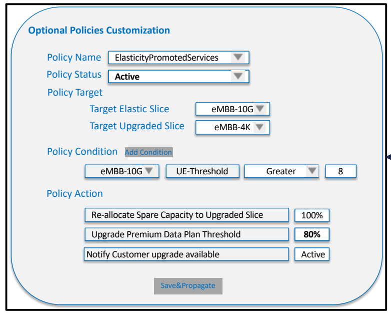
# UC2: Connectivity Revenue Optimization: Policy Propagation Flow

Analytics Dashboard

Aug 23, 2021 — Connectivity Analytics Elasticity Policy Report

| | eMBB 10G | eMBB 4K |
|---|---|---|
| ElasticityComplementaryServices.PolicyStatus | Inactive | Not Applicable |
| ElasticityComplementaryServices.SpareUE-Capacity | 8 | 925 |
| ElasticityComplementaryServices.UE-Threshold | 8 | N/A |
| ElasticityComplementaryServices.HourlyTrigger | N/A | N/A |
| ElasticityComplementaryServices.Extended-4K-MaxUE | N/A | 4000 |

Update Policy Definition (Activation Status + Threshold)




Enterprise Portal

Policy Propagator

Charging Function

Passenger Comm System

Elasticity Promote Services Policy Execution Towards Charging/Users

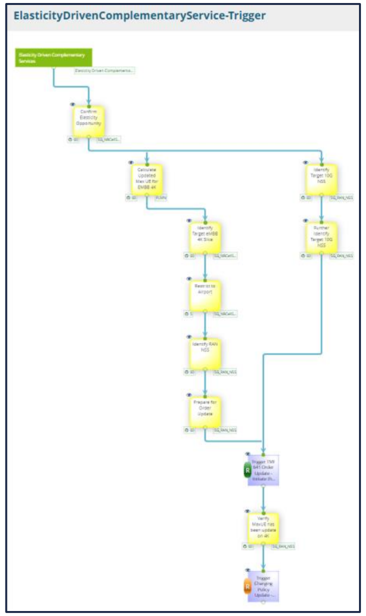
Assurance Function

Elasticity Promote Services Policy Definition including Elasticity Thresholds

Orchestration Function

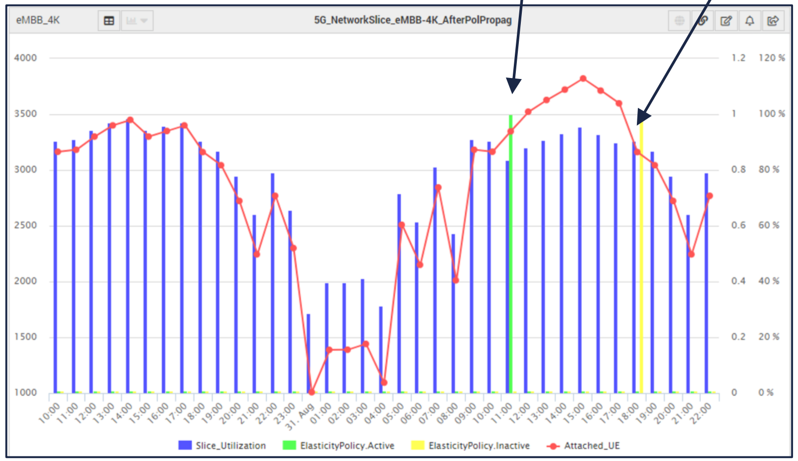
Elasticity Promote Services Policy Execution Towards Orchestration

Assurance Elasticity Workflow




Policy Execution (Activation)

