PSI Case Study

PSI-CST

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1 Document Meta Information

1.1 Document Signature Table

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Table 1.1: Signature Table.

1.1.1 Document Change Record

1.1.1.1 Changes

Date	Version	author	message
2023-04-27	MS4	David Valcarcel	Initial version
2023-07-26	MS5	Norbert Czeranka	Restructurings, extracted roadmaps and portions of SDP, extracted case study
2023-10-05	MS6	Divya Chauhan	Added information stemming from SES internal case study, improved descriptions of broker and provider PSS
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Table 1.2: DCR Table.

1.1.1.2 Source Control

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Repo	Date	Author	Branch	Hash

Table 1.3: GIT Changelog Table.

Figure 1.1: DCR QR-Code.

1.2 Documents

1.2.1 Applicable Documents

Acronym	Reference	Title	Version

Table 1.4: Applicable Documents.

1.2.2 Reference Documents

Acronym	Reference	Title	Version
PSI-DL	PSI-DL	PSI CGI Document List	current MS (doc version)
PSI-MADR	PSI-MADR	PSI Markdown Administrative Decision Records	see before
PSI-TAD	PSI-TAD	PSI Terms, Abbreviations and Definitions	see before
PSI-TOD	PSI-TOD	PSI Tasks and Operations Dictionary	see before

Table 1.5: Reference Documents.

2 Introduction

The Pooling & Sharing Interfaces Definitions (PSID) project is an ESA co-funded effort to define a common standard for the interfaces of Pooling & Sharing Systems (PSS) for Satellite Communication (SatCom) services. A PSS is a digital platform for matchmaking (Gov)SatCom users' demands (both commercial and institutional) with (Gov)SatCom providers' offers. Bringing together multiple (Gov)SatCom providers in one platform makes the market transparent, thus allowing users to get an overview of the market and to compare different offers efficiently. Additionally, a PSS assists users with little knowledge about the (Gov)SatCom domain defining their requirements on the (Gov)SatCom services. Those two aspects combined allow for fast access to the services and an efficient usage of the available capacities. To accomplish this, a PSS steps in between the usual processes of finding a provider/supplier, requesting an offer, and ordering the desired products or services, either as a service broker or by pooling products and services from different providers and offering them as an intermediary or distributor. Subsequently, the PSS can be used to monitor the services and manage multiple missions in a single application.

Eventually, a PSS can also be used as (or manage) a community hub, i.e., a number of end users or customers with similar interest that *share* their common resources and utilize a commonly obtained *pool* of (Gov)SatCom capacities. This strategy increases the efficient usage of scarce resources further.

There are already different approaches on PSSs, that might lead to an unnecessary fragmentation of the market. Therefore, a common standard for the interfaces of a PSS is required to allow the interaction between those different PSSs and reduce the effort of (Gov)SatCom providers to offer their product and services via multiple PSSs to maximize their reach.

Such a standard needs to take care of the different interfaces involved in the aforementioned processes, i.e.,

1. an interface between PSS and resource providers (satellite operators, service providers, or other PSSs),
2. an interface between the PSS and users, and
3. an interface between PSS and its own governance.

The goal of this project is to mainly define aspect 1 and to develop a software mock-up as needed to validate the various interfaces being developed.

The PSI standard derives from the existing industry-standard "Open Digital Framework" of **TM Forum** alliance[1]. The "Open Digital Framework" is a reference framework for delivering online Information, Communications and Entertainment services to the telecom world. It empowers market participants to compete and cooperate. One of PSI's goals is to make this existing standard fit for the world of satellite communication.

The consortium for this project consists of the service & technology providers SES Techcom and CGI, as well as of the (Gov)SatCom operators SES, Hellas Sat, Hispasat, Hisdesat, and LuxGovSat, and Inmarsat being both a service & technology provider and a (Gov)SatCom operator.

