State of the Industry Report

May 2023

Paradigm Shift – Automating Business Functions Between Service Providers

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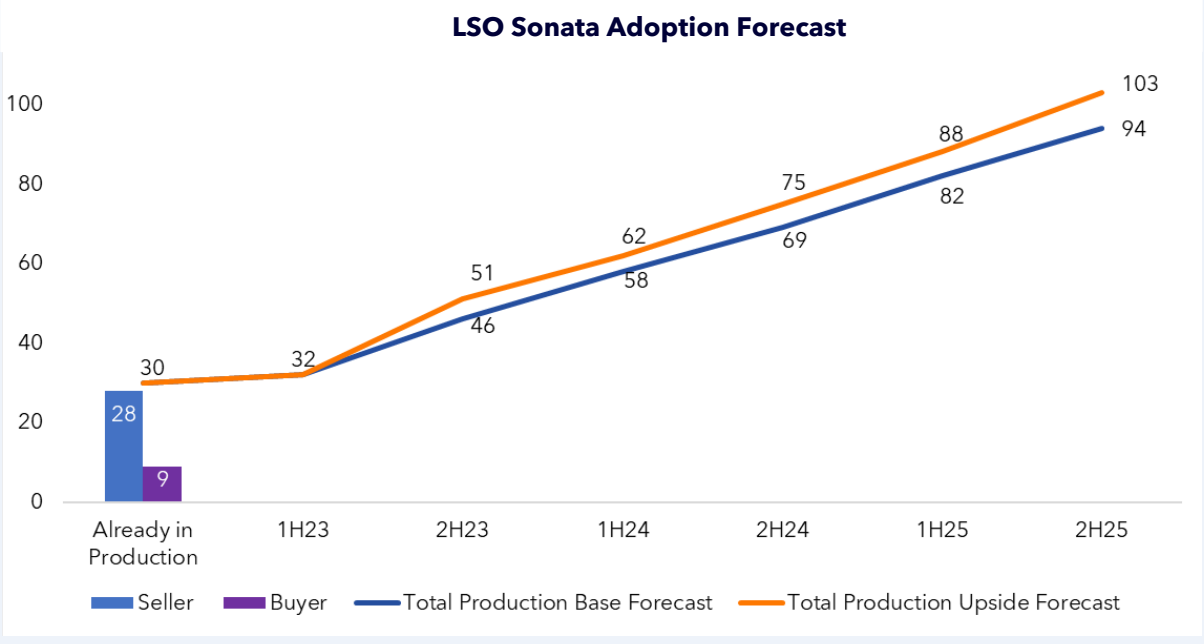
Executive Summary

The communications industry is undergoing a multi-year transformation to secure dynamic services across a global ecosystem of automated networks to address enterprise requirements for cloud-like experiences. Network-as-a-service (NaaS) platforms are particularly reflective of this trend because they combine on-demand connectivity, application assurance, cybersecurity, and multi-cloud-based services across automated networks to help enterprises achieve business outcomes without having to build and maintain their own infrastructure. NaaS solutions offer many advanced capabilities – including user control, real-time and application-driven changes, end-to-end performance visibility, pay-as-you go and monthly subscription options, etc. – that will require coordination of resources across many networks.

Next-generation services increasingly will be made of piece parts of many providers, which could include retail service providers, wholesale service providers, hyperscalers, technology solution providers, data center providers, and others. The networks supporting these services will be fully API-driven and will require standards-based automation between ecosystem players. Automation must happen throughout the supply chain where all parties in the supply chain adopt a common, standardized set of processes and APIs at both the business process and operational levels.

MEF has developed standards-based Lifecycle Service Orchestration (LSO) business process APIs and operational APIs that uniquely provide the high fidelity (tightly defined context), plug-and-play interoperability, and extensibility required to enable service providers to "invest once" and efficiently scale implementations with many partners and services.

This report primarily focuses on the hugely popular MEF LSO Sonata APIs that automate business processes between service providers. Worldwide adoption of these APIs is laying the foundation needed at the business process level for the industry to support dynamic services and NaaS solutions across the ecosystem of standards-based automated networks.



Executive Summary

MEF's proprietary research reveals 122+ service providers worldwide are now in some stage of the LSO Sonata adoption lifecycle, with at least 63 companies already in commit, plan, development, test, or production stages.

MEF forecasts the number of companies in production will increase rapidly from 30 today to 69+ by the end of 2024 before continuing to surge ahead to 94 to 103+ by the end of 2025.

Among key benefits, the LSO Sonata buy/sell model enables service providers to:

- Accelerate service delivery, with reports of an average 25% reduction in order cycle times
- Accelerate time-to-revenue on every LSO API-enabled order
- Boost revenue opportunities by becoming a preferred provider
- Improve customer experience and loyalty
- Migrate toward more competitive, dynamic services
- Quickly implement a set of LSO Sonata APIs in 3 to 5 months with the help of LSO solution providers
- Cost-efficiently scale implementations with many partners and services, especially when using the MEF LSO API Onboarding & Interop Test (OIT) service

MEF currently offers a robust set of LSO Sonata business APIs for address validation, site query, product offering qualification, quote, product order, product inventory, trouble ticketing and incidents, appointment, work order, and billing and settlement supporting Carrier Ethernet Access E-Line and Internet Access services. More business functions and additional MEF-standardized and MEF-endorsed services – including wavelength, dark fiber, edge compute, 5G fixed wireless access, and other services – will be supported in the future.

Essentially the same set of LSO APIs – in the form of LSO Cantata APIs – can be used to automate business functions between service providers and enterprises for subscriber CE and Internet Access services today and will support SD-WAN, SASE, Zero Trust, edge compute, and other services in the future.

This report highlights many resources available to help accelerate adoption of all MEF LSO business and operational APIs.

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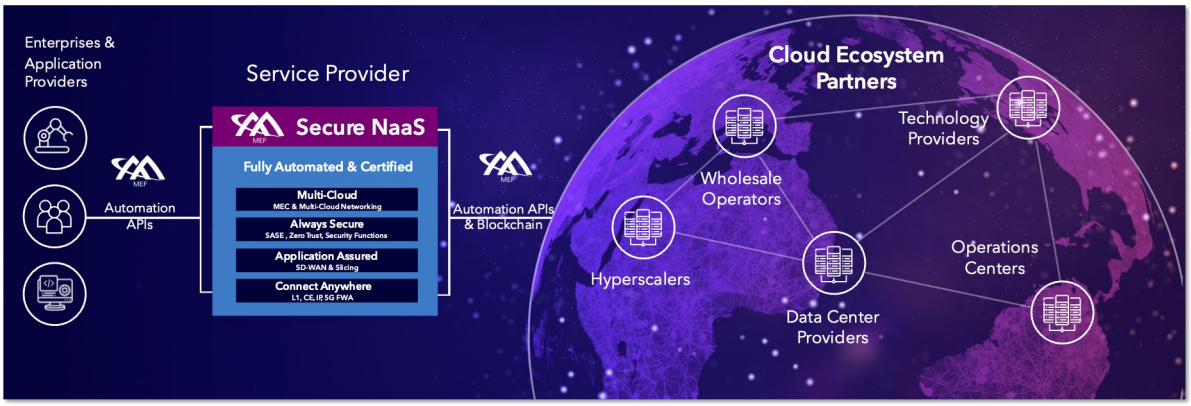
Introduction – Enabling Secure Dynamic Services Across Automated Networks

Industry Transformation & Automation

The communications industry is undergoing a multi-year transformation to secure dynamic services across a global ecosystem of automated networks. Enterprises worldwide are accelerating digital transformation and cloud migration to improve operational excellence, increase business agility, and provide a better customer experience. Service providers are striving to empower customers with innovative solutions designed to meet a diverse range of connectivity, cloud access, application performance, visibility, control, and cybersecurity requirements in multi-cloud and work-from-anywhere environments.

SPs, technology solution providers, and industry organizations are collaborating at a stepped-up pace to build a standards-based ecosystem that will accelerate service delivery across multiple providers, speed time to revenue, provide a cloud-like customer experience, and power new innovations like network-as-a-service (NaaS).

Building a Frictionless Automated Ecosystem



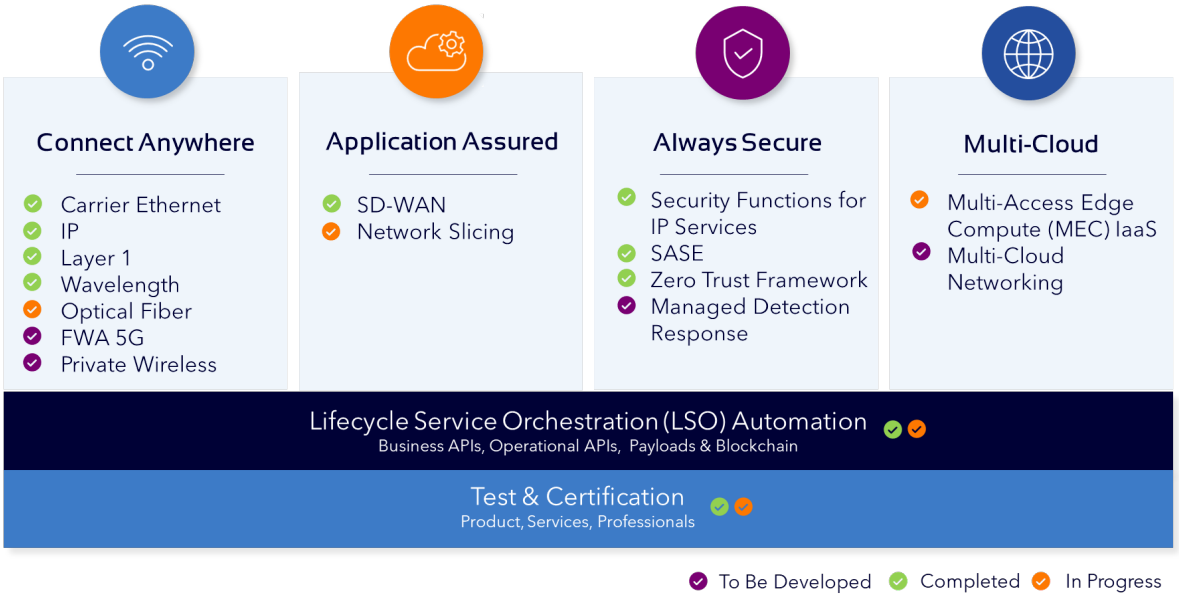
The shift towards a rapid transaction, automated ecosystem is energized by business, operational, network, and workforce transformations taking place within many innovative SPs, but the driving force at a macro level is the exponential pace of technological change in today's hyper-connected digital economy. The unprecedented pace of change is an inescapable force motivating business leaders to automate wherever possible to boost productivity, compete more effectively, and deliver compelling value in an increasingly on-demand world.