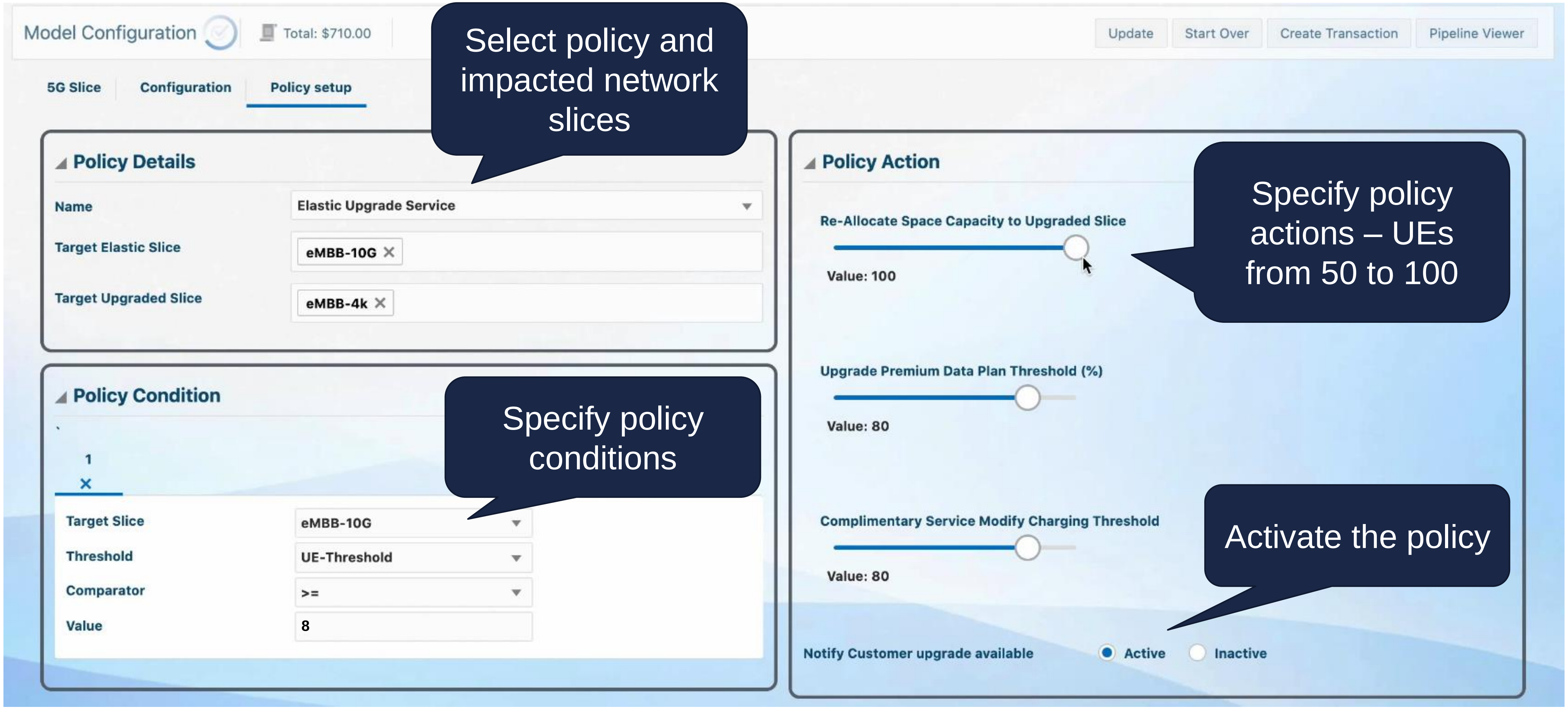
Policy Execution (De-activation)




Aug 31, 2021 — Aviator_ServiceDashboard_After

| | ServiceType | Usage Trend | Revenue Trend |
|---|---|---|---|
| eMBB_10G | Connectivity | Decrease | Internal |
| eMBB_4K | Connectivity | Increase | Increase |
| mMTC_sensors | Connectivity | Decrease | Internal |