[1] See https://www.tmforum.org/resources/reference/gb991-tm-forums-core-concepts-and-principles-v22-0-0/

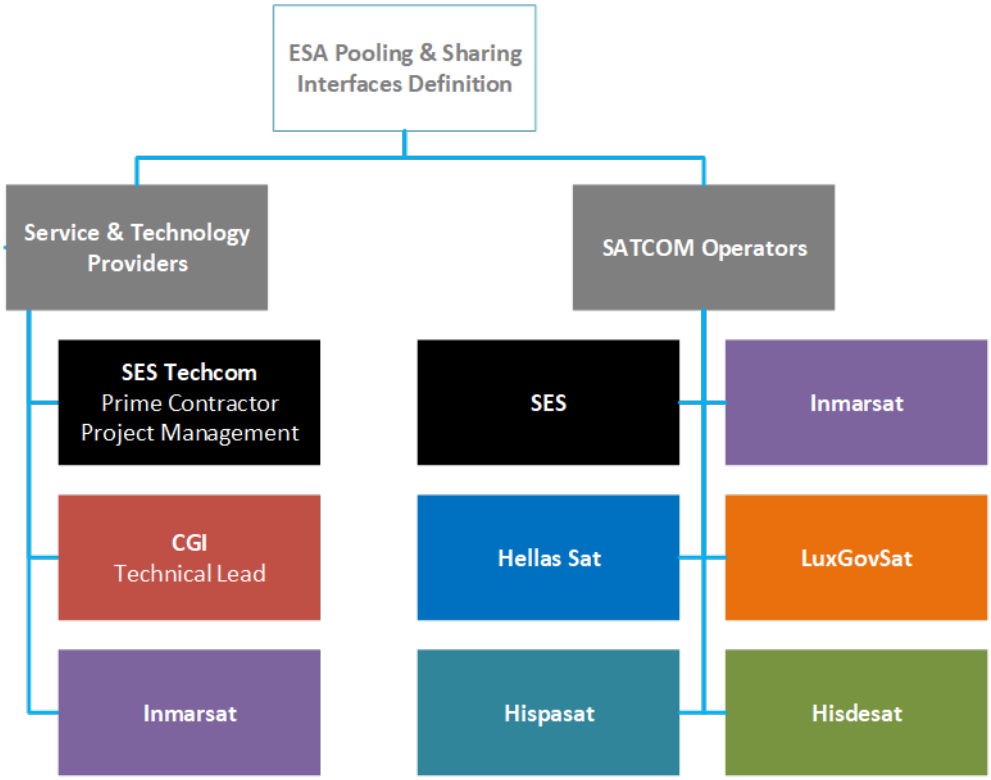

Figure 2.1: The PSI consortium.

2.1 Document Scope

This document describes a case study for the Pooling And Sharing Interfaces Standardisation Project (PSI). In this case study, we examine an organization (referred to as the “governance”) that faces a critical problem within the context of (Gov)SatCom (Government Satellite Communications) products. The issue at hand revolves around consumers of (Gov)SatCom products not receiving timely access, experiencing a lack of assurance regarding desired product attributes (e.g., security), and incurring suboptimal costs. The following sections heavily refer to terms, abbreviations and definitions defined in the [PSI-TAD].

2.1.1 Compiled Document

NOTE: THIS IS A COMPILED DOCUMENT [2]

This document has been compiled/generated from external sources and is not being written as-is. Therefore, any changes made within this compiled version of the document will be lost upon recompilation!

To make (permanent) changes, edit the respective sources directly or contact the PSID team.

2.1.2 Signature

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[2] Document compiled on 2025-02-12 11:45.

2.1.3 PSI Release Notes

2.1.3.1 Introduction

Welcome to the third release of the Pooling and Sharing Interface API! Below, you'll find details about the features, enhancements, and other important aspects of this release.

2.1.3.2 Key Highlights

The focus of this release lies on **mission management**, to facilitate a common understanding of user requirement towards communication. It aims to complement the Inquiry API by providing workflows and *understanding* to service requirements. This is mainly a user-oriented API, but it also enables exchange of mission data between PSS systems and therefore cross-platform-market places. This could become a future focal point. Such data exchange would include actual user requirements (expressed as missions), as well as templates for such missions. By the use of templates, user mission creation is streamlined and allows a governance to safeguard, streamline or ease the process of user requirement gathering.

Together with the APIs, we are working on a Plug&Play component for P&S systems (Hubs, Brokers, Marketplaces...), based on ODA. This will be a standalone Micro-Frontend open to be integrated into existing OSS/BSS/PSS systems. A first draft is included in this release.