Organizations working to build out the automated ecosystem are guided by a common desire to create a frictionless environment that will generate new business opportunities for all ecosystem participants and increase their business agility to deal with constant change.

First and foremost, players want to provide a cloud-like experience for enterprises. This means not only seamlessly delivering dynamic services when and where enterprises want them, but also providing visibility into performance end-to-end regardless of customer locations. In an industry sea change, it also means enabling enterprise software developers, enterprise applications, and enterprise systems to directly interact with SP networks via standardized APIs – taking a big leap forward for innovation compared to interaction via proprietary portals commonplace today.

Prioritizing the needs of both enterprise IT professionals and application developers is especially important because the cloud-like experience should flow from the enterprise, and all the alignment of wireline and wireless (i.e., 5G and WiFi) network resources and partners across the ecosystem should be hidden from users. While IT pros deal in the world of detailed APIs like the LSO APIs currently available and covered in this report, the industry also needs to be forward thinking about an intent-based networking (IBN) model that can meet the needs of app developers working on digital transformation use cases. App developers would like to interact with the network via a natural language/declarative approach – like "get quote," "share my location," etc. – without having to ask low-level API questions. IBN APIs are an exploratory area of MEF work and beyond the scope of this paper, but companies making decisions about investing in LSO APIs need to keep IBN in mind as part of their automation journey.

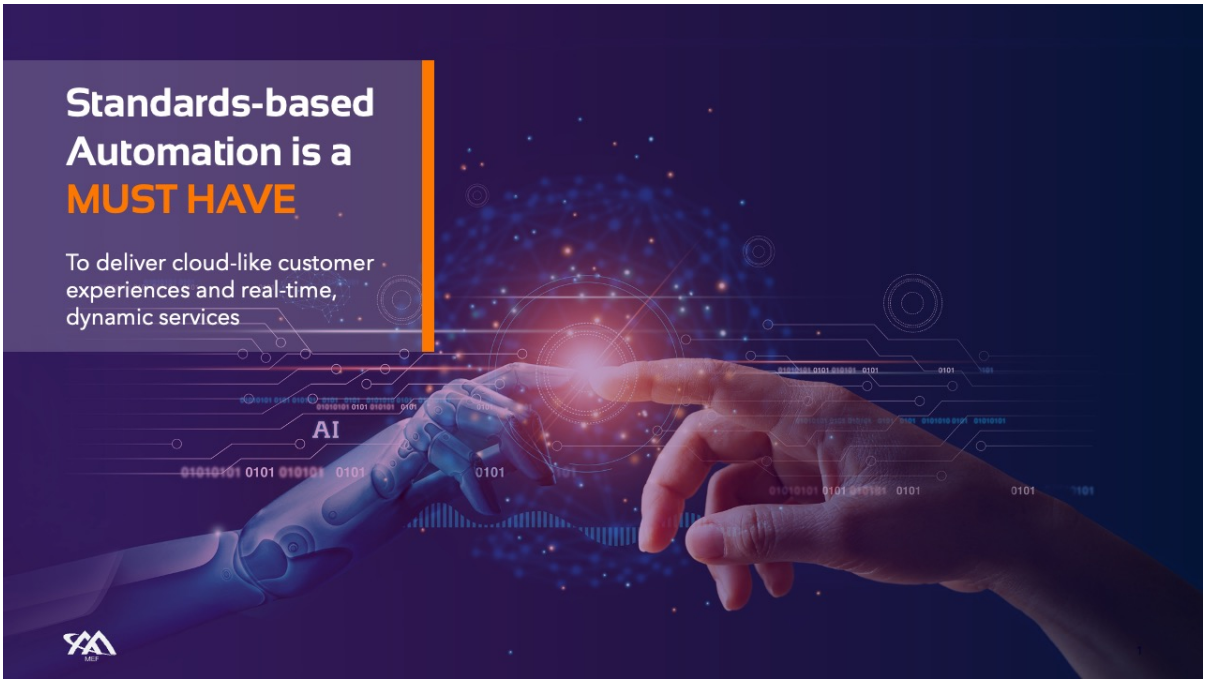
MEF Technical Underpinning for Secure NaaS



NaaS is one of the hottest areas innovation today that is particularly reflective of the transformation vision of a global ecosystem of interconnected, automated networks. NaaS platforms combine on-demand connectivity, application assurance, cybersecurity, and multi-cloud-based services across automated networks to help enterprises achieve business outcomes without having to build and maintain their own infrastructure. NaaS solutions are elastic and dynamic and generally will offer many advanced capabilities – including user control, real-time and application-driven changes, end-to-end performance visibility, pay-as-you go and monthly subscription options, etc. – that require coordination of a federation of resources provided by numerous ecosystem partners.

NaaS cannot be done without automation that is standards-based. This automation must happen throughout the supply chain where all parties in the supply chain adopt a standard set of processes and APIs at both the business process and operational levels.

MEF currently is developing a blueprint for secure NaaS that combines standards-based services, LSO automation, test and certification programs, and more. This will be the topic of a separate State of the Industry report that will be available in early 2024.



With this as a backdrop, standardized automation clearly is no longer a choice for a large and growing number of service providers. It is a "must have" to deliver cloud-like customer experiences. This is the case within SPs (north/south) and between SPs and connected partners, data center companies, enterprise customers, and cloud providers (east/west).

Standardized APIs are Foundational for Automated Ecosystem
Standardized APIs are essential building blocks for automating business and operational functions and are critical for enabling parties to interact reliably and efficiently within an interconnected, automated ecosystem. Industry organizations – including MEF, the ITW Global Leaders' Forum (GLF), and TM Forum – have collaborated to drive development and adoption of standardized APIs with the goal of unlocking the full potential of this ecosystem.

MEF has introduced sets of standards-based business process APIs and operational APIs that build upon and enhance TM Forum APIs to enable SPs to "invest once" and scale implementations with many partners and services across automated supply chains that extend to enterprises and cloud providers. In March 2023, the GLF formally announced its endorsement of MEF LSO APIs in order to accelerate their adoption and promote ubiquitous automated connectivity worldwide.

MEF Business Process APIs are Hot!
This report focuses primarily on MEF APIs used to automate business functions between service providers because this is the hottest area of market activity. These APIs – collectively called LSO Sonata APIs – are emerging as the preferred way to do business for buyers and sellers seeking to transition from costly, time-consuming, and unscalable manual processes and proprietary APIs. That said, LSO Sonata adoption is just the one of several important steps on a complete automation journey that encompasses LSO operational APIs and blockchain as well.

MEF Business APIs Enable Unique Scalability with Partners & Services

MEF LSO Sonata APIs have attracted worldwide attention because they are uniquely designed to enable SPs to transition from manual processes and isolated islands of customized APIs to an open, interoperable standards model that enables plug-and-play reuse of APIs with any partner and service with minimal additional cost and effort. This is a critically important benefit that helps justify initial investment in LSO Sonata API development, testing, and implementation. In addition, companies that have invested in TM Forum APIs generally will find a workable migration path to LSO Sonata APIs that leverages their investment while unlocking the ability to quickly and affordably scale in a federated ecosystem.

MEF offers a robust set of LSO Sonata APIs for address validation, site query, product offering qualification, quote, product order, product inventory, trouble ticketing & incidents, appointment, work order, and billing and settlement supporting Carrier Ethernet Access E-Line and Internet Access services. More business functions and additional MEF-standardized and MEF-endorsed services – including wavelength, dark fiber, edge compute, 5G fixed wireless access, and other services – will be supported in the future. This polymorphic nature of the APIs makes them ideally suited for building NaaS platforms and bundled service solutions.

There is more good news. Essentially the same business APIs can automate similar business functions between SPs and enterprises when selling subscriber services, including CE E-Line, CE E-LAN, and Internet Access today, and SD-WAN, SASE, edge compute, and other services in the future. In this case, they are referred to as LSO Cantata APIs.

Implementing MEF Business & Operational APIs for End-to-End Service Automation

This report explores how MEF's standardized business APIs are reshaping the industry by automating commercial service transactions in a scalable manner. We will describe their role in the automated ecosystem, explore their current and forecasted adoption, and dive into the compelling business case for SPs to implement them as buyers/sellers. We also will explain how integrating business APIs with LSO Blockchain can further reduce supply chain friction by reducing and eliminating billing-related disputes between buyers and sellers.

While the report centers on LSO business APIs, we also will examine the importance of a holistic approach to service automation that includes standardized LSO operational APIs for service provisioning/control/change, performance management, fault management, etc. as part of the overall digital transformation process.

Finally, we will discuss the many LSO solution providers, MEF's Onboarding and Interop Test (OIT) service, the MEF 3.0 LSO Business API Certification program, and other resources available to accelerate the automation journey regardless of a company's starting point.

Report Background & Companies Engaged in Research

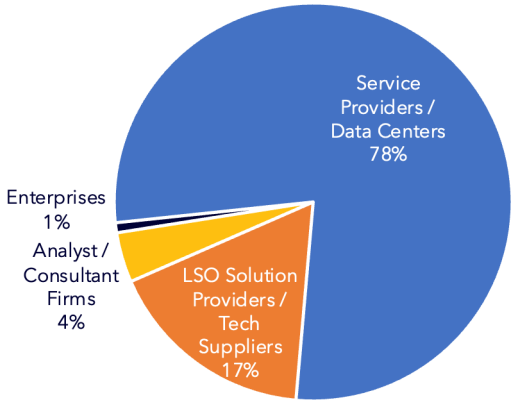
This document is MEF's inaugural *State of the Industry* report focused on automation of business functions between service providers, which is foundational to the creation of an inter-connected ecosystem supporting secure, dynamic services with cloud-like agility. The report builds upon and significantly extends beyond MEF's survey-based *LSO Sonata Adoption Trackers* published in 2021 and 2022 exclusively for MEF members.

