MEF Specification
MEF 55.0.1

Amendment to MEF 55 – Operational Threads

October, 2017

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1   List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

AT&T	Cisco Systems
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2   Abstract

This document is an amendment to Lifecycle Service Orchestration (LSO) Reference Architecture (RA), MEF 55 [A1-1]. The changes to MEF 55 are:

- Changes to Section 3 (Terminology) and Section 10 (Operational Threads for LSO)

3   Additional References (This document only)

[A1-1] MEF Forum 55, Lifecycle Service Orchestration Reference Architecture and Framework, March 2016.

4   Changes to Section 3 of MEF 55 – Terminology and Acronyms

The following entries are added to the terminology table of MEF 55.

Term	Definition	Source
ADAGIO (ICM:ECM)	The element Management Interface Reference Point needed to manage the network resources, including element view related management functions	This document
ALLEGRO (CUS:SOF)	The Management Interface Reference Point that allows Customer Application Coordinator supervision and control of dynamic service of the LSO service capabilities under its purview through interactions with the Service Orchestration Functionality.	This document
Business Applications (BUS)	The Service Provider functionality supporting Business Management Layer functionality	This document
BUS-partner	Business Applications in the Partner domain	This document
BUS-sp	Business Applications in the Service Provider domain	This document

Term	Definition	Source
CANTATA (CUS:BUS)	The Management Interface Reference Point that provides a Customer Application Coordinator (including enterprise Customers) with capabilities to support the operations interactions with the Service Provider's Business Applications for a portion of the Service Provider service capabilities related to the Customer's Products and Services.	This document
Customer Application Coordinator (CUS)	A functional management entity in the Customer domain that is responsible for coordinating the management of the various service needs (e.g., compute, storage, network, etc.) of specific applications.	This document
Element Control and Management (ECM)	The set of functionality supporting element management layer capabilities for individual network elements.	This document
Infrastructure Control and Management (ICM)	The set of functionality providing domain specific network and topology view resource management capabilities including configuration, control and supervision of the network infrastructure.	This document
INTERLUDE (SOF:SOF)	The Management Interface Reference Point that provides for the coordination of a portion of LSO services within the partner domain that are managed by a Service Provider's Service Orchestration Functionality within the bounds and policies defined for the service.	This document
LEGATO (BUS:SOF)	The Management Interface Reference Point between the Business Applications and the Service Orchestration Functionality needed to allow management and operations interactions supporting LSO connectivity services.	This document
PRESTO (SOF:ICM)	The resource Management Interface Reference Point needed to manage the network infrastructure, including network and topology view related management functions.	This document
Service Orchestration Functionality (SOF)	The set of service management layer functionality supporting an agile framework to streamline and automate the service lifecycle in a sustainable fashion for coordinated management supporting design, fulfillment, control, testing, problem management, quality management, usage measurements, security management, analytics, and policy-based management capabilities providing coordinated end-to-end management and control of Layer 2 and Layer 3 Connectivity Services.	This document
SOF-partner	Service Orchestration Functionality in the Partner domain	This document
SOF-sp	Service Orchestration Functionality in the Partner domain	This document
SONATA (BUS:BUS)	The Management Interface Reference Point supporting the management and operations interactions (e.g., ordering, billing, trouble management, etc.) between two network providers (e.g., Service Provider Domain and Partner Domain).	This document

Table A1- 1 Terminology and Acronyms

5   Replaces Section 10 of MEF 55 – LSO RA Operational Threads

Replace Section 10 of MEF 55 with the following text and figures:

10 LSO Operational Threads

This section is focused on the Operational Threads for the LSO Reference Architecture. Operational Threads describe the high level Use Cases of LSO behavior as well as the series of interactions among LSO management entities, helping to express the vision of the LSO capabilities. The interactions described within each Operational Thread address the detailed involvement of the Interface Reference Points in the LSO Reference Architecture. Each subsection identifies and outlines some of the operational threads that are being developed as part of the LSO Reference Architecture. Each Operational Thread describes the orchestration within the LSO Reference Architecture highlighting the coordination within a Service Provider domain and also addressing the interactions with both the Customer domain and Partner domain. In addition, Operational Threads are mapped to the requirements they support in the LSO Reference Architecture and Framework. The detailed Operational Threads defined in this section describe the interactions relative to each Interface Reference Point. These interaction details will serve as a foundation for future work on the functional requirements for each Interface Reference Point. Such functional requirements will be used as the basis for Interface Profile definitions.