It will come with different views:

- Time based (e.g. mission timeline, Gantt-Chart, to express that is needed *when*)
- Geography based (e.g. mission zones or network nodes on a map to express what is needed *where*)
- Logical View (e.g. communication interdependency graph to express *how* the requirements will look like)

Another area of improvement is the **performance management API**.

A new API has been added that allows to request performance reports to an ongoing mission from the provider. That is: the report itself is generated on provider's systems. The API handles the request and exchange of the report. The report has to be in line with the product's SLA and allows monitoring of compliance. It allows also to define alarm thresholds and receive a push of threshold violations by the provider, avoiding a constant pull.

We also added the technical considerations and resulting decisions to the document set. This allows easier future evolution and maintenance of the standard.

2.1.3.3 What's New

- [PSI-GID] now contains descriptions about the ODA component for mission management
- [PSI-ICD] now contains new and updated APIs - see below!
- [PSI-ADR] first release of our decision records
- [PSI-TAD] now contains descriptions of concepts for user missions, as well as performance and alarm management
- [PSI-TOD] now contains new tasks and operations for user missions, performance and alarm management

2.1.3.3.1 Newly added APIs

- PSID002 Mission Management
- This customer-facing API allows them to manage missions and assign products, services and resources to them.
- It can also serve as an entry point for the Customer Inquiry API to find matching products for their requirements.
- PSID143 Performance Monitoring
- Based on MEF143 - Performance Monitoring API (Version 2.0.0-RC).
- The performance monitoring allows a PSS or customer to request performance reports from a provider.
- PSID642 Alarm
- Based on TMF642 - Alarm API (Version 4.1.0).
- Allows the provider to notify a PSS or customer about detected problems with their products.

2.1.3.3.2 Updates APIs

- PSID001 Customer Inquiry
- Improved handling of places by adapting TMF Geography types.
- PSID620 Product Catalog
- Based on TMF620 - Product Catalog Management API (Version 4.1.0).
- Changed `SLARef` to `ServiceLevelSpecificationRef`
- Streamlined GeoJSON types
- PSID633 Service Catalog
- Based on TMF633 - Service Catalog Management API (Version 4.1.0).
- Changed `SLARef` to `ServiceLevelSpecificationRef`
- Streamlined GeoJSON types
- PSID634 Resource Catalog
- Based on TMF634 - Resource Catalog Management API (Version 4.1.0).
- Changed `SLARef` to `ServiceLevelSpecificationRef`
- Streamlined GeoJSON types
- PSID657 Service Quality Management
- Based on TMF657 - Service Quality Management API (Version 4.1.0).
- Add endpoints to manage KPIs that are supported by the PSS.

2.1.3.3.3 Added Requirements

- MISSION requirement category
- REQ-06-03 Key Indicator Management
- REQ-06-04 Performance Monitoring Job Management
- REQ-06-05 Performance Monitoring Report Management
- REQ-06-06 Alarm Management

2.1.3.4 Known Limitations

1. The Service Quality Management is rather basic. There is an ongoing effort to align this set of APIs with the results of a TM Forum Catalyst project. More information will follow in one of the next releases.
2. The Mission Management Service is at an early state. However, the available API implements basic mission management services, import and export. A full set of APIs to implement such a service are subject to an upcoming release. Refer also the [PSI-GID] to learn about the available API use cases.

2.1.4 Outlook

Currently, we are working on the next release with the following focal points:

- Finalize the mission management component
- Update the API baseline to TM Forum 5
- Converge with MEF schema for some selected APIs

2.1.5 Feedback and Contributions

We value your feedback! If you encounter any issues or have suggestions, please reach out. Additionally, we welcome contributions from the community.

3 Case Study

3.1 Problem Identification

The governance has analyzed the situation and identified the root causes of these challenges:

Demand-side Fragmentation: A significant portion of the problem arises from the fragmentation on the demand side. This fragmentation is driven by the proliferation of small contracts initiated by a multitude of isolated customers. Interestingly, these customers essentially require the same (Gov)SatCom product. This situation results in inefficient resource allocation and product duplication.