This report is one of the industry's most comprehensive research efforts ever conducted on the topic of automating business functions between service providers. Senior MEF staff engaged in direct conversation with more than 360 individuals from 123+ companies between March 2022 and May 2023 to develop the research base for the report. This includes 300+ professionals from 96+ SPs and data center companies.

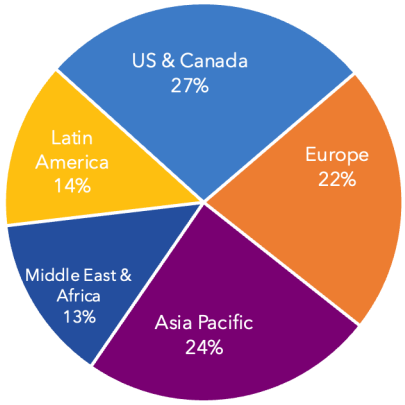
Many individuals who participated in discussions with MEF are executives and other senior-level professionals who attended global and regional networking events, including ITW, Capacity Europe, Mexico Connect, PTC, Metro Connect USA, Capacity Middle East, Capacity LATAM, and MEF Member Meetings.

The following is a breakdown of the types of companies involved in the research effort.

123+ Companies Engaged in Research



96+ SPs & DCs Engaged in Research



This report also incorporates additional data from MEF's 2021 and 2022 LSO Sonata surveys and public information from the GLF and TM Forum.

"On behalf of MEF, I want to thank all of the individuals and companies who have participated in discussions with our team, sponsored this report, and contributed to LSO API standards development and implementation. Your time, effort, and energy have been invaluable and are greatly appreciated!"

— Stan Hubbard, Principal Analyst, MEF

Building an Automated Ecosystem Based on Standardized APIs

Industry Collaboration Creating Standards-Based Framework for Automated Ecosystem
For nearly a decade, industry organizations, service providers, and technology vendors have been driving toward a common goal of enabling more secure dynamic services across an ecosystem of automated networks based on standardized APIs and standardized services. In recent years, the pace of this shift has picked up with the help of increased collaboration among member-driven international organizations like MEF, TM Forum, and the GLF. Highlights include:

2023
- The GLF formally endorsed worldwide adoption of MEF LSO APIs.

2022
- The number of companies in the LSO Sonata adoption lifecycle exploded to 112+ by the end of the year, with 28 in production.

2021
- MEF published its first *LSO Sonata Adoption Tracker*, which initially counted 32 companies in the LSO Sonata adoption lifecycle, with 13 in production.

2020
- MEF and TM Forum announced completion of initial efforts ensuring their alignment to use standardized APIs to automate inter-provider services.

2019
- AT&T and Colt announced the first production implementation of LSO Sonata APIs to automate service ordering.
- The GLF began publicly supporting MEF's LSO Sonata API work to make it easier to buy and sell services between international SPs.

2018
- MEF made available its first LSO Sonata API specifications and software development kits (SDKs) in a developer release. By this time, more than 40 service and technology companies had participated in standardization, demonstration, and other LSO API-related initiatives.

2017
- MEF introduced its transformational MEF 3.0 Global Services Framework for defining, delivering, and certifying assured services across a global ecosystem of automated networks.
- MEF 3.0 Proof of Concepts and TM Forum Catalyst demonstrations around this time included combinations of TM Forum Open APIs and MEF LSO APIs.

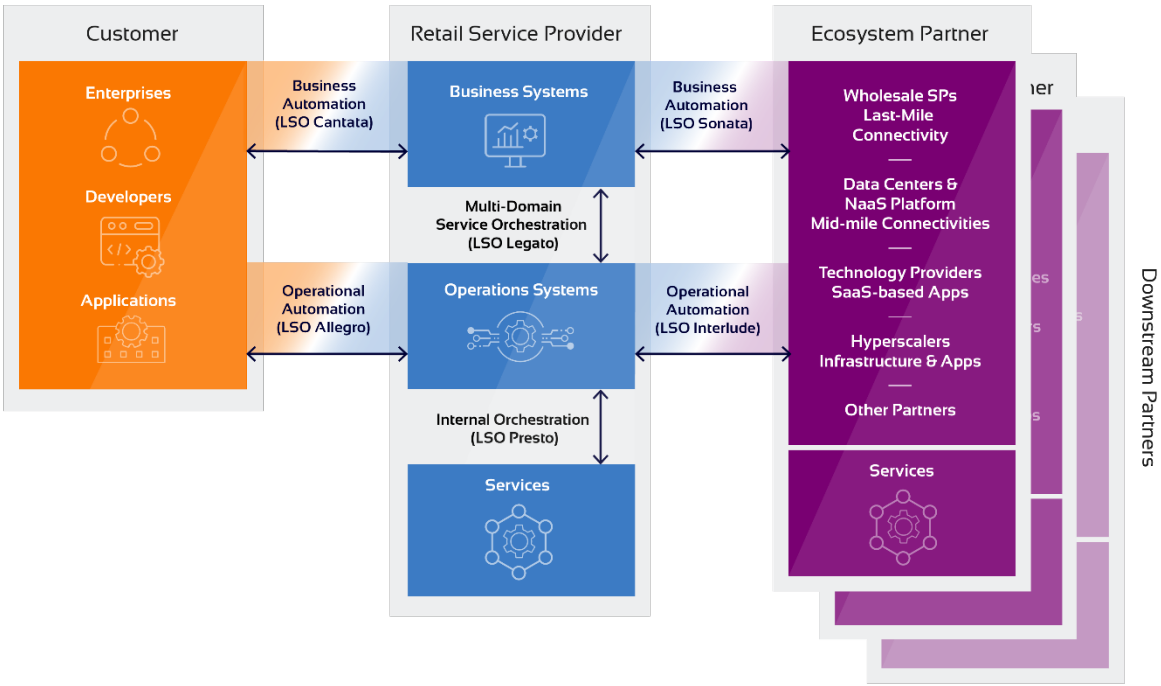
2016
- MEF published its foundational LSO framework standard.
- MEF spearhead a joint white paper with TM Forum and other organizations that articulated a shared vision for enabling agile services across automated networks.

2015
- MEF and TM Forum created a landmark collaboration program to accelerate the shift to dynamic services across automated, interconnected networks based on standards.

MEF LSO Model for Automated Ecosystem

As highlighted above, MEF has played a lead role in creating the foundational architecture for a standards-based global ecosystem of automated networks. The MEF 3.0 Global Services Framework incorporates all the key elements necessary to build such an ecosystem, including standards-based underlay and overlay connectivity services (Carrier Ethernet, Internet Access/IP, Optical Transport, and secure SD-WAN), Secure Access Service Edge (SASE) services, Zero Trust, cybersecurity, LSO APIs, and test and certification programs for services, technologies, and professionals. And the MEF 3.0 LSO Reference Architecture and Framework provides the model for automating the full lifecycle of MEF-defined and non-MEF services end-to-end across ecosystem participants and within service provider networks.

Lifecycle Service Orchestration (LSO) Model for Automated Ecosystem



The MEF LSO framework describes the interface reference points for LSO APIs that are required to automate business process functions between ecosystem partners and operational functions between and within network service providers. MEF refers to these reference points in musical terms as follows:

- LSO Sonata and LSO Cantata for automating business functions between companies
- LSO Interlude and LSO Allegro for automating operational functions between companies
- LSO Legato and LSO Presto for automating operational functions within service providers

MEF has published 45 LSO-related standards and nine LSO SDKs and currently has more than 35 LSO-related active projects, incubation groups, and other initiatives underway. This work has involved contributions from professionals employed by dozens of companies as well as coordination with other organizations like TM Forum and the GLF.

Benefits of Shifting from Manual Processes & Proprietary APIs to Scalable Automation Model

MEF LSO Sonata and other LSO APIs are designed to enable the industry to shift from costly, time-consuming, complex, error-prone, and unscalable manual processes and customized APIs to an open standards model that enables companies to "invest once" and scale implementations with many partners and services with minimal additional investment. As illustrated below, this many-to-many model yields numerous competitive service, revenue, and operational benefits for adopters along with a superior experience for customers.

MEF LSO APIs Enable Scalable Plug-and-Play Standards Model

CUSTOMER EXPERIENCE
Long cycle times out of synch w/ digital enterprise needs
Complex manual processes and costly human errors
Mix of emails, spreadsheets, ASOG/ASR, portals & proprietary APIs

COMPETITIVE, DYNAMIC SERVICES
Most services are static
Dynamic services are typically over own network, isolated islands

SERVICE DELIVERY
Slow – months or weeks w/ manual processes, queuing delays

REVENUE
Slow time to revenue
Potential revenue loss to competitors who adopt standardized APIs

API INTEGRATION WITH BSS/OSS
Significant time/cost for each new partner – up to 18 months/partner
Potentially many years/decades to customize APIs w/ dozens of partners

COST CONTROL & SCALABILITY
Expensive, poor scalability w/ pairwise APIs for each partner & service
High resource costs – multiple processes, manual errors, steep learning curve, time & personnel to manage many proprietary APIs and portals

CUSTOMER EXPERIENCE
Shorter cycle times aligned w/ digital enterprise needs
Cloud-centric, on-demand, frictionless experience
E-to-E business process & operational automation w/ scalable APIs

COMPETITIVE, DYNAMIC SERVICES
Automation-enabled secure NaaS, on-demand, dynamic services
Dynamic services can extend to many partners w/ standardized APIs

SERVICE DELIVERY
Faster – minutes when physical infrastructure is in place

REVENUE
Faster time to revenue and higher quote volumes
Gain preferred status & potential revenue boost w/ API-enabled buyers

API INTEGRATION WITH BSS/OSS
One-time development cost & a few months for a set of LSO business APIs
Then a few weeks or less for pre-production interop testing per partner

COST CONTROL & SCALABILITY
Lower opex, ease of use, high scalability – develop set of standard APIs once; reuse with any partner & service w/ minimal additional investment

The Problem – Manual Processes & Proprietary APIs of Legacy Buy/Sell Model

For context related to LSO Sonata APIs, let us consider the case of a retail service provider who needs to provide an enterprise customer connectivity to many locations in different cities or regions. No single SP has facilities to reach all customer locations. Typically, a provider can reach some of the locations on their own network (on-net) but must work with a set of partners to reach the other locations off their network (off-net). For much of the industry, the commercial interaction between SPs and partners to deliver on-net and off-net services is still predominantly manual – involving emails, spreadsheets, phone calls, negotiations, etc., resulting in long wait times and extra costs to set up connectivity.