Operational Threads identified for LSO include:

- Partners on-boarding (to be defined in future version)
- Product Ordering and Service Activation Orchestration
- Controlling a Service
- Customer Viewing Service Performance and Fault Reports and Metrics
- Placing and Tracking Trouble Reports
- Assessing Service Quality Based on SLS
- Collection and Reporting of Billing and Usage
- Securing Management and Control Mechanisms (to be defined in future version)
- Providing Connectivity Services for Cloud (to be defined in future version)

10.1 Partners On-Boarding

10.1.1 Purpose:

The Service Provider begins a business relationship with Partner providers. The Product Offering capabilities of each Partner are shared with the Service Provider, along with any associated billing information and quality objectives. Rules guiding the business arrangement with the Partner may be codified within Policies. The Service Provider may use the details of the Partner's Product Offerings to identify the potential capabilities of Service Components that could be implemented using the Partner's products. The flow described in this operational thread is intended to represent the generalized steps and associated interactions for partner on-boarding.

Assumptions: Commercial agreements are established external to this operational thread. Partner can choose the level of detail that is shared with the Service Provider.

10.1.2 Steps:

To be defined.

10.2 Product Ordering and Service Activation Orchestration

10.2.1 Purpose:

Describe an operational thread for ordering of a product through activation orchestration within the LSO ecosystem for a connectivity service both within the provider domain and also addressing the partner domain portion of the service. The intent of this operational thread is to include the various components within the ordering lifecycle including, but not limited to, the use of a product catalog, quoting, and serviceability. These capabilities may exist independently outside the order submission process or may be inclusive within the defined order submission workflow.

10.2.2 Steps:

1. Customer browses Product catalog and existing Product assets (e.g., existing service locations, existing UNIs, existing Product Instances, etc.): Customer -> CANTATA -> Business Applications
2. Customer selects, specifies parameters and gets serviceability and a quote for the connectivity Product: Customer -> CANTATA -> Business Applications
3. Business Applications decompose the product into its services and SOF decomposes the services into its service components
   a) Business Application begin determination of the Product serviceability (e.g., interacts with Billing, selection of Partner products, etc.)
   b) Business Applications request that SOF use its topology information to determine components of the service within the SP footprint and within the Partner footprint. BUS-sp -> (LEGATO) -> SOF
      a. An alternative is for the Business Applications to lookup Partnering service options using a Product Catalog instead of topology information.
   c) Business Applications inquire the SP footprint aspects of serviceability BUS-sp -> LEGATO -> SOF
   d) Business Applications inquire the Partner footprint aspects of the service and interrogate the Partner for Serviceability and quotes BUS-sp -> SONATA -> BUS-partner
   e) Business Applications generate the quote for the Customer: Business Applications -> CANTATA -> Customer
4. Customer orders connectivity Product: Customer -> CANTATA -> Business Applications
5. Business Applications perform Product to Service mapping
6. Business Applications analyze Partner footprint aspect of the ordered Product and places the appropriate Product Orders with Partners (and receives Partner commitments): BUS-sp -> SONATA -> BUS-partner
7. Business Application requests fulfillment of the connectivity Service(s) within the SP footprint: Business Applications -> LEGATO -> SOF
8. SOF designs the Service Components within the SP footprint (some may exist, some may need to be designed and created) including forwarding constructs across forwarding domains and associated interfaces as well as network functions to support the Service, including identification of the External Providers (e.g., access providers) for any additional forwarding constructs and network functions within the Partner footprint.
   [Note: Determination of Service Components within the Partner footprint may be determined by the Business Applications before the service request is placed or via Partner domain discovery at Service level]
   [Note: SOF might need to initiate the installation request for hardware (e.g., CPE) and be aware of scheduling and lifecycle of all service components]
9. SOF requests configuration and activation of interfaces, forwarding constructs and network functions:
   a) SOF requests configuration and activation of network functions and forwarding constructs across each internal forwarding domain: SOF -> PRESTO -> ICM
   b) SOF requests fulfillment of Product Orders or Service Requests to Partner for connectivity services including components such as network functions, interfaces, and forwarding

constructs across each external forwarding domain. There are two options for such inter-actions between the Service Provider and the Partner:
   a. SOF-sp -> INTERLUDE -> SOF-partner(Guided by policy rules with the service definition)
   b. SOF-sp -> LEGATO -> BUS-sp -> SONATA -> BUS-partner