Supply-side Fragmentation: The governance has also recognized fragmentation on the supply side. This issue emerges when (Gov)SatCom products with surplus capacity cannot be effectively shared among customers. Consequently, the inability to share these products hampers access and leads to underutilization of available resources.

3.2 Proposed Solution

The proposed solution entails the implementation of a Pooling and Sharing System (PSS). Under this system, (Gov)SatCom products will be consolidated into a shared pool, which will, in turn, enable the effective sharing of products among customers through product allocation and de-allocation procedures.

In order to facilitate a clear understanding of the proposed solution and its implementation, the governance has defined the following concepts needed for the Pooling and Sharing System (PSS):

- **Broker:** The complete solution combining physical locations, software, people, processes, and infrastructure so as to provide broker operators the means to monitor and operate broker business processes.
- **Broker Software (PSS):** The collection of software systems that share the overall goal of providing a cohesive and single solution to implementing broker business processes. Individually, each subsystem will implement one or more business processes. Collectively, the software subsystems work together to provide the overall functions of the broker solution.
- **Product:** Any process built around communication that is deemed to be useful for customers. These processes can be integrated into the core operations of the broker, enhancing the range of services and solutions offered to customers.
- **Resource Provider:** A “Resource Provider” is defined as any accredited entity responsible for offering Products within the framework of the broker solution. Accreditation procedures for these providers are established and managed by the governance, ensuring compliance with specified standards and quality.
- **Customer:** A “Customer” encompasses both individual users and groups of individuals who utilize Products offered through the broker. These Customers rely on the broker to access (Gov)SatCom products.
- **Governance:** The organization responsible for defining and executing general governance processes of the broker, such as procuring Products, on-boarding Products to the Product portfolio or allocating products to customers.

The Governance has identified the following six key functions that it needs to perform as part of its solution:

1. **Provider and Product Accreditation:** The governance will perform Provider as well as Product Accreditation. This consists in ensuring that Resource Providers meet a set of requirements with respect to security, guarantee of access and product features. This will be a manual step that can later can be automated.
2. **Product Procurement:** The governance will act as a central procurement department, and it will procure suitable Products from various Resource Providers as part of supply aggregation. Once the governance has procured (Gov)SatCom Products through a defined procedure, the Products become part of the broker pool, and can be allocated to Customers without the need to carry out an additional procurement procedure.
3. **Supply Aggregation:** The governance performs supply aggregation by procuring Products into a pool. The pool is the collection of procured Products that is kept ready to use. The strategic pooling of Products significantly enhances response times, especially in scenarios where Products provisioning and procurement costs are substantial.
4. **Demand Aggregation:** The governance will provide the means to Customers to order Products. Once these Products are within the pool, Customers can initiate orders, similar to an online shopping experience tailored for (Gov)SatCom Products.
5. **Product Allocation:** The Governance will allocate Products to Customers via sophisticated aggregation of demand, matching, prioritization, and optimization techniques.
6. **Product De-allocation:** The governance will oversee the de-allocation of Products from Customers in cases when the contract ends or is terminated before completion.

The governance will perform some of these functions with the help of the broker software. The governance has decided that the main element of the broker software is a PSS, and that the PSS is the main enabler for automation and efficient execution of the functions. The governance has also decided to use the PSID APIs as part of their PSS, and as a fundamental tool on which to build the integration upon of all elements of the overall solution.

The following figure provides a visualization of some of the above functions: (Please refer the chapter “The role of the PSID APIs” of this document to understand the `PSIDxx` numbering.)