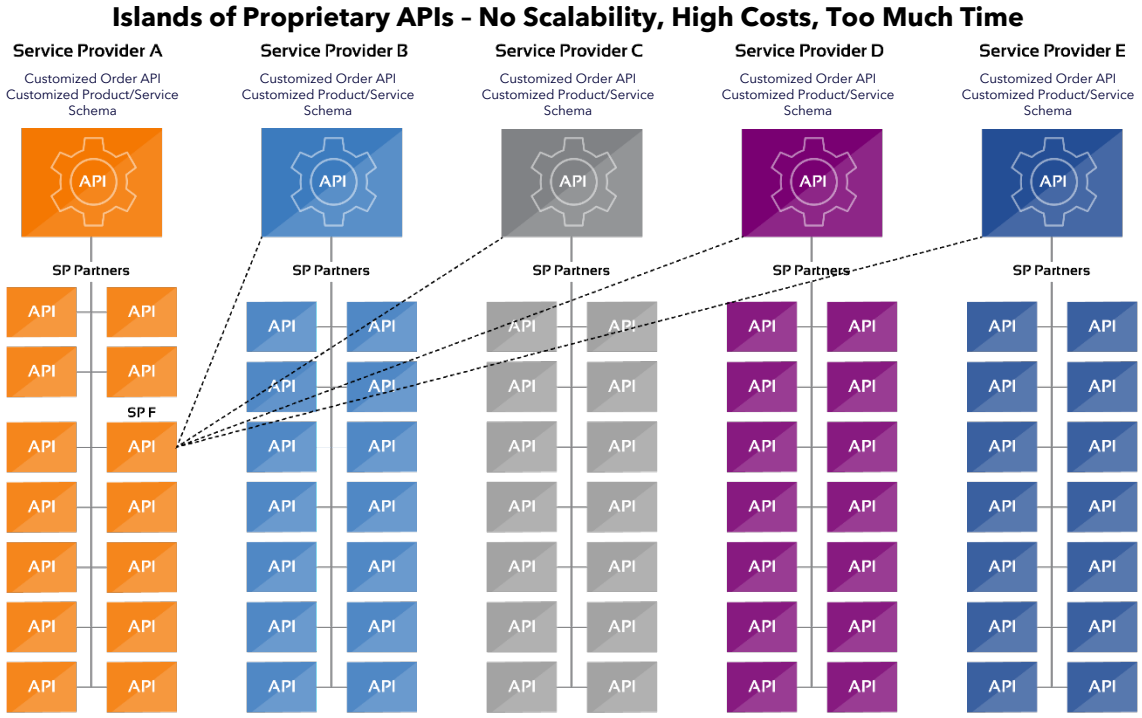
The case often is obvious that having APIs to automate quote, product order, and other functions could help accelerate service delivery and time to revenue, remove much potential error inherent in manual processes, and provide greater value for customers. The conversation then tends to focus on what kind of APIs should be utilized, for which partners and products/services should APIs be used, and how much it will cost to develop, test, and scale API implementations over time.

A number of large SPs in recent years have invested in custom, pairwise APIs to automate some business functions with a limited number of high-volume buy/sell partners for a small number of services. While this has yielded a certain level of benefits, setting up proprietary APIs just with a single buy/sell partner can take a year to 18 months for large SPs. Customizing the APIs for each significant buy/sell partner and multiple types of services with these partners would be prohibitively expensive and time-consuming. Some of the largest SP buyers, for example, have hundreds of seller partners. As an API expert at a large pan-European provider explained, "If I had to set up proprietary APIs with 200+ partners, we'd still be here working on it in 100 years."

The diagram below illustrates that investing in proprietary APIs simply is not sustainable from a business point of view if you have any intention of scaling cost-effectively and in a timely manner with a significant number of partners. Let us assume that service providers A thru E (buyers) want to automate a single API (product order) for a single service with downstream partners (sellers).

- All five SPs decide to jump-start API development by leveraging – as an example – the TMF622 Product Ordering standard, which is a very good specification but is designed to be generic in nature. Because the API is generic, it has to be modified, and product & service schemas have to be added. These changes result in each of the five SPs creating their own proprietary APIs.
- SPs A thru E all require their seller partners to snap to their own customized version of the order API. This leads to islands of APIs that are all configured and customized differently.
- Additionally, each partner of SP A would have to modify their API to be able to sell to any of the other SPs, as illustrated by the dotted lines flowing from SP F. To make matters worse, each of these proprietary APIs would have to be supported over time with updated releases.

Clearly this is not a sustainable approach for building a large and vibrant automated ecosystem.



The Solution – MEF LSO Standards-Based Service Automation Model

Fortunately, MEF's LSO-based automation model fundamentally alters the equation when it comes to presenting a compelling business case for automating business and operational functions with standardized APIs. MEF's unique approach enables SPs to develop, test, and implement a set of LSO Sonata APIs in as little as three to five months and reuse the APIs to scale implementations with many partners and services with minimal additional investment (including periodic expenditures to align to new SDK releases that expand support for new functions or services).

In short, MEF has enhanced TM Forum Open APIs, created many resources to assist LSO API implementations, and developed MEF-defined product & service schemas that enable companies to scale deployments with tightly defined business context, plug-and-play interoperability, and extensibility to support a broad range of products and services.

MEF Enhances & Extends Beyond TM Forum APIs

Enhance Generic TMF APIs for Higher Fidelity

- MEF standardized or plans to standardize 20+ LSO business & operational APIs, most leveraging TMF APIs
- MEF expands context definition of parameters in TMF APIs
- MEF enhances TMF APIs w/optional parameters
- Governance & alignment to TMF API Domain Context Specialization (DCS) guidelines
- MEF's polymorphic approach combines product/service-agnostic envelopes + product/service-specific payloads

MEF API Resources for Better Developer & Deployment Experience

- Business Requirements and Use Case specifications
- API Developer Guides
- Static & dynamic binding approaches
- LSO Marketplace
- LSO solution providers & LSO partners
- LSO Onboard & Interop Test (OIT) Service
- Cloud-based certification
- LSO Partner Conferences/Summit
- LSO Adoption Tracker

MEF-Defined Product and Service Schemas for Full Interoperability & Extensibility

- Committed to supporting nearly 20 MEF-standardized or MEF-endorsed product and service payloads
- Extensibility to create any product and/or service using MEF guidance documentation

TMF Generic APIs / Envelope
- Generalized context

Generic API Framework

Product-Independent Functions

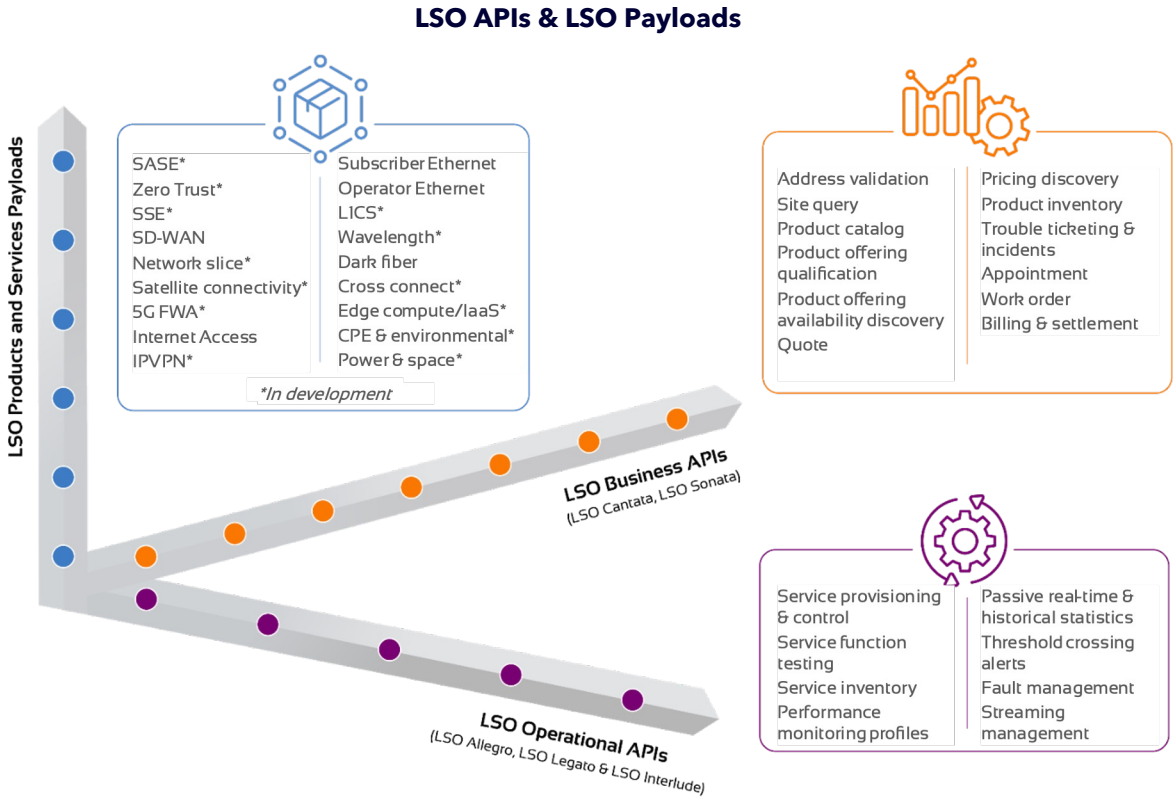
TMF Payloads
- No standards for schema

MEF Modified LSO APIs / Envelope
- Specific context for interoperability based on MEF Business Requirements and Use Case Standards
- Modifications of TMF APIs in governance with TMF

MEF Standardized
Product/Service-Specific

- SASE*
- ZT*
- SSE*
- SD-WAN*
- Network slice*
- Satellite connect.*
- 5G FWA*
- Internet Access
- IPVPN*
- Subscriber Ethernet
- Operator Ethernet
- L1CS*
- Wavelength*
- Dark fiber*
- Physical & virtual cross connect*
- Edge compute/IaaS
- CPE & environmental*
- Power & space*
- Non-MEF payloads built for MEF Marketplace to be used as *defacto* standard