# UC2: Updating Business Intent through change in Policy Parameter



# TMF Artefacts & Proposed Contributions

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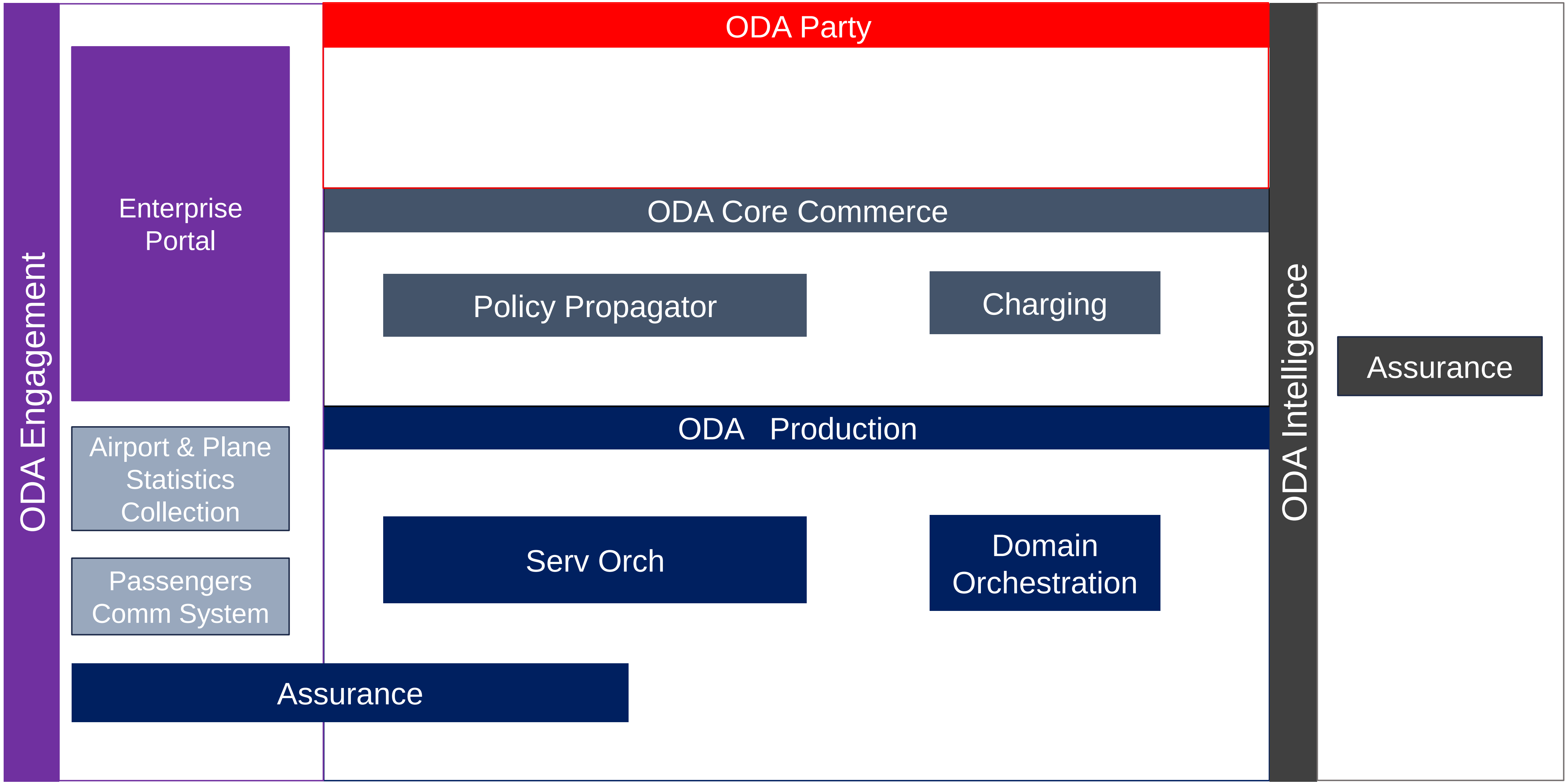
# Catalyst Context in ODA