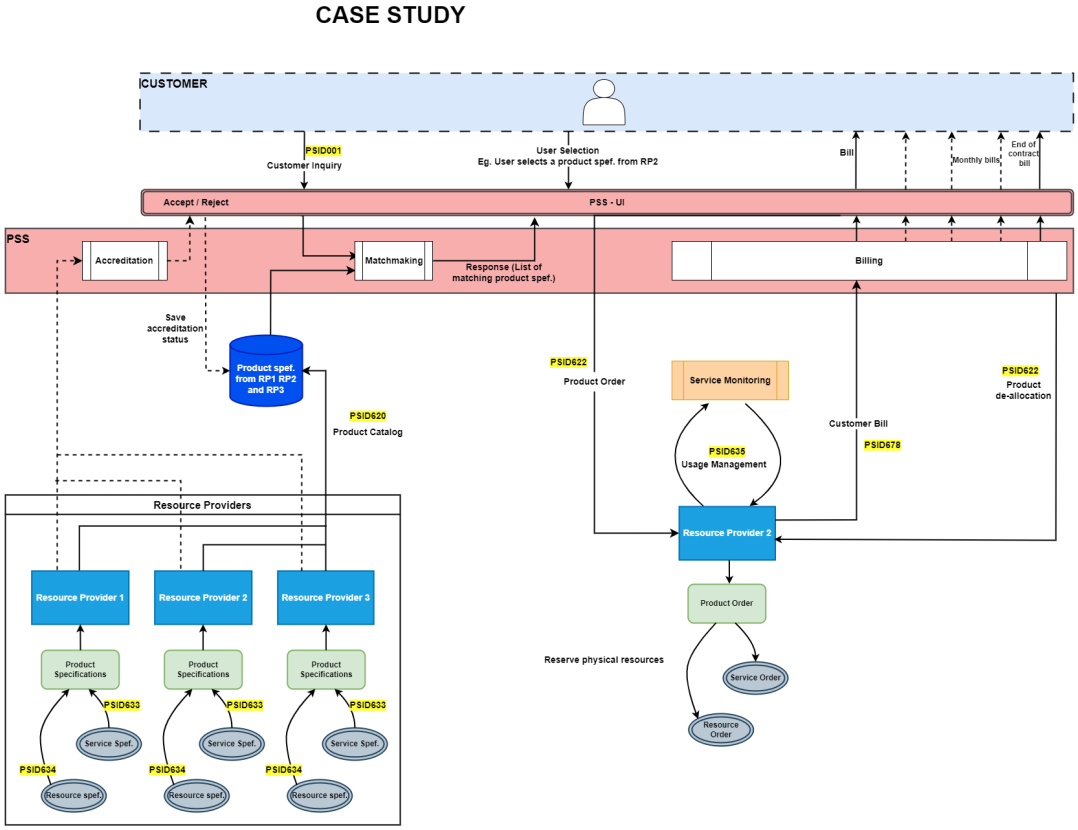

Figure 3.1: Case Study Diagram.

As can be seen in the figure above, the PSID APIs is the tool which enables machine-to-machine communication between Resource Provider Software and the PSS, which is the main element of the Broker Software.

The above figure illustrates the following steps:

- **STEP1 :** The governance performs the accreditation process for the Resource Providers in the PSS. After the accreditation is successful the Resource Providers are added in approved list.
- **STEP2 :** PSS performs supply aggregation from accredited Resource Providers - RP1, RP2 and RP3.
- **STEP3 :** All three Resource Providers publish their products via the PSID620 API to the PSS, and the Product information is stored in the PSS database.
- **STEP4 :** Customer sends the product requirements in form of an Inquiry using the PSID001 API.
- **STEP5 :** Matchmaking occurs at the PSS level, where the system identifies suitable products based on customer requirements.
- **STEP6 :** Customer is presented with a list of matching products through the PSS user interface.
- **STEP7 :** Customer selects a product and places an order.
- **STEP8 :** The PSS checks the selected product, associates it with the relevant Resource Provider (e.g., RP2), and creates a Product Order using the PSID622 API.
- **STEP9 :** RP2 receives the order, updates its inventory, and reserves the necessary physical resources for the product.

- **STEP10 :** Once the Order is placed and confirmation is sent, the contract is established. RP2 then performs the service monitoring and generates the bills monthly throughout the lifecycle of the contract.
- **STEP11 :** At the end of the contract, the PSS sends a Product Deallocation request to RP2 using the same PSID622 API initially used for allocation.

These streamlined steps provide a clear overview of the process, emphasizing the key actions and interactions between the PSS, Resource Providers, and Customers.

3.3 PSS Architecture and Concept

A PSS aims to unify and centralise the (Gov)SatCom market and all associated interfaces. It consists of three main contexts:

- Frontend
- Mission Context
- Business Context

Each context comprises a set of related subsystems. The *Frontend* contains the main interface to any actor of the PSS. The subsystems in the *Mission Context* target the main Use Cases of the customers and their service-needs. The *Business Context* refers to subsystems providing complimentary support to the main mission creation process, such as Customer Management.