**In development*



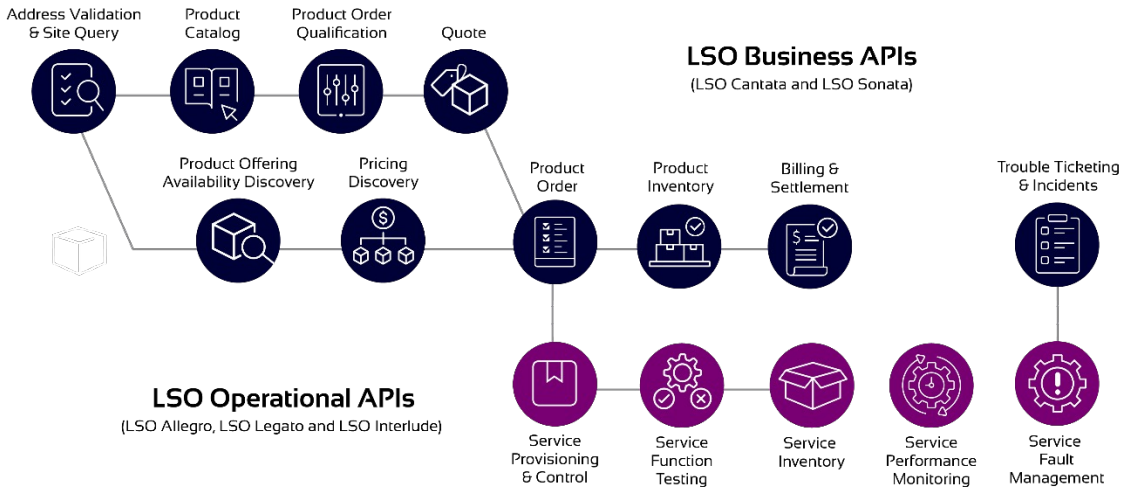
First, MEF has focused on defining more prescriptive, contextualized LSO API standards on top of TM Forum API standards so that SPs have tighter interoperable solutions for automating business and operational functions with buy/sell partners. MEF has created or is in the process of creating standards for more than 20 LSO business and operational APIs that leverage and enhance TM Forum APIs, as shown in *Appendix 1* & *Appendix 2*. MEF has expanded the context definition of parameters in APIs and enhanced these APIs with optional parameters in alignment with TM Forum's API Domain Context Specialization guidelines. The specific context for interoperability is based on MEF Business Requirements and Use Case standards associated with each of the 20+ business and operational functions.

Uniquely, MEF has taken a polymorphic approach to creating the LSO APIs that involves a combination of two key elements:

- **Product- or service-agnostic "envelopes"** – e.g., address validation, product offering qualification, quote, order, performance management, and other functions.
- **Product- or service-specific "payload" schema** – e.g., CE Access E-Line, Internet Access, SD-WAN, SASE, and other products and services.

This approach gives LSO APIs tremendous versatility. They can support MEF-defined product payloads, as well as schema developed outside of MEF, both of which can be used with LSO API envelopes. Any product and service schemas can be blended with any of the LSO business and operational API envelopes.

LSO Business and Operational APIs



To reiterate a point made earlier, MEF has focused on enabling automation of the complete lifecycle of services, including business and operational processes between ecosystem partners as well as operational processes within SPs. Investing in MEF LSO Sonata and other LSO APIs should be viewed as important steps on a holistic transformational journey that will create new business opportunities related to dynamic services and the potential to efficiently interact with a huge number of partners within an automated ecosystem/federation.

The planned rollout in July 2023 and December 2023 of multiple LSO APIs to automate operational functions between ecosystem partners introduces a particularly powerful new paradigm for the industry. For the first time, SPs will be able to provision services, test service functions, and share performance and fault information across partners and with enterprises using standardized LSO operational APIs.

Circling back to how MEF helps scale LSO API implementations, the MEF community offers a large and growing volume of resources to assist companies throughout all stages of the LSO adoption journey. This includes an expanding group of LSO solution providers, LSO SDKs, Business Requirements and Use Case standards, API Developer Guides, a powerful LSO API blending tool, and other valuable resources in the MEF LSO Marketplace, as well as MEF's popular Onboarding & Interop Test (OIT) service.

Starting in 2018, MEF has published many LSO SDKs designed to help software developers create LSO APIs. New versions of the SDKs are released approximately every six months. There is one SDK per LSO Interface Reference Point (e.g., LSO Sonata SDK, LSO Cantata SDK, etc.). Since December 2020, each release has been named alphabetically:

- Fergie: July 2023
- Ella: January 2023
- Dolly: June 2022
- Celine: January 2022
- Billie: June 2021
- Aretha: December 2020

See the *LSO Solution Providers & Implementation Scenarios* and *LSO Implementation Resources* sections of this report for more details on available resources.

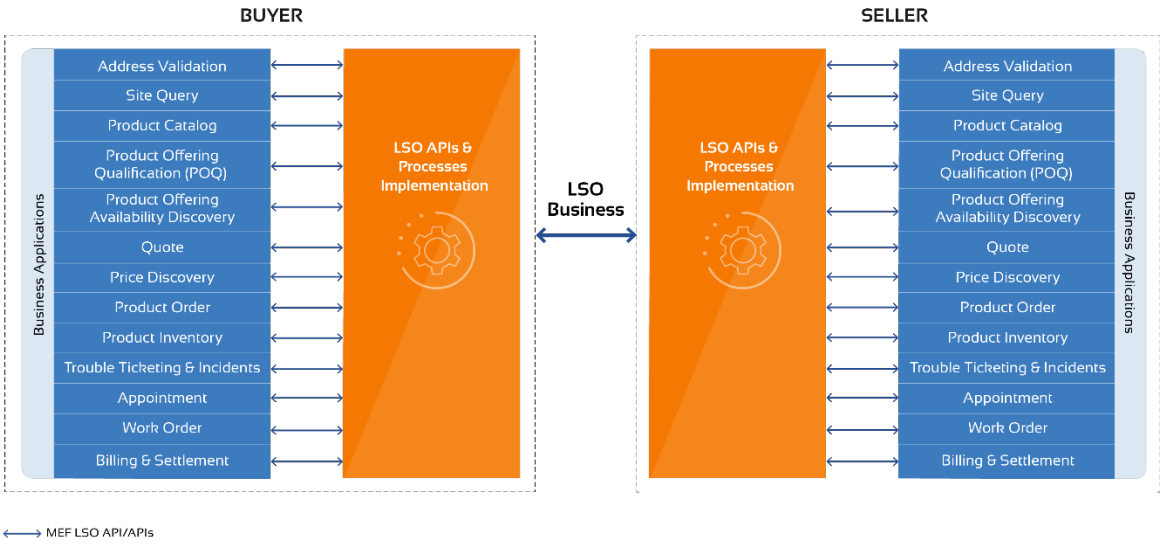
Finally, MEF is committed to supporting nearly 20 MEF-standardized or MEF-endorsed product and service payloads that can be tied to LSO API envelopes. MEF currently is working on creating extensions for multiple products and services – including SASE, Zero Trust, secure service edge (SSE), SD-WAN, network slice, and edge compute/IaaS – due to the lack of commonality among vendor technologies supporting these offerings. In addition, several active MEF Showcase projects are designed to help develop Business Requirements and Use Cases for various schemas, including edge compute/IaaS, Internet Access, satellite connectivity, wavelength, and dark fiber.

MEF LSO Product & Service Payloads

Service	Product Payload (for use in LSO Business APIs)	Service Payload (for use in LSO Operational APIs)	Plan to Include in LSO Marketplace	Plan Extension
Secure Access Service Edge (SASE)	Future	Future	MEF-standardized	✔
Zero Trust	Future	Future	MEF-standardized	✔
Secure Service Edge (SSE)	Future	Future	MEF-standardized	✔
SD-WAN	Future	Available	MEF-standardized	✔
Network slice	Future	Future	MEF-standardized	✔
Satellite Connectivity	Future	Future	MEF-endorsed	
5G Fixed wireless access	Future	Future	MEF-endorsed	
Internet Access	Available	Available	MEF-standardized	
IPVPN	Future	Future	MEF-standardized	
Subscriber Ethernet	Available	Available	MEF-standardized	
Operator Ethernet	Available	Available	MEF-standardized	
Layer 1 Connectivity Service (L1CS)	Future	Available	MEF-standardized	
Wavelength	Future	N/A	MEF-endorsed	
Dark fiber	Future	N/A	MEF-endorsed	
Physical and virtual cross-connect	Future	Future	MEF-standardized	
Edge compute/IaaS	Future	Future	MEF-standardized	✔
CPE & environmental	Future	Future	MEF-standardized	
Power & space	Future	Future	MEF-standardized	

Automating Business Functions Between Service Providers and Between SPs & Enterprises
With the Ella LSO Sonata and LSO Cantata SDK Releases, MEF now offers LSO APIs for address validation, site query, product offering qualification, quote, product order, product inventory, trouble ticket, appointment, work order, and billing. Product catalog, product offering availability discovery, and pricing discovery are planned for the Fergie SDK Release in July 2023. The LSO Sonata APIs automate these functions between SPs for CE Access E-Line and Internet Access services, and similar LSO Cantata APIs automate the functions between retail SPs and enterprises for subscriber CE and Internet Access services.

LSO Sonata/Cantata APIs Automate Business Functions



LSO Sonata/Cantata APIs Compatibility

Address Validation	A	B	C	D	E	F	G
Site Query	A	B	C	D	E	F	G
Product Catalog						F	G
Product Offering Qualification	A	B	C	D	E	F	G
Product Offering Availability Discovery						F	G
Quote	A	B	C	D	E	F	G
Price Discovery						F	G
Product Order*	A	B	C	D	E	F	G
Product Inventory	A	B	C	D	E	F	G
Trouble Ticketing & Incidents		B	C	D	E	F	G
Appointment				D	E	F	G
Work Order				D	E	F	G
Billing & Settlement					E	F	G

Key

A	Release (see list below)
↔	No Change
↔	Minor Change (Read release notes)
↔	Major Change (Read release notes)

LSO Releases

- **A** = LSO Aretha (Dec 2020)
- **B** = LSO Billie (Jun 2021)
- **C** = LSO Celine (Jan 2022)
- **D** = LSO Dolly (June 2022)
- **E** = LSO Ella (Jan 2023)
- **F** = LSO Fergie (planned Jul 2023)
- **G** = LSO Grace (planned Dec 2023)

***Note:** LSO Order API highlighted to reflect its importance in choice of LSO release.*

Below is the current roadmap for LSO business APIs. For future updates, see the SDK Release Roadmaps in the LSO Marketplace for the most up-to-date information.