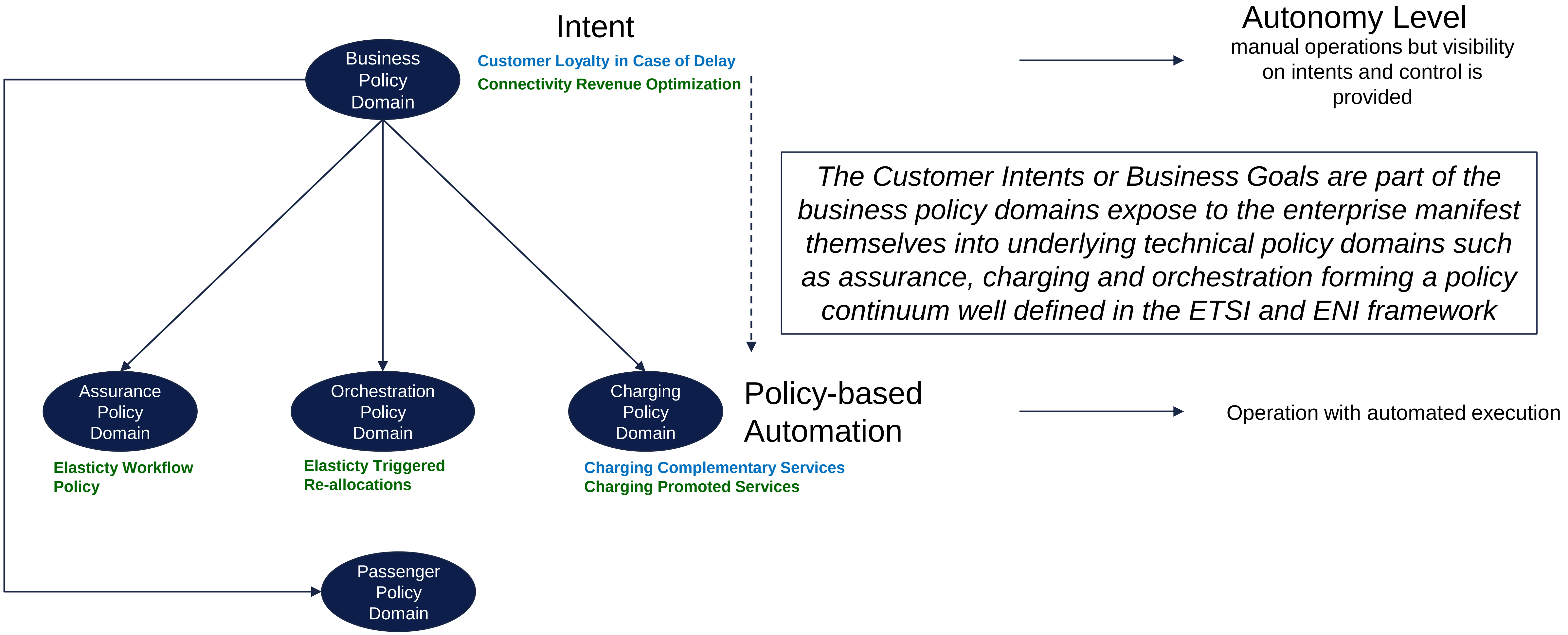


# Leveraged and Extended APIs

| SDO / API ID | API Name | DTWS 20 Use Case Usage | DTWS 21 Use Case Usage | New CR /Contribution |
|---|---|---|---|---|
| TM Forum Open API 641 | Service Ordering API | UC1 / UC2 / UC4 (CR) | UC2 | |
| TM Forum Open API 633 | Service Catalog API | UC1 | | |
| ETSI SOL-5 NSD API | Network Slice Descriptor Management | UC1 | UC2 | |
| TM Forum Open API 638 | Service Inventory API | UC2 | UC2 | |
| TM Forum Open API 635 | Usage Management API | UC3 (CR) | | |
| TM Forum Open API 628 | Performance Management Collection | UC3 | | |
| TM Forum Open API 664 | Resource Fulfilment API | UC4 (CR) | | |
| ETSI SOL-5 NS LCM API | Network Slice Lifecycle Management | UC 4 | | |
| New TM Forum Proposed Policy API | Policy Information & Events Exchange | | UC1 / UC2 | X |

Catalyst contribution: Propesed new TMF Open API for policy management and propagation