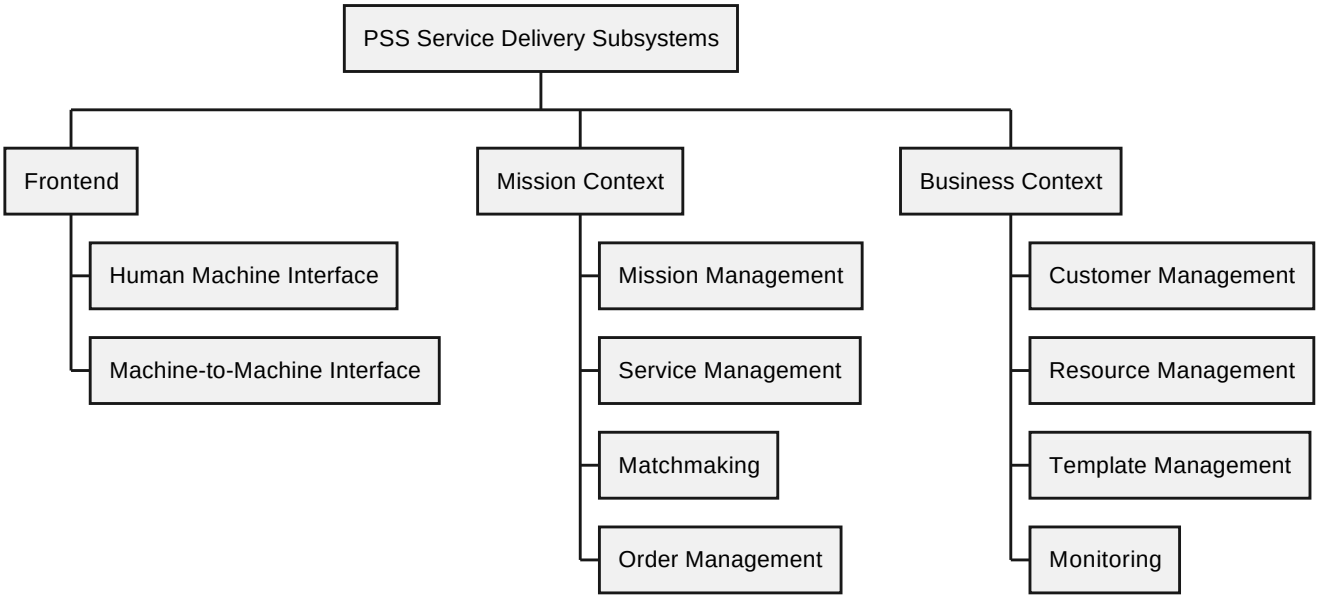

Figure 3.2: Service Delivery Subsystems.

3.4 Resource Provider Concept

The Resource Provider PSS system should essentially have the following modules:

- Order Management System (OMS): This refers to a “backend” system responsible for processing of customer order establishment, customer qualification, customer order validation, customer order tracking & management, physically reserving resources related to the order, service monitoring throughout the lifecycle of the contract and generating the invoices(billing).
- Asset Management System (AMS): This refers to a “backend” system responsible for general management of assets, which are Products/Services/Resources. More specifically: Catalog/Inventory management, which describe assets (product-service-resources relations, SLAs, etc.) and the current state (i.e., location, allocation, etc.).

3.5 The role of the PSID APIs

The desired outcome is that each provider who is compatible with this standard can connect to each PSS.

The PSS APIs can be organized in groups:

- Catalog and Inventory Management
- PSID620: Product Catalog Management API
- PSID637: Product Inventory Management API
- PSID633: Service Catalog Management API
- PSID638: Service Inventory Management API
- PSID634: Resource Catalog Management API
- PSID639: Resource Inventory Management API
- Monitoring
- PSID635: Usage Management API
- Ticketing
- PSID621: Trouble Ticket Management API
- Order Management
- PSID622: Product Ordering Management API
- PSID679: Product Offering Qualification Management API
- PSID648: Quote Management API
- Document Management
- PSID667: Document Management API

3.6 Description of Key Business Processes

This section provides a description of the key business processes.