10. Each ICM determines the elements involved and controls the activation of the network functions and forwarding construct across each element: ICM -> ADAGIO- > ECM
11. Once the Service Components supporting the Service are successfully configured and activated, SOF orchestrates Service Activation Testing (Note: can be staggered when more than 2 sites): SOF -> PRESTO -> ICM (also SOF-sp -> INTERLUDE -> SOF-partner for partner components)
12. When the end-to-end testing is successful:
   a) SOF synchronizes and activates proactive performance monitoring for the service and components (can be staggered when more than 2 sites)
   [Note: It is possible to address testing failures with policy driven closed loop control]
13. When all testing is completed (can be staggered when more than 2 sites), the SOF performs the state change for the Service (per order component) and informs the Business Applications that the service is now active. (note: state changes will be tracked and made available to the customer throughout ordering and activation): SOF -> LEGATO -> Business Applications
14. The customer is notified that the Product Instance is ready to use: Business Applications -> CAN-TATA -> Customer
15. Customer performs testing and accepts the Product Instance: Customer -> CANTATA -> Busi-ness Applications
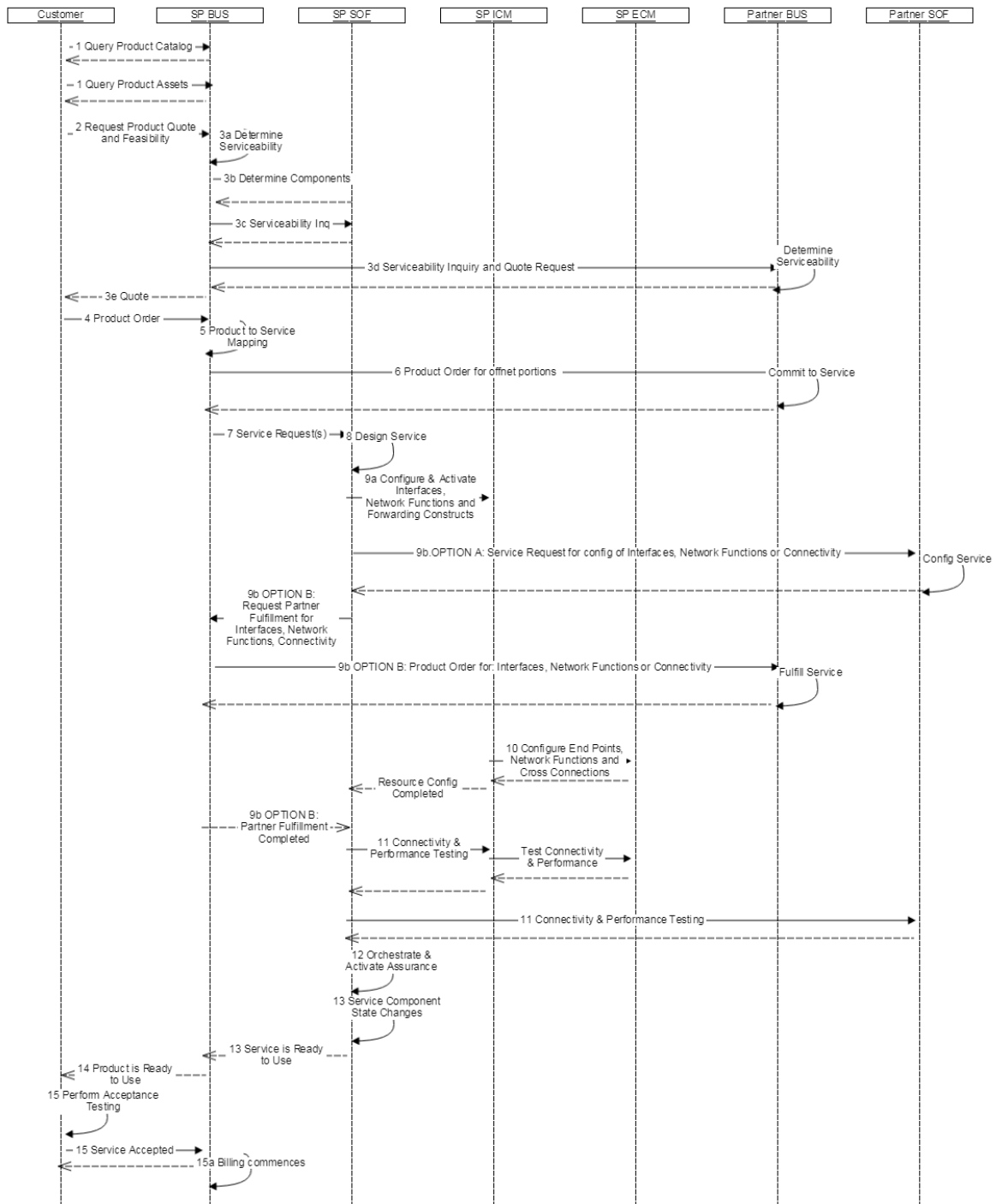   a) E.g., Billing capability for the product assets (can be staggered); Billing commences

Figure A1- 1 Product Ordering and Service Activation Orchestration Sequence Diagram

10.3 Controlling a Service

10.3.1 Purpose:

The Customer initiates a request to dynamically control a permitted aspect of its Service (e.g., bandwidth change or implementing traffic filtering controls, etc.).

In the Service Provider domain, LSO uses the defined service constraints and policies to determine if the dynamic control request is permitted and parameterized within the permissible bounds. If the dynamic control request needs to be supported by Service Components within a Partner domain, LSO coordinates the changes needed to support the request with the Partner. In addition, LSO effects the necessary changes within its own domain to service the request. The updated Service Components are tested. The Customer is also informed about the status of the request.