# Aviator & TMF Autonomous Framework

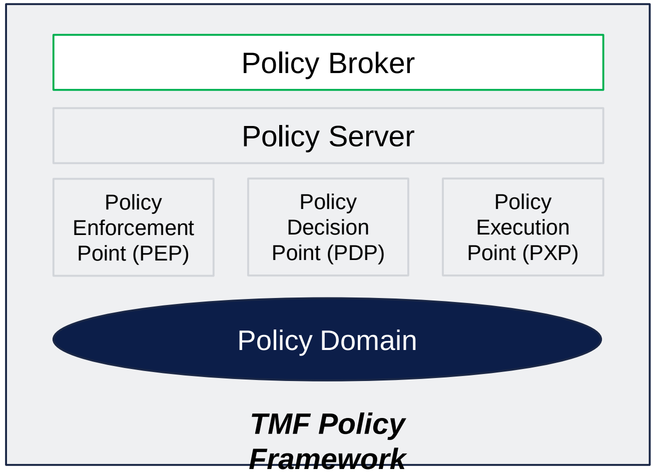


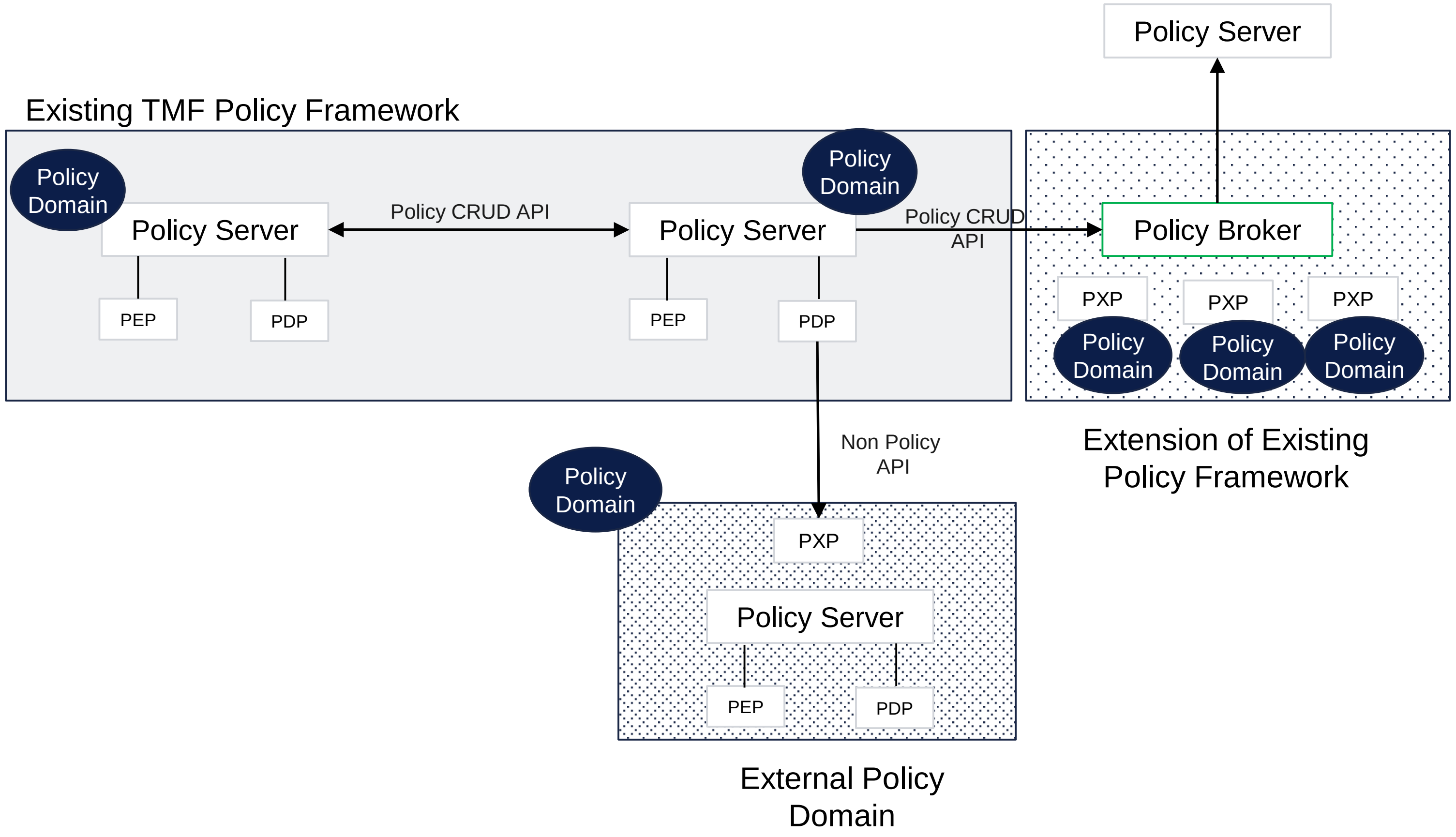

*The Customer Intents or Business Goals are part of the business policy domains expose to the enterprise manifest themselves into underlying technical policy domains such as assurance, charging and orchestration forming a policy continuum well defined in the ETSI and ENI framework*

# Proposed Contributions to TMF Standards

- The existing TMF TIP Policy Information Exchange SOAP APIs implement the key policy continuum notion expressed above: it is proposed to evolve to Open API modern REST profile with defined example of calls + we believe new requirements for policy triggering through a policy broker are necessary
- The Intent based Approach as defined in the TMF Autonomous Framework assumed adoption of AI/ML based autonomy where we believe policy rules-based automation will still exist for some time to come and actually be an intermediary step towards adopting automation approached while creating trust and visibility on the rules in a human readable and controllable fashion. This being said the policy-based approach mentioned above and the Intent Handling need to be consolidated, their co-existence, synergy and overlap needs to be defined
- We see multiple domain-specific APIs being defined such as the TMF 649, TMF 657, TMF 623 for setting Threshold, SLO or SLAs monitoring setting-up specialized policies on monitoring systems. The industry could benefit from using a single multi-context, polymorphic API increasing chances of interoperability and overall cost of implementation