3.6.1 Product Accreditation

In a scenario in which the broker platform has been completed (so all software, including the broker PSS and any others, and infrastructure is ready, all people are trained, all processes defined etc.), the next steps would be to certify an initial set of Resource Providers. For example, SES and A-Sat might have expressed interest in participating in the broker program and have enhanced their software landscape to implement all relevant PSID APIs. In this case, once SES and A-Sat are ready, a certification campaign would be performed involving the governance and SES and A-Sat. The campaign will aim to certify one or more SES / A-Sat products as GOVSATCOM-compliant products (which would be somehow formally defined). As part of the campaign, the software components implementing PSID APIs of both Resource Providers would be certified via semi-automated testing campaigns. One of the outputs of the PSID initiative is a test suite for all PSID APIs. This test suite could be used and/or adapted for such certification purposes. In any case, at the end of the certification campaign, the products, infrastructure, software, people, and processes of both Resource Providers would be certified and approved to participate in the broker platform.

3.6.2 Product Procurement

Once certification is completed, the governance will decide, perhaps based on some forecasting of potential demand, what products to procure from what Resource Providers. This will involve processes such as pricing negotiation, contracts, and others.

In the scope of this Case Study, the example will be for the Resource Provider system to push to the broker PSS system (PSS) the details of the procured products via PSID APIS, in the form of the PSID data model (Physical Resource Specifications, Logical Resource Specifications, Service Specifications, Product Specifications, Product Offerings, etc.). This will be a manual step.

3.6.3 Supply Aggregation

While the previous two business processes did not rely on the broker PSS nor on PSID APIs and were performed out of the scope of the broker software, once the products are procured, the broker and Resource Provider software can now leverage the PSID APIs to introduce automation into the process.

For it to be available in the broker platform, the SES Product needs to be defined as per the PSID terms. Please refer to section “Specifications, Catalogs and Offerings” of the PSID “TAD (Terms, Abbreviations and Definitions)” document for a description of what PSID terms are used to define a given product.

An example definition of the SES product is as follows - Name: Trunk mPOWERED product (only a general description is provided for practical purposes, as precise specifications would be too lengthy and not required for the purpose of this document):

- Physical Resource Specifications: Intellian Terminal, 2 x 1.3m 20W, model mP130, Gateway infrastructure, etc.
- Logical Resource Specifications: Bandwidth allowing for a minimum combination of FWD and RTN of 50 Mbps, where FWD and RTN have variable pre-defined ratios.
- Service Specifications: Connectivity transport service based on Layer 2 Ethernet P2P E-Line service (E-Access/E-Transit), Layer 3 IP transport
- Product Specifications: Trunk mPOWERED

- Product Offerings: Trunk mPOWERED, Intellian mP130, FWD 25 Mbps RTN 25 Mbps; Trunk mPOWERED, Intellian mP130, FWD 35 Mbps RTN 35 Mbps; etc. One for each potential variation of FWD and RTN. The product offering will also contain details about SLAs (i.e., network uptime $>$ 99.5 %, Satellite Latency $<$ 150 ms, committed information rate (CIR) definitions, etc.).

In practice, the exact characteristics of what Product Offerings would be procured by the governance would be detailed and defined in contractual documents as part of the business process described in the previous step. In the same manner as the governance procured products from SES, it would procure other products from other Resource Providers.

One possibility is for the Resource Provider systems to leverage the PSID APIs to publish the procured products to the broker PSS via the APIs. This process could be implemented in a manner such as that governance operators receive notifications of new published Product Offerings in the broker. The operators might then need to access the broker portal so to validate and approve the publishing of the Offerings.

In this manner, the broker PSS catalog would be populated semi-automatically by having all relevant Resource Providers push all previously procured products to the catalog. This would be a continuous process and would enable the PSS catalog to effectively create a pool of aggregated supply from all Resource Providers.

3.6.4 Demand Aggregation

The most probable scenario in which demand aggregation is achieved would be to leverage the fact that customers would use a graphical user interface (such as a web application that is part of the broker platform) to either browse the product offerings available in the pool or to submit a product inquiry.