10.3.2 Steps:

1. Customer queries the defined constraints and policies that describe the permitted dynamic behavior of the Service (e.g., bandwidth change or implementing traffic filtering controls, bounds on parameters, etc.): Customer -> ALLEGRO > SOF-sp
   [Note: Dynamic behavior at the service level is derived from the customer product contract]
2. Customer requests changes in Service related parameters as permitted by the defined constraints and policies : Customer -> ALLEGRO > SOF-sp
3. SOF-sp verifies that the requested changes fall within the permitted constraints, bounds, and policies.
4. SOF-sp identifies Service Components including forwarding constructs across forwarding domains and associated interfaces as well as network functions that need to be reconfigured in support of the request. This includes identification of the Service Components supported by External Providers (e.g., access providers) for update to any necessary forwarding constructs and network functions within the Partner footprint.
5. SOF-sp requests reconfiguration of identified interfaces, forwarding constructs and network functions:
   1. SOF-sp requests reconfiguration of identified Service Components within the internal forwarding domains of the Service Provider: SOF-sp -> PRESTO -> ICM
   2. SOF-sp requests reconfiguration to External Providers for identified Service Components (Partner Services) across each external forwarding domain: SOF-sp -> INTERLUDE -> SOF-partner
6. Each ICM determines the elements involved and controls the reconfiguration of the network functions and forwarding construct across each element: ICM -> ADAGIO- > ECM
7. Each ICM reports back the results of the reconfiguration request: ICM -> PRESTO -> SOF-sp
8. Each External Provider reports back the results of the reconfiguration request: SOF-partner -> INTERLUDE-> SOF-sp
9. SOF-sp requests testing of identified Service Components (e.g., interfaces, forwarding constructs and network functions):
   1. SOF-sp requests testing of identified Service Components within the internal forwarding domains of the Service Provider: SOF-sp -> PRESTO -> ICM
   2. SOF-sp requests testing to External Providers for identified Service Components (Partner Services) across each external forwarding domain: SOF-sp -> INTERLUDE -> SOF-partner
10. Each ICM determines the elements involved and controls the testing of the network functions and forwarding construct across each element: ICM -> ADAGIO- > ECM
11. Each ICM reports back the results of the testing request: ICM -> PRESTO -> SOF-sp
12. Each External Provider reports back the results of the testing request: SOF-partner -> INTERLUDE-> SOF-sp

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13. Once the Service Components supporting the request are successfully reconfigured and tested, SOF-sp synchronizes the Inventory and Assurance capabilities for the Service and Service Components.

14. SOF-sp generates a Usage Event to the Business Applications for Product Instance: SOF-sp -> LEGATO -> Business Applications
Note: The Business Applications determine billing impact of the Usage Events due to service control changes.

15. The customer is notified that the Service is updated, tested, and is ready to use: SOF-sp -> AL-LEGRO-> Customer

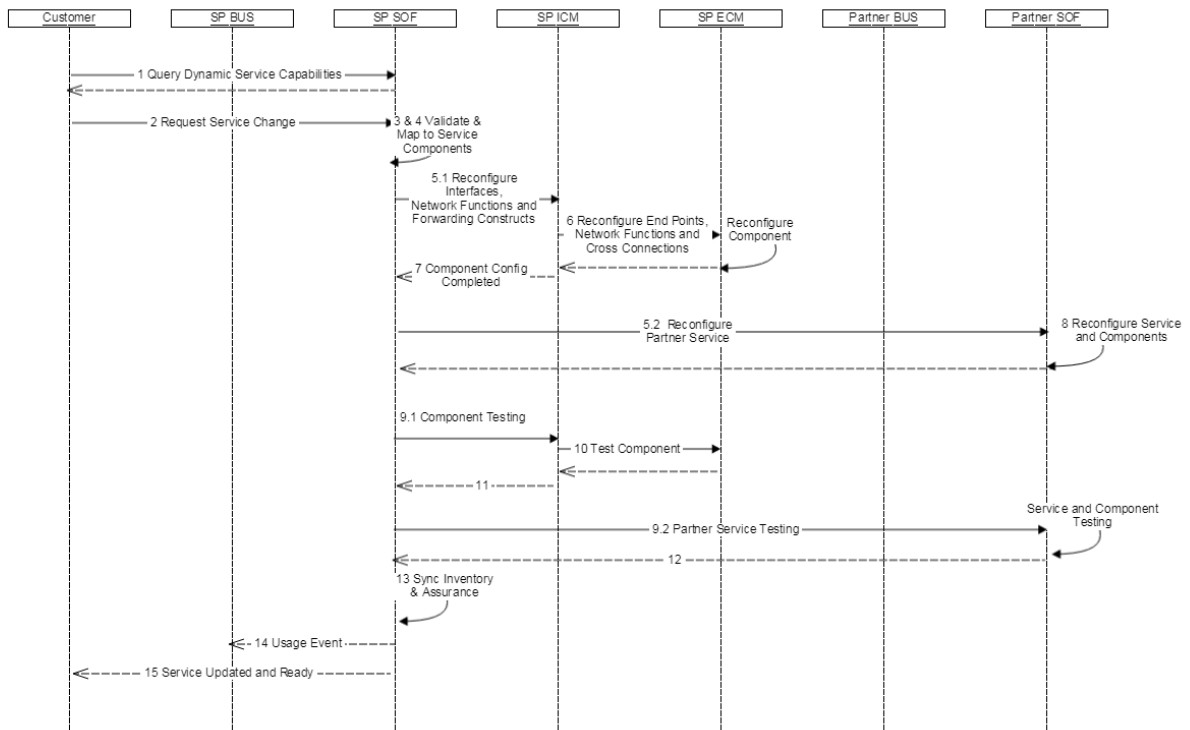**Variations**: scheduled changes; reservations;