# Overall policy design: Framework, entities & APIs



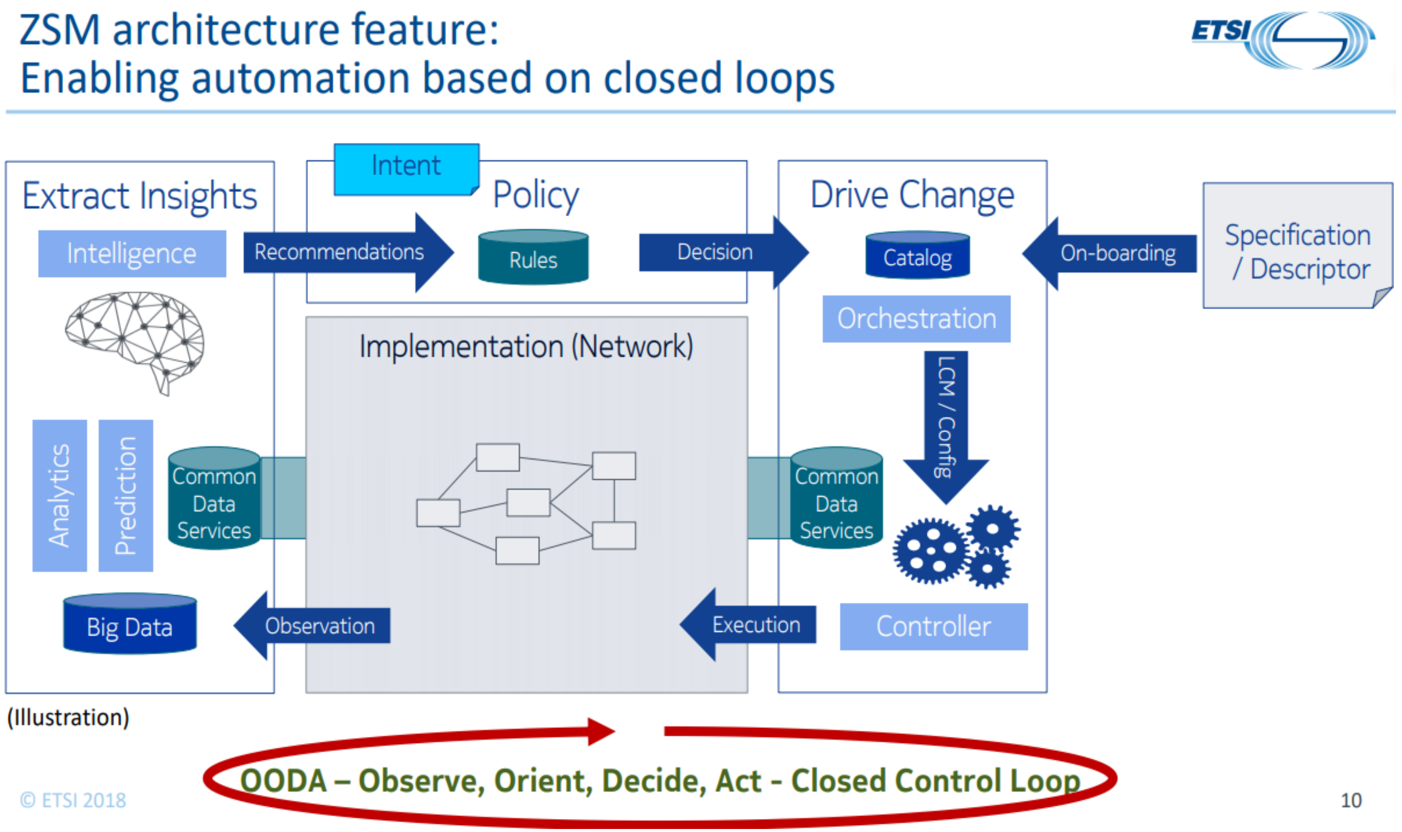

- Polity Entities
  - Policy Enforcement Point (PEP)
  - Policy Decision Point (PDP)
  - Policy Execution Point (PXP)

- The existing TMF TIP Policy Information Exchange SOAP APIs implement the key policy continuum notion expressed above: it is proposed to evolve to Open API modern REST profile with defined example of calls + we believe new requirements for policy triggering through a policy broker are necessary

# SDO Context: Aviator & ETSI ZSM

Other policy frameworks are very much targeted to network behaviour and not as much on the management systems …

ZSM: Definition of Autonomous domains and service layer having their own independent assurance stack decomposed in collection, analytics, intelligence, orchestration layer



# SDO Context: ETSI ENI & Policy Management

#### 4.5.3.4.4 Policy Management Functional Block

The purpose of the Policy Management Functional Block is to provide decisions to ensure that the system goals and objectives are met (see clause 6.3.9 for more information on how decisions are made). Policies are used to provide scalable and consistent decision-making. Policies are generated from data and information received by the Knowledge Management and Processing set of Functional Blocks. Formally, according to [i.4], the definition of policy is:

> *"Policy is a set of rules that is used to manage and control the changing and/or maintaining of the state of one or more managed objects",* see [i.17], [7] and [8].

Policies may be used in several ways in ENI:

- Policies are defined by ENI for managing, monitoring, controlling, and orchestrating behaviour of Functional Blocks in the Assisted System.
- Policies are defined by ENI to request changes in the Assisted System (e.g. for monitoring a new output).
- Policies that are input to ENI by an external entity (e.g. end-user or application) are subject to verification by ENI (e.g. they need to pass a parsing or compilation stage with no errors or warnings produced).