LSO Business APIs Roadmap

Key

- F — Release (see list below)
- ↔ — No Change
- ↔ — Minor Change (Read release notes)
- ↔ — Major Change (Read release notes)

LSO Releases

F = LSO Fergie (planned Jul 2023)
G = LSO Grace (planned Dec 2023)
H = LSO Haley (planned Jun 2024)

Reducing Supply Chain Friction with Automated Billing Process

Earlier in this report, we proposed that service providers should view adoption of LSO Sonata and other APIs as part of a comprehensive, transformational automation journey. The journey begins with business, operational, network, and workforce transformations within SPs, then evolves to LSO Sonata/Cantata API-enabled automation of business transactions between buy/sell partners to accelerate service delivery, speed time to revenue, and improve the customer experience.

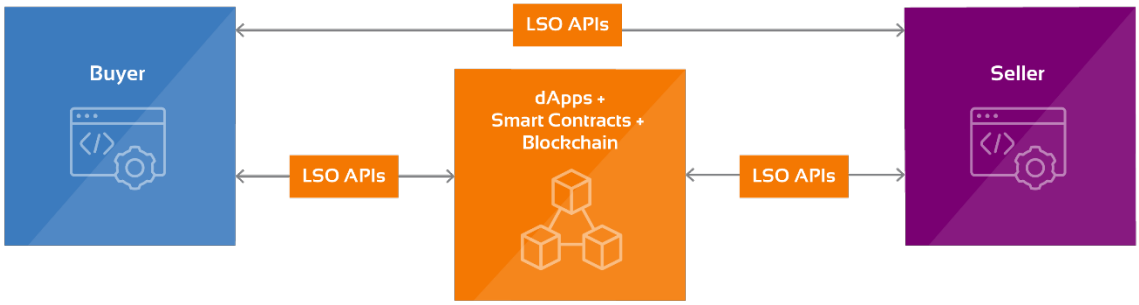
The next logical step is to extend automation to cover the complete billing process between providers, including rating, invoicing, reconciliation, and settlement. Automation of the entire billing process is critical for further eliminating commercial friction, enabling ecosystem players to offer on-demand/dynamic services across multiple networks, and cost-effectively expanding revenue opportunities for high-volume, short-duration services.

Until now, the overall billing process has been highly inefficient and error-prone. It often takes 45 to 60 days per order, is a point of contention between buyers and sellers, and can cost individual SPs millions of dollars in lost revenue per year. Revenue recovery is a time-consuming problem that many SP executives agree should be a priority item to address. As one Tier 1 SP executive stated, "Any amount you are recovering is less optimal than getting it right in the beginning."

DLT, LSO Blockchain & Smart Contracts

In recent years, SPs and technology vendors have turned to distributed ledger technology (DLT) and blockchain to help improve market efficiencies and reduce or eliminate billing-related disputes. MEF's current LSO Blockchain initiative builds upon a base MEF DLT standard and incorporates the concept of smart contracts between and among ecosystem buyers.

MEF LSO Blockchain & Smart Contracts



In 2021, MEF published its MEF 114 DLT-Based Commercial and Operational Services Framework – Billing standard that defines a DLT-based commercial and operational product framework for use in billing and settlement between SPs. The document describes how to achieve a common state frame of reference for billing transactions, presents an integration architecture between DLT and the LSO Framework, and defines a DLT-based reference architecture that facilitates bilateral and omni-lateral commercial transactions. Billing's consecutive processes are spelled out as follows:

- Rating: application of rate to product usage records
- Invoicing: the process of generating an invoice and sending it to the buyer
- Reconciliation: the process of reaching agreement on the amount in an invoice to be settled
- Settlement: the transfer of funds between parties based on invoicing and reconciliation

MEF 114 introduces the concept of DLT-based smart bilaterals and smart omni-laterals that enable confidential and complex collaborations between/among SPs without necessarily exposing sensitive business data to anyone but the companies engaged in a transaction. Smart contracts are a form of smart bilaterals.

MEF LSO APIs can be used with smart contracts to enable both the transfer of information between SPs and real-time access to a shared system of record with an audit trail that cannot be manipulated or repudiated.

LSO Blockchain is the environment in which smart contracts will live. In fact, MEF is developing a library of open standard smart contracts that address NaaS and other telecom use cases. These smart contracts will be based on Business Requirements and Use Case standards developed by MEF members. Companies will have the option of using open standard DAO (Decentralized Autonomous Organization) templates to enable trusted partners to operate the MEF smart contracts on a multilateral basis.

As explained in an October 2022 blog by Divesh Gupta of Console Connect, smart contracts are a path to a smarter future. With an automated solution that uses a smart contract, each order and its billable attributes are recorded on a distributed ledger that is made accessible to any participating SP. This eliminates the manual paper verification process and reduces settlement times from a couple of months to an instant. The success of this type of automated billing and settlement solution hinges on industry-wide collaboration, which MEF is committed to facilitate.

Securing Business and Operational APIs

Ensuring the security of LSO APIs is another important step on the automation journey that MEF is helping service providers address with the publication of the MEF 128 LSO API Security Profile standard (July 2022). This document defines the security profile, security approaches, and security architecture for LSO API security using OAuth2 and OIDC within either a centralized or federated identity provider framework.

Up until 2022, business to business automation standards as expressed through the LSO APIs lacked basic cybersecurity standards – cybersecurity "blocking and "tackling" – and advanced threat protection. One key prerequisite for a Zero Trust Framework is the implementation of blocking and tackling standards such as authentication and authorization as foundational building blocks to provide security and assurance across trust boundaries.

MEF 128 provides such context-specific cybersecurity blocking and tackling by describing specific cybersecurity functional requirements and mechanisms that help to produce consistently secure LSO API-based communications between entities across trust domains. This standard's aim is to gain alignment on detailed LSO API security mechanisms for interface reference points related to both LSO business and operational APIs, including LSO Sonata, LSO Cantata, LSO Interlude, and LSO Allegro.

Automating Operational Functions Between Ecosystem Partners and Customers

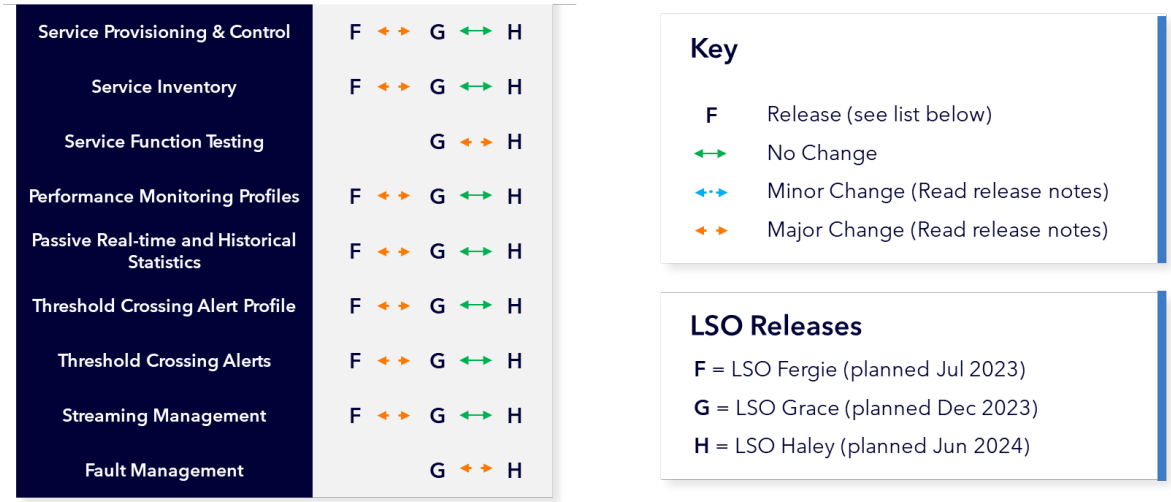
LSO operational APIs round out the picture when it comes to service automation between ecosystem partners and their customers. LSO operational APIs are designed to enable sellers of services to share with their buyer customers key elements of the lifecycle of a service once it has been ordered and provisioned, all the way through to its decommissioning. These APIs improve the user experience by providing automated visibility into, and control of, "in-flight" services with the absolute minimum of manual interaction with the seller. They also can provide significant cost savings – for example, by making it unnecessary for retail SPs to deploy network interface devices (NIDs) at customer sites served off-network by leveraging the ability of their wholesale partners to share performance data with them via an API.

In January 2013, MEF began introducing LSO operational APIs in the Ella LSO Legato SDK covering service ordering/provisioning and service inventory for use within SPs.

The next big step from an ecosystem point of view will be the rollout of many LSO operational APIs for use between buy/sell partners in the Fergie LSO Interlude and LSO Allegro SDKs planned for July 2023. These SDKs are expected to include support for service provisioning and control, service inventory, performance monitoring profiles, passive real-time and historical statistics, threshold crossing alert profile and alerts, and streaming management. Support for service function testing and fault management between providers will follow in the Grace SDKs planned for December 2023.

Below is the current roadmap for LSO operational APIs. For future updates, see the SDK Release Roadmaps in the LSO Marketplace for the most up-to-date information.