Figure A1- 2 Controlling a Service Sequence Diagram

10.4 Customer Viewing Service Performance and Fault Reports and Metrics

10.4.1 Purpose:

The Customer wishes to view performance and fault information related to its Product Instances and associated Services. In the Service Provider domain, LSO may receive fault and performance related information about the Service, either end-to-end or per each Service Component. This information is organized to facilitate the evaluation of the overall performance and status associated with the Customer's Services and Product Instances. LSO gathers the information requested by the Customer and assembles it into a report. The Customer may also request that reports be generated on a scheduled or exception basis.

10.4.2 Steps:

1. The Customer retrieves information about the types of Performance and Fault Reports that may be requested for a specific Service: Customer -> ALLEGRO -> SOF-sp
2. The Customer requests a specific Performance or Fault Report related to existing Services and / or a visible Service Components (e.g., If the SP permits the Customer to view specific connectivity flows or network functions etc.): Customer -> ALLEGRO-> SOF-sp
3. SOF-sp determines the Information (e.g., Performance or Fault Metrics) that are needed in order to assemble the Performance or Fault Report requested by the Customer.
4. If the needed Information are not cached and current:
    1. SOF-sp requests the Information from the ICM domains that are responsible for generating the needed pieces of information: SOF-sp -> PRESTO -> ICM; ICM -> ADAGIO -> ECM
    2. SOF-sp requests the Information from the Partner domains that are responsible for generating the needed pieces of information: SOF-sp -> INTERLUDE -> SOF-partner
5. SOF-sp assembles the Performance or Fault Report containing the Information requested by the Customer, and alerts the Customer of the Performance or Fault Report availability: SOF-sp -> ALLEGRO -> Customer
6. The Customer retrieves the Performance or Fault Report from the Service Provider: SOF-sp -> ALLEGRO -> CUSTOMER

Variations:

Scheduled Performance Reports

Triggered Performance Reports (e.g., SLS threshold exceeded, policy based, etc.)
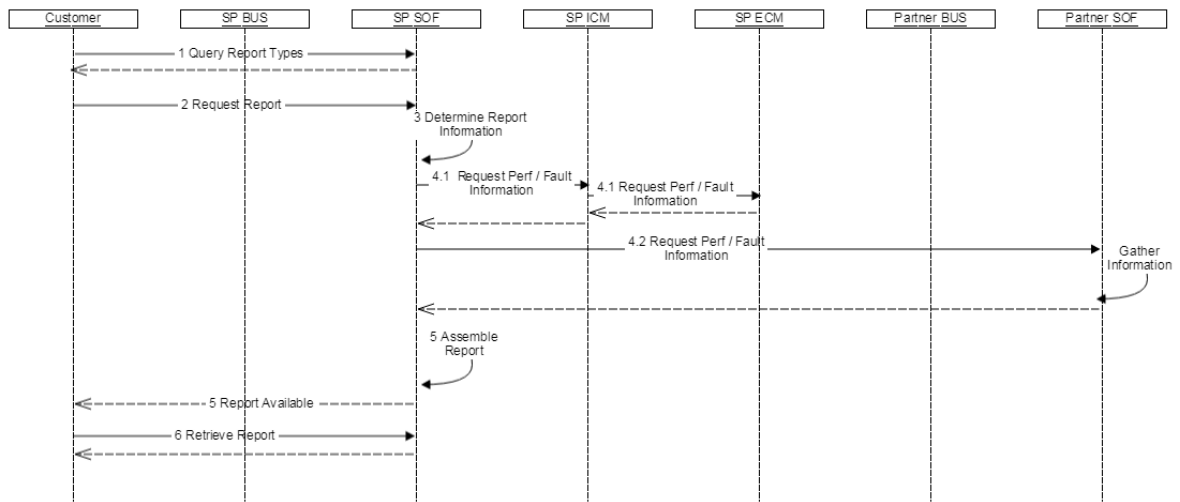
Figure A1- 3 Customer Viewing Service Performance and Fault Reports and Metrics Sequence Diagram

10.5 Placing and Tracking Trouble Reports

10.5.1 Purpose:

Trouble Reports related with the Customer's Product Instances and Services may be placed by the Customer. In the Service Provider, LSO gathers and fuses trouble and fault information related to the Customer's Product Instances and Services and associates it to the Trouble Report. LSO would also attempt to remedy the reported trouble by reconfiguring, reassigning, and / or rerouting aspects of the Service. LSO also indicates if manual intervention is required to resolve the trouble, and tracks the status of any associated repair activities to help determine trouble resolution status. The status of trouble resolution is reported back to the Customer.