In each case, policies may represent goals, recommendations, or commands. Typically, any information to be conveyed to the Assisted System or its Designated Entity take the form of a set of policies. Each set of policies may be made up of one or more imperative, declarative, and/or intent policy. The details of policy definition, generation, and processing are defined in clause 6.3.9.

#### 6.3.9.3 Function of the Policy Management Functional Block

As described in [i.17] and [i.2], there are three different types of policies that are defined for an ENI System:

**Imperative policy:** a type of policy that uses statements to explicitly change the state of a set of targeted objects. Hence, the order of statements that make up the policy is explicitly defined. An example of an imperative policy, using informal English, is:

*WHEN an Alarm is received*
*IF the severity of the Alarm is Critical*
*THEN execute the CriticalAlarm Policy*

In the present document, Imperative Policy will refer to policies that are made up of Event, Condition, and Action clauses.

**Declarative policy:** a type of policy that uses statements to describe a set of computations that need to be done without defining how to execute those computations. Hence, state is not explicitly manipulated, and the order of statements that make up the policy is irrelevant. An example of a declarative policy, using First Order Logic, is:

$\exists x \exists y\ (Customer(x) \wedge SLA(y) \wedge have(x, y))$

The English equivalent is:

*Some Customers have an SLA*

In the present document, Declarative Policy will refer to policies that execute as theories of a formal logic. The syntax of a declarative policy typically uses some type of first order logic.

**Intent policy:** a type of policy that uses statements from a restricted natural language to express the goals of the policy, but not how to accomplish those goals. In particular, formal logic syntax is not used. Therefore, each statement in an Intent Policy may require the translation of one or more of its terms to a form that another managed functional entity can understand. An example of an intent policy is:

*No processor shall run at more than 75 % utilization*

In the present document, Intent Policy will refer to policies that do not execute as theories of a formal logic. They typically are expressed in a restricted natural language, and require a mapping to a form understandable by other managed functional entities.

#### 6.3.9.4 Operation of the Policy Management Functional Block

Figure 6-13 illustrates a key concept of Policy, called the Policy Continuum [i.17], [7] and [8].

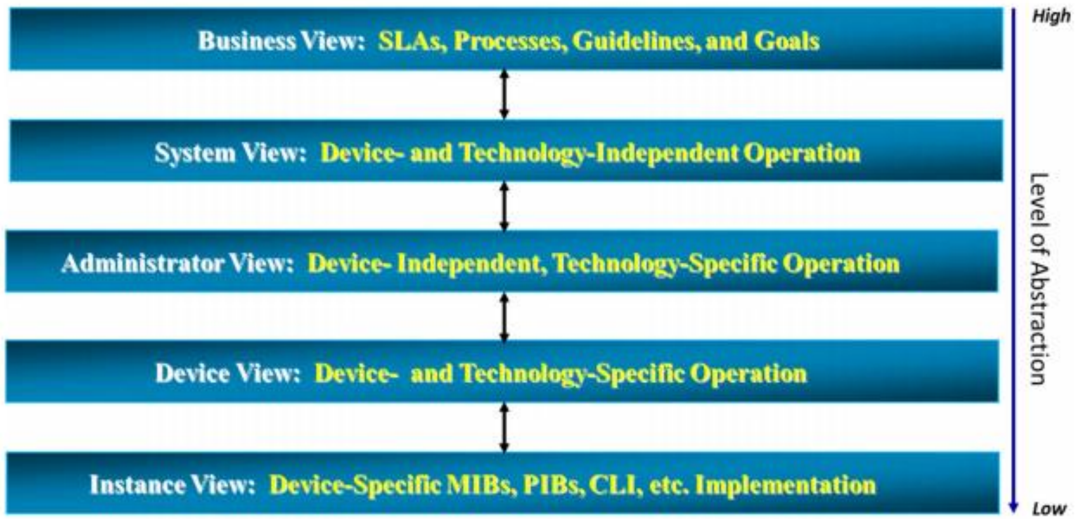



**Figure 6-13: The Policy Continuum**

The purpose of the Policy Continuum is to formally differentiate between the needs of different constituencies in defining and expressing policy. Each constituency is made up of a set of users that have similar business needs, and more importantly, use similar concepts and terminology. For example, business users and product managers use significantly different terminology than application developers or network administrators. The number of continua in the Policy Continuum shall be determined by the applications using it. There is no fixed number of continua. Figure 6-13 shows five, because this enables a set of much smaller translations of terms (e.g. from a representation without technology, to one with technology while being device, vendor, and technology independent, to successively lower levels that fix each of these three dimensions). However, Figure 6-13 is used to illustrate the principles of the Policy Continuum, not to define the type or number of continua used in ENI.