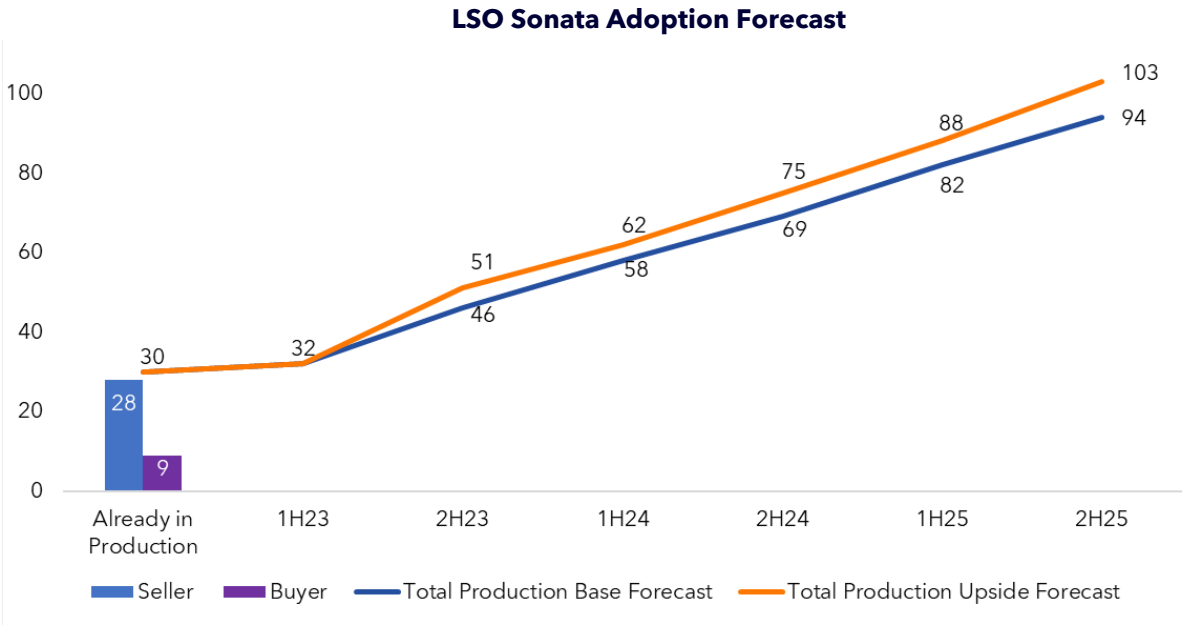
LSO Operational APIs Roadmap



Worldwide Adoption of Scalable Standardized Business Process APIs

Forecast of Companies in Production & Transacting via MEF LSO Sonata APIs
MEF research reveals a steep increase in interest and activity related to LSO Sonata APIs over the past year. **122+** service providers are now in some stage of the LSO Sonata adoption lifecycle – up ~90% since April 2022.

MEF forecasts the number of companies in production with LSO Sonata APIs will more than triple from **30 today to 94 by the end of 2025**, with an upside potential of 103+.



Building Baseline Forecast	Adoption Accelerators
• Buyer requests driving seller adoption • OIT usage by many partners • Maturing SDKs • CE Access E-Line focus	• More buyers requesting/demanding adoption by suppliers • Commitment from lead SPs in regions • Pull through of competitive providers who do not want to be left behind • Availability of solutions, tools & support to make it simpler, cost-effective to adopt APIs • Increased efforts to transition US market from ASR ordering • Support for Internet Access, waves, dark fiber, etc.

Sellers: SPs with sell-side LSO Sonata implementations are expected to increase from 28 today to 91 in 2025. 89% of 47 surveyed sellers view the APIs as a "must have." Many companies have invested in the APIs in response to specific buyer requests to implement them before the end of 2023 if possible. We expect Internet Access (DIA) will kick in as an important driver in 2024, with broadening use for other services also helping fuel activity over the forecast period.

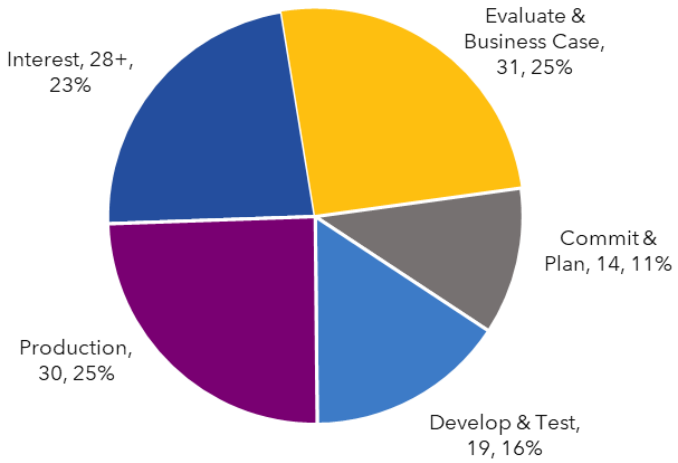
Buyers: Companies with buy-side LSO Sonata implementations are poised to grow from nine today to a range between 17 and 22 by the end of 2025. Both new buyers and existing LSO Sonata-enabled buyers upgrading from early SDK releases will be able to take advantage of a large and growing volume of sellers who have implemented or are planning to implement Dolly and Ella SDK releases.

LSO Sonata Adoption by Stage

The chart below represents a snapshot of the **122+** companies that MEF is tracking in some stage of the LSO Sonata adoption lifecycle – from interest through to production.

LSO Adoption Lifecycle

Service Provider LSO Sonata Adoption by Stage



63 companies are in commit, plan, development, test, or production stages. Of the 30 companies in production today, at least 9 are in production with multiple partners.

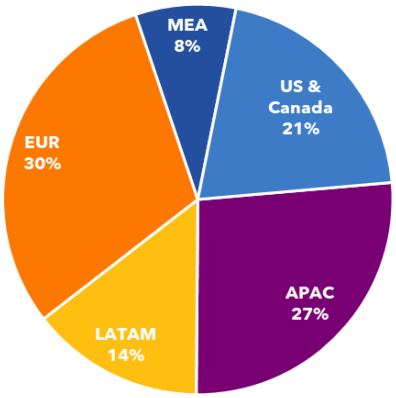
31 companies appear to be in the evaluate or business case stages, with many close to committing to working with specific LSO solution providers and partners.

28+ companies appear to be in at least the interest stage. Many of these already have had discussions with one or more potential partners. Numerous SPs currently in the interest stage factor into our 2025 baseline and upside forecasts, but we need to learn more details from them to have a better sense regarding the likelihood and timing of implementations.

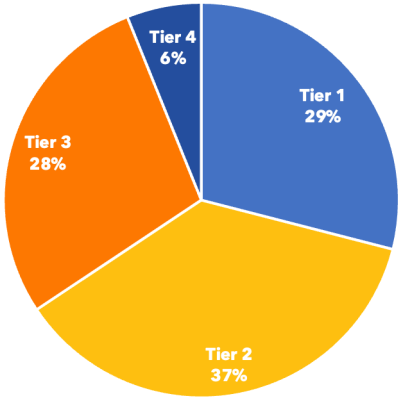
Service Providers in LSO Sonata Adoption Lifecycle by Region & Tier

LSO Sonata-related discussions and activities are growing with companies in every region of the world and are strong across Tier 1, 2, and 3 SPs. We currently appear on track to see LSO Sonata-based quoting and ordering available in at least 51 countries by the end of 2023.

All SPs in LSO Sonata Adoption Lifecycle – by Region



All SPs in LSO Sonata Adoption Lifecycle – by Tier



Europe: 37+ companies based in Europe are in the LSO Sonata adoption lifecycle, including 22 in production or committed to production with LSO Sonata APIs. Europe leads the world in the number of SPs in production (10). Europe also leads in the commit, plan, development, and test phases (12). At least 18 Tier 1 and 2 SPs based in the region are in production or committed to production.

Asia Pacific: 32+ companies based in APAC are in the LSO Sonata adoption lifecycle, including 18 in production or committed to production. At least 14 Tier 1 and 2 SPs based in APAC are in production or committed to production.

US & Canada: 25+ companies based in the US or Canada are in the LSO Sonata adoption lifecycle, including 12 in production or committed to production. 10 Tier 1 and 2 SPs and a large multinational enterprise based in the region are in production or committed to production. The largest SP buyers and sellers – including AT&T, Verizon, and Lumen – are committed at an executive level to driving the transition from the legacy ASR ordering process to LSO Sonata.

Latin America: 18+ companies based in LATAM are in the LSO Sonata adoption lifecycle, including nine in production or committed to production.

Middle East & Africa: 10+ companies based in the Middle East & Africa are in the LSO Sonata adoption lifecycle, including a couple in the commit, plan, development, or test phases.

ITW GLF Board Members: 23 of the 32 international SPs on the ITW Global Leaders' Forum Board are tracked in the LSO Sonata adoption lifecycle, including 15 in production or committed to production with LSO Sonata APIs.

Companies Committed to and in Production with LSO Sonata APIs
Below, we have included logos with permission for 31 of the 63 companies in production or committed to production with LSO Sonata APIs and buyers and/or sellers. These companies represent a mix of tiers from every region of the world. We expect to add many more logos to our list in the coming months.

30 Companies in Production with LSO Sonata

33+ Companies Committed to Implementing LSO Sonata

Quite a few companies currently in production implemented earlier R4, R3, or R2 SDK releases. We understand multiple companies are in the midst of upgrading to more recent releases, which will enable them to transact with more partners in the growing ecosystem.

What About LSO Operational APIs? An important industry milestone was achieved in 1H 2023 with the first service provider entering production with an LSO operational API. Satellite operator SES has implemented an LSO API for performance monitoring and intends to migrate its customer base to MEF-standardized APIs. MEF will be tracking companies in the LSO Operational APIs adoption lifecycle in coming months.

Business Case for Standardized LSO Sonata Business Process APIs

In our discussions with service providers and data center players, we have encountered companies that generally fall into two camps when it comes to the LSO Sonata business case. There are (1) "just do it" companies and (2) companies that want to spend more time up-front to examine the merits of the APIs and develop an extensive business case for investing in them.

Considerations of "Just Do It" Companies
Over the past two years, a large number of SPs outside of the United States have told us they are implementing on planning to implement LSO Sonata APIs on the sell side to address a key customer requirement. To paraphrase a typical comment we have heard: "When one of your largest wholesale customers tells you that you need to implement LSO Sonata APIs, that makes a compelling business case for doing so."

We also have encountered numerous executives and other senior experts at companies who readily acknowledge the need to invest in LSO Sonata APIs upon learning about their purpose and market adoption – independent of a request from a specific partner to implement them. Here are some examples of what we have heard:

- A senior product expert at a US Tier 1 SP said that sometimes the business case is so obvious – as with LSO Sonata – that you don't need to spend a lot of time developing it.
- The head of operations at an APAC Tier 1 SP stated that "everyone in the industry is moving toward automation," and his company is as well with the intention of using LSO Sonata APIs.
- One CEO at a US Tier 3 SP called LSO Sonata APIs a "no brainer" after hearing about them the first time.
- A VP of software at an APAC Tier 3 SP said that "at some point, it becomes a no brainer" for his company to implement LSO Sonata given their widespread adoption.