10.5.2 Steps:

1. Customer provides a Trouble Report related to a connectivity Product: Customer -> CANTATA -> Business Applications
2. Business Applications perform Product to Service mapping
3. Business Applications inform SOF of the customer reported problem with the connectivity Service(s): Business Applications -> LEGATO -> SOF-sp
4. SOF analyzes the reported problem on the Service and identifies related Service Components including forwarding constructs across forwarding domains and associated interfaces as well as network functions supporting the Service, including identification of the Service Components provided by Partners
5. SOF identifies any previously detected errors and faults that are correlated to the Service or Service Components.
6. SOF requests current configuration and fault information related to the identified interfaces, forwarding constructs and network functions:
    1. SOF requests configuration and fault information of network functions and forwarding constructs across each internal forwarding domain: SOF-sp -> PRESTO -> ICM
    2. SOF requests configuration and fault information of Service Components in each external forwarding domain: SOF-sp -> INTERLUDE -> SOF-partner
7. If not already cached, each ICM determines the elements involved and requests fault and configuration for the network functions and forwarding construct across each element: ICM -> ADAGIO-> ECM
8. Once the configuration and fault information for the Service Components supporting the Service are successfully gathered, SOF analyzes the information to diagnose and identify the Trouble, if necessary SOF orchestrates additional end-to-end and per Service Component testing: SOF-sp -> PRESTO -> ICM (also SOF-sp -> INTERLUDE -> SOF-partner for partner components)
9. SOF coordinates and tracks the resolution of the Trouble, including reconfiguring, reassigning, and / or rerouting aspects of the Service.
10. SOF also indicates if manual intervention is required to resolve the trouble, and tracks the status of any associated repair activities to help determine trouble resolution status.
11. The status of trouble resolution is reported to the Business Applications: SOF-sp -> LEGATO -> Business Applications
12. The status of trouble resolution is reported to the Customer: Business Applications -> CANTATA -> Customer (ALTERNATIVE, SOF could provide updates via ALLEGRO)
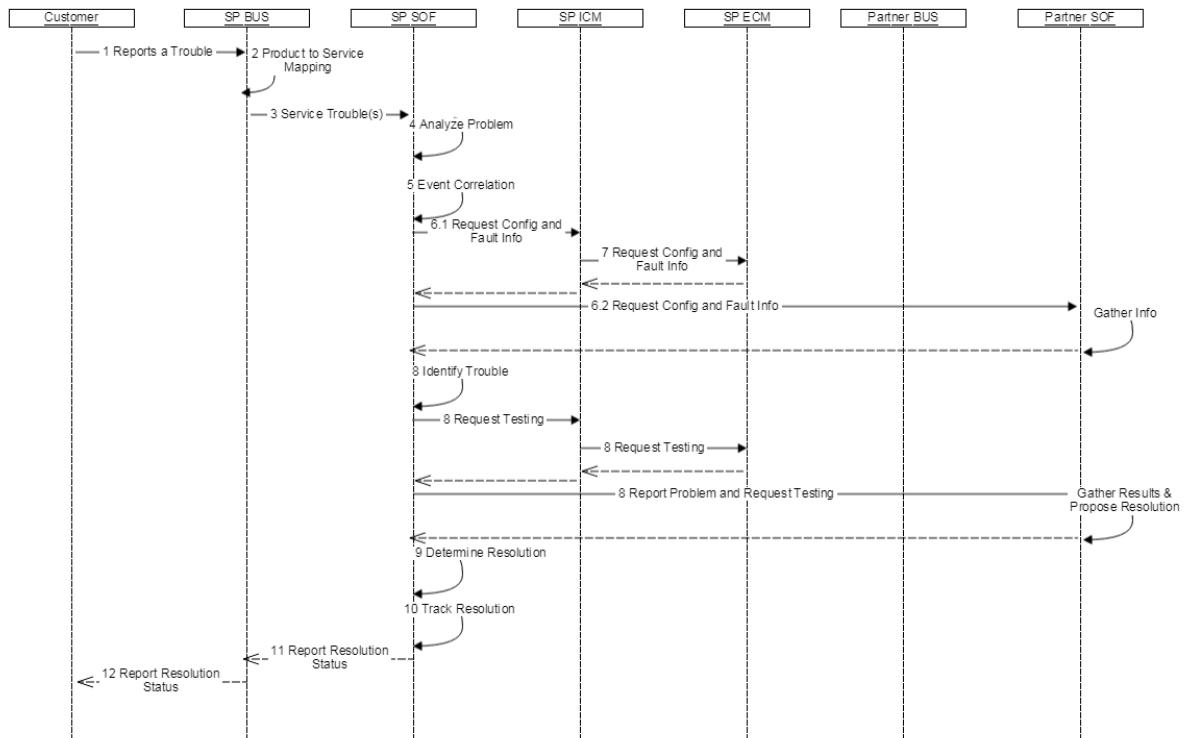
ALTERNATIVE: proactive trouble detection.