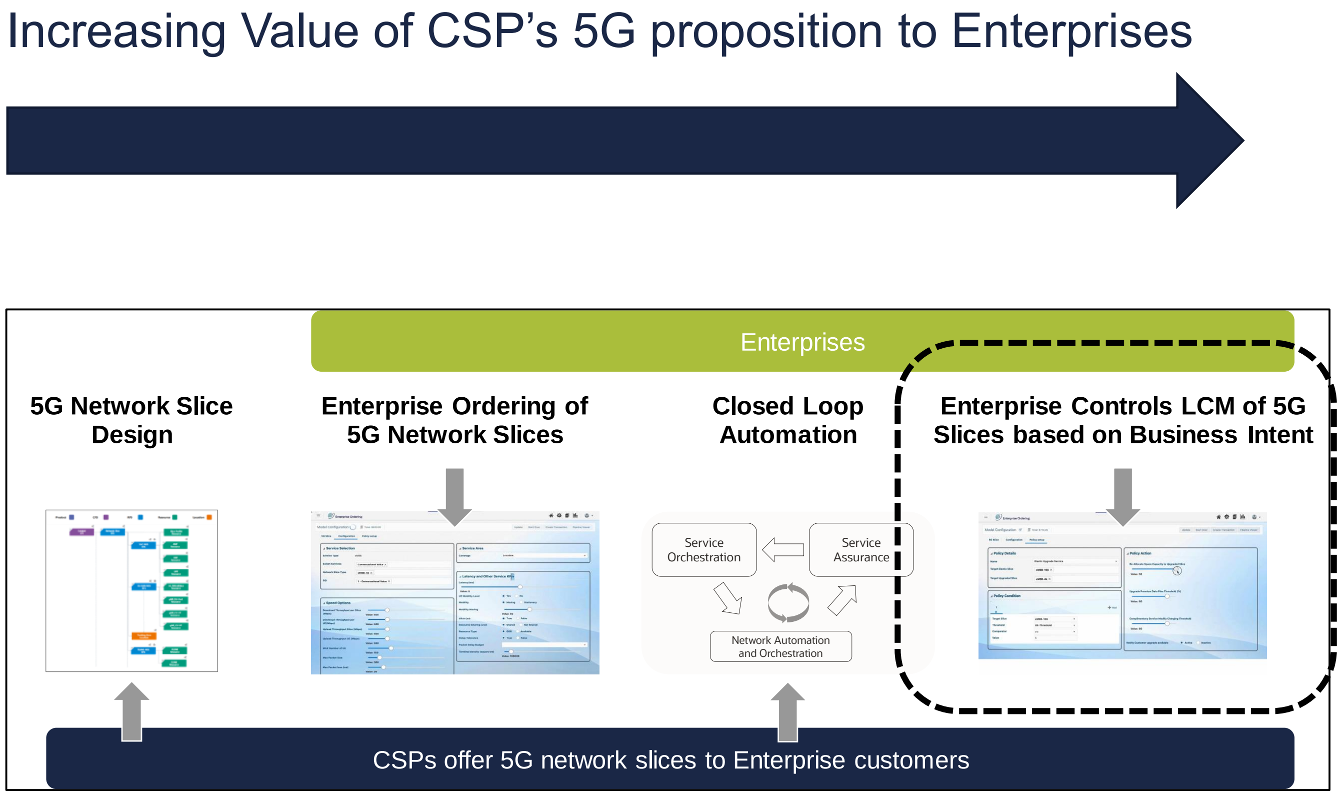
Figure 6-14 shows a simplified functional architecture of the Policy Management Functional Block. The functional block diagram shown in Figure 6-14 does not prescribe an implementation. Rather, it describes the high-level Functional Blocks that are needed to implement the needs of policy-based management in a given administrative domain. Different implementations may need to add other Functional Blocks to meet their particular operational requirements. An exemplary implementation is described in [i.12].

# Summary

CATALYSTS

# Summary

- CSPs need to enable enterprises to flexibly and efficiently configure and control their use of CSP 5G connectivity
- Based on their business intent, enterprises want to specify how such 5G connectivity should be governed to support their business objectives & priorities
- This catalyst explores how CSPs can expose such mechanisms, manifested as business policies, to enterprises
- Proposing a new TMF Open API for policy mgmt. and propagation aligned with TMF and other SDOs in this area



# thank you

tmforum labs