The PSID APIs such as the Product Ordering Management API (PSID622) would be leverage internally in the PSS so to perform the process. Other scenarios in which the PSID APIs would be leveraged would be in the case that a quote is needed from one or more Resource Providers.

3.6.5 Product Allocation

Either matchmaking is delegated to the resource provider or the broker PSS would have some matchmaking algorithms that would propose a solution to the customer request. In the end, the customer would confirm the proposal and an order process would occur. In this case, several PSID APIs would be leveraged, mostly between the PSS and the Resource Provider systems. Most probably these would be APIs such as the Product Ordering Management API (PSID622) and the inventory-related APIs (Product Inventory Management API (PSID637), Service Inventory Management API (PSID638), Resource Inventory Management API (PSID639)).

The APIs would be used to ensure both the PSS pool and inventories are synchronized with Resource Provider systems and processes.

3.6.6 Product De-allocation

Once the product allocation has ended, a de-allocation step occurs. This could be in the case of service term expiry or premature service cancellation from customer's side. In a similar manner as the previous step, most probably the PSID APIs that would be leveraged would be APIs such as the Product Ordering Management API (PSID622) and the inventory-related APIs (Product Inventory Management API (PSID637), Service Inventory Management API (PSID638), Resource Inventory Management API (PSID639)).

4 A User Story: Demonstration of capabilities

The outlined case study shows how the interplay between different PSSs and different entities - a customer aiming at booking specific services to meet their communication needs, a provider offering resources or services via a PSS to broaden their reach to different user communities - can work adapting the PSI APIs. The User Story accompanying the Case Study showcases how the interaction between different PSSs can be implemented. The different roles of providers and PSS can be set within the context of this consortium as follows:

Consortium Partner	Role	Description
A-Sat	Provider	Provisioning of services
B-Sat	Provider	Provisioning of services
SES	Provider, PSS	Provisioning of services and PSS
CGI	Customer, PSS	Demonstration user, Broker platform PSS

Table 4.1: User Story players.

4.1 Step 1: Accreditation and service introduction

The broker PSS is importing data from both A-Sat and B-Sat. This can be done via JSON import if the services from A-Sat and B-Sat are being presented in a PSI API compatible JSON scheme format. If the optional demonstration step should be included, the services should include raw bandwidth services. After import, the required accreditation will be conducted for both providers.

SES sends both *resource specifications* and *service specifications* via the API, showcasing the API connection between the broker PSS and the provider PSS. Subsequently, the broker PSS displays the received data and conducts the accreditation for this provider as well. Finally, the provider PSS sends *product offerings* to the broker PSS via the aforementioned APIs as well. One product offering includes *internet access*, to enable step 2.

4.2 Step 2: Mission creation and product order

The demonstration user logs into the broker PSS. The user creates a mission specifying services that are matching the ones send by the provider PSS. Subsequently, the user performs the matchmaking. The broker PSS presents the user the product offering as introduced by the provider PSS in step 1. The user selects this offer and sends the product order.

4.3 Step 3: Order processing in provider PSS

The product order is transferred from the broker PSS, via the APIs, to the provider PSS. The new order is displayed in the provider PSS and further processed within the provider PSS. This might include showcasing how party management is handled within the provider PSS. Once the order is checked, a confirmation is send back to the broker PSS.

4.4 Optional: Showing additional matchmaking

Optionally another matchmaking action, using imported data in step 1 from A-Sat, can be shown on the example of raw bandwidth services. Potentially, the same services as those from SES can be shown with B-Sat derived services. The user refines the mission to include raw bandwidth services. The matchmaking in the broker PSS is being conducted once more, showing the raw bandwidth services from A-Sat as options. Potentially, if present, the services from B-Sat can be shown here as well, but it is demonstrated that those from SES are chosen to show step 4.

4.5 Step 4: Order confirmation and start of Service

The provider PSS has confirmed the order. The broker PSS shows the order's confirmation status and also the service status.

4.6 Step 5: Integration tests

The user story has been completed. Within step 5, the capabilities for other endpoints are shown. This is done conducting the integration tests with a mock-up, i.e. mocking requests from customers or mocking further actions being conducted by potential providers or PSS <-> PSS interactions.

Last Page of Document