Figure A1- 4 Placing and Tracking Trouble Reports Sequence Diagram

10.6 Assessing Service Quality Based on SLS

10.6.1 Purpose:

The Service Provider needs to determine if the SLS for a Service is being met. Service quality is analyzed by gathering the necessary service performance related measurement and comparing these service performance metrics with the service quality objectives described in the SLS.

10.6.2 Steps:

1. Periodically, SOF requests current performance information related to the identified interfaces, forwarding constructs and network functions. (Note: Instead of, or in addition to, periodic polling, the ICM (via PRESTO) or the partner SOF (via INTERLUDE) might also send TCAs when particular performance thresholds are crossed):
   1. SOF requests performance information of network functions and forwarding constructs across each internal forwarding domain: SOF-sp -> PRESTO -> ICM
   2. SOF alerts Partner and requests performance information of Service Components in each external forwarding domain: SOF-sp -> INTERLUDE -> SOF-partner
2. If not already cached, each ICM determines the elements involved and requests performance information for the network functions and forwarding construct across each element: ICM -> ADAGIO- > ECM
3. Once the performance information for the Service Components supporting the Service are successfully gathered, SOF analyzes the information based on the SLS to identify the performance degradation, if necessary SOF orchestrates additional end-to-end and per Service Component testing: SOF-sp -> PRESTO -> ICM (also SOF-sp -> INTERLUDE -> SOF-partner for partner components)
4. SOF coordinates and tracks the resolution of SLS related degradations, including reconfiguring, reassigning, and / or rerouting aspects of the Service.
5. SOF also indicates if manual intervention is required to resolve the degradation, and tracks the status of any associated activities to help determine resolution status.
6. The status of SLS degradation resolution is reported to the Business Applications: SOF-sp -> LEGATO -> Business Applications
7. The status of SLS degradation resolution is reported to the Customer: Business Applications -> CANTATA -> Customer (ALTERNATIVE, SOF could provide updates via ALLEGRO)
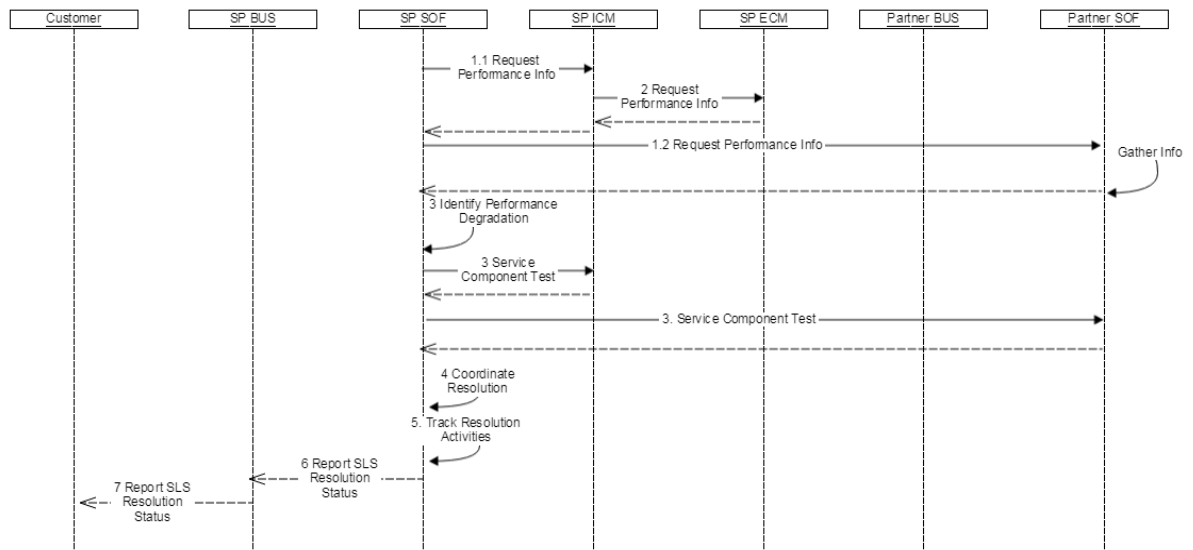
Figure A1- 5 Assessing Service Quality Based on SLS Sequence Diagram

10.7 Collection and Reporting of Billing and Usage

10.7.1 Purpose:

The Service Provider gathers relevant usage measurements and usage events in order to generate and provide a bill to the Customer. LSO collects usage measurements, traffic measurements, and service-related usage events (e.g., Customer initiated changes in service bandwidth, etc.) describing the usage of Service Components and associated resources. This information is correlated to specific Services and Product Instances. The appropriate business applications perform rating and billing based on the usage information and business rules. Where Service Components have been used beyond their SLS commitments (e.g. counting yellow traffic that provides an opportunity to upsell the customer), exception reports may be generated. Note: Partner domains may also be involved in reporting usage and generation of billing information.

10.7.2 Asynchronous Event-Driven Steps:

  i.   SOF reports service usage events to business applications: SOF-sp -> LEGATO -> BUS
  ii. SOF reports SLS violations and beyond SLS exceptions to business applications: SOF-sp -> LEGATO -> BUS

10.7.3 Steps:

  1. SOF requests current traffic and usage information related to the interfaces, forwarding constructs and network functions related to the service instance. Note: Usage can be delivered as scheduled reports:
       1. SOF requests traffic and usage information of network functions and forwarding constructs across each internal forwarding domain: SOF-sp -> PRESTO -> ICM
       2. SOF requests traffic and usage information of Service Components in each external forwarding domain: SOF-sp -> INTERLUDE -> SOF-partner
  2. If not already cached, each ICM determines the elements involved and requests traffic and usage information for the network functions and forwarding construct across each element: ICM -> ADAGIO- > ECM
  3. Once the traffic and usage information for the Service Components supporting the Service are successfully gathered, SOF analyzes the information for specific Service instances.
  4. SOF reports traffic and usage summary to business applications: SOF-sp -> LEGATO -> BUS
  5. Business applications perform rating and billing based on the usage information and business rules
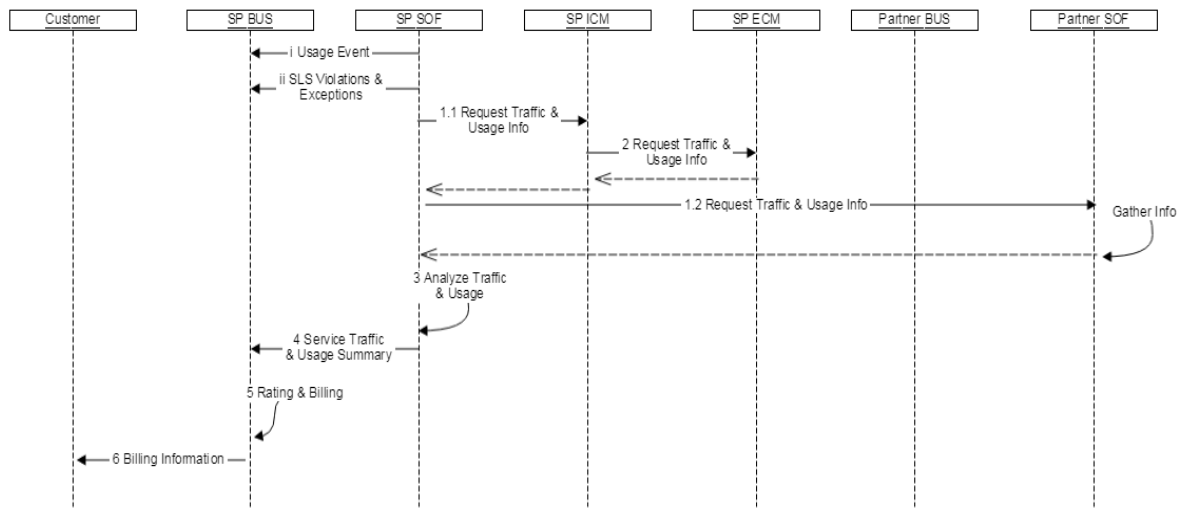 6. Bill is provided to Customer: BUS-sp -> CANTATA -> Customer

Figure A1- 6 Collection and Reporting of Billing and Usage Sequence Diagram

10.8 Securing Management and Control Mechanisms

10.8.1 Purpose:

The Service Provider needs to provide security for its management and control mechanisms. In this Operational Thread, LSO manages controlled access to management and control functions, including authentication, authorization, and auditing within LSO and with Partner and Customer domains.

10.8.2 Steps:

To be defined.

10.9 Providing Connectivity Services for Cloud

10.9.1 Purpose:

The Customer Application Coordinator in the Customer domain manages the various service needs of the cloud based applications it is supporting. It may determine that additional capacity is needed between two data centers in order to provide for the demands of the applications. The Customer Application Coordinator interacts with the Service Provider to control the bandwidth of the Connectivity Services between these two data centers.

10.9.2 Steps:

To be defined.