Considerations of Companies Building Business Case
Factors justifying the business case for implementing and transacting via LSO Sonata APIs will vary across the industry, but we believe there are a core set of factors that service providers and data center players should consider regardless of how far along they are on their automation/digital transformation journey. There are also additional factors to consider for companies that already have begun their automation journey with proprietary/customized APIs and are exploring if/when they should transition to LSO business APIs, and possibly also LSO operational APIs.

Important considerations for the LSO Sonata business case are summarized below.

- API economy is surging
- Service providers see high value in automating business functions with LSO Sonata APIs
- LSO business and operational APIs are key to meeting the GLF service providers' requirements
- Future network is fully API-driven and requires standardized automation between players
- LSO Sonata APIs yield many real-world benefits/ROI
- LSO Sonata adoption is a question of when, not if, for many SPs
- LSO Sonata APIs can be implemented in a phased approach
- MEF LSO API OIT service accelerates implementations and upgrades
- MEF offers a robust set of popular LSO Sonata SDKs with maturing APIs
- Expect LSO Sonata implementations supporting many product payloads
- MEF offers many resources to help accelerate adoption of LSO APIs

API Economy is Surging

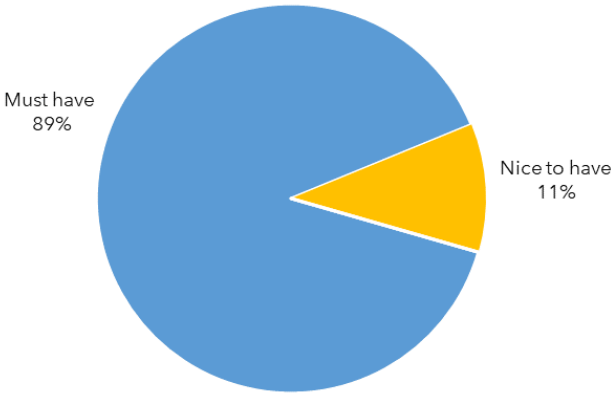
In January 2023, API hub provider Rapid released its annual *State of APIs Report*, which highlights global trends in software development and API usage across industry verticals, including financial services, technology, manufacturing, telecommunications, healthcare, professional services, and government. Drawing upon feedback from 850 professional developers and others, Rapid found that "the market has shifted to where businesses focused on digital transformation now need to be an API business in order to thrive." As Rapid CEO Iddo Gino stated, "Many organizations rely on their developers for technologies that will help them stay competitive in today's economy, and in turn the developers are increasingly leveraging APIs for speed and operational efficiency."

Rapid found that the API economy is surging. Over 75% of surveyed developers across all verticals see participating in the API economy as a priority or plan to prioritize APIs soon. API momentum is strongest in the telecommunications vertical, with 83% saying participating in the API economy is a top priority (72%) or soon will be a priority for their company (11%).

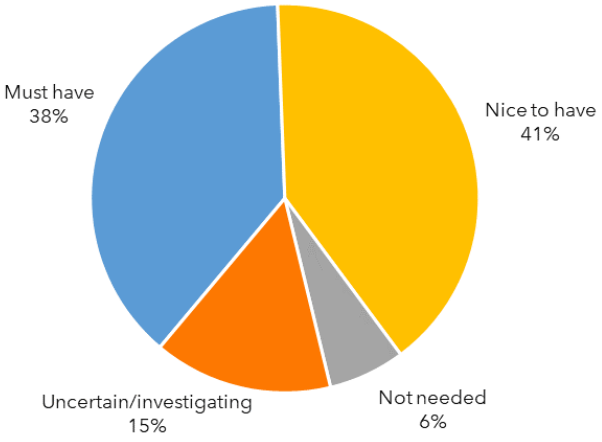
Service Providers See High Value in Automating Business Functions with LSO Sonata APIs

Eighty-nine percent of 47 service providers participating in MEF's 2021 and 2022 LSO Sonata surveys said LSO Sonata APIs are a "must have" as a seller. Thirty-eight percent said the APIs are a "must have" as a buyer. While many on the sell side told us their decision to invest in LSO Sonata initially was driven by a request from a specific buyer, 87% of seller respondents in our 2022 survey described LSO Sonata implementation as ultimately "strategic" for their wholesale business.

Automating Business Functions with LSO Sonata APIs as Seller



Automating Business Functions with LSO Sonata APIs as Buyer



LSO Business & Operational APIs Are Key to Meeting GLF Service Providers' Requirements

In March 2023, the ITW Global Leaders' Forum and MEF announced a memorandum of understanding (MOU) formalizing their longstanding collaboration to foster development of a global ecosystem of automated networks. The GLF's Board consists of executives from 32 international SPs, many of whom are also MEF members. Along with the MOU, the GLF officially endorsed adoption of LSO business and operational APIs in order to help implement the GLF's vision of an automated ecosystem of SPs competing and collaborating to better serve customers.

In its Tomorrow's Telco report (Nov. 2022), the GLF highlighted the need for increased collaboration to meet customers' future connectivity requirements end-to-end, regardless of how many carrier networks are involved in providing a service. The GLF identified seven key requirements and four new capabilities that need to be consistently available across multiple providers to deliver a seamless end-point to end-point connectivity experience.

MEF LSO business and operational APIs, LSO Blockchain, and LSO security have critical roles to play in addressing these requirements and enabling desired capabilities across interconnected, automated networks on a global basis. MEF and the GLF can be expected to elaborate on the close alignment of their interests and activities in coming quarters.

GLF Next Generation Networks Requirements & Desired Capabilities

Requirement/Capability	Where does the industry need to collaborate?
01 Capacity on demand	Interconnect & settlement model for capacity on-demand
02 Real-time inventory	Industry standard approach for exposing inventory
03 Route diverse selection	Promote increase in infrastructure route diversity
04 Usage-based pricing	Development of usage-based pricing and settlement model
05 QoS-level guarantee	Industry standard approach for QoS for different service levels
06 Dynamic capacity management	Agreement on uniform dynamic capacity management service & settlement approach
07 Automated Trusted Business Process	Leveraging distributed ledger technology to ensure secure & trusted data flows
08 End-to-End Security	Development of minimum security standards
09 Cloud-native	Standards to build interoperable cloud-based solutions for the network
10 Real-time interoperability	Operational rules for automated interoperability of multiple networks
11 Network Agnostic	QoS standards for constant experience using multiple delivery infrastructures

"Business and operational automation are key features to implement the GLF vision of an ecosystem of carriers competing and collaborating to better serve our customers, and the work done by MEF with the LSO APIs goes exactly in this direction. We are thrilled to work with MEF to accelerate adoption and promote ubiquitous automated connectivity,"

— Elisabetta Romano, Chief Network, Operations and Wholesale at TIM and Chair of the GLF Board

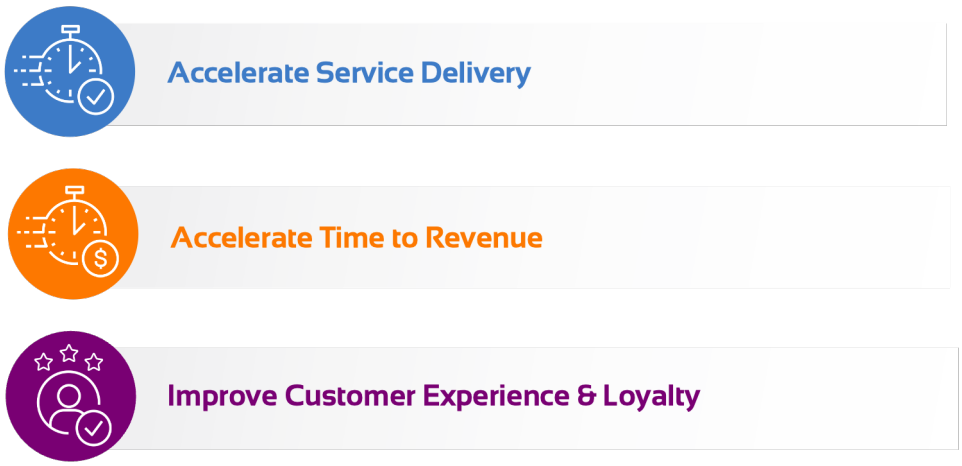
Future Network is Fully API-Driven and Requires Standardized Automation Between Players
The GLF's comprehensive set of network requirements and desired capabilities can be viewed as a wish list for SPs putting together NaaS solutions that span an automated ecosystem. NaaS represents a new way to deliver network services and capabilities that will be made of piece parts of many providers, which could include retail SPs, wholesale SPs, hyperscalers, technology solution providers, data center providers, LSO connectivity exchanges, and others.

NaaS solution providers, for example, could use a multi-cloud core (rather than their own network) + middle mile providers + last mile access on their own network and partner networks, and then enable enterprise users to purchase services and interact with network resources with cloud-like agility. Every part of this at the business process and operational levels is going to be driven by APIs, and blockchain will help round out the picture for billing and settlement of dynamic services.

The bottom line is that standardized LSO APIs across the complete service lifecycle are a must have with NaaS. And the future network optimized for the digitally transformed enterprise cannot be managed without API harmonization across the supply chain.

Aligning industry players on a common approach to ecosystem automation is no small task, but the good news is that integration with ecosystem partners no longer has to be a multi-year project. As one senior expert at a large cloud-based software company that works with both TM Forum and MEF APIs stated, "MEF is templatizing the integration landscape, making it easy for CSPs to integrate with the ecosystem and enterprises."

LSO Sonata APIs Yield Many Real-World Benefits/ROI



For many SPs, the justification for investing in LSO Sonata APIs centers on a simple observation: (1) accelerated service delivery leads to (2) faster time to revenue and (3) an improved customer experience. Between 76% to 79% of 42 SPs in MEF's 2021 and 2022 LSO Sonata surveys said they expect "high value" from these benefits. Just like with Amazon, satisfied customers will keep coming back if they know they can have a superior buying experience with predictable, rapid service delivery.

Conversations with companies who have implemented the APIs indicate these benefits and more are being realized by those with a significant volume of LSO Sonata-enabled transactions.

Below, we elaborate on eight major expected and realized benefits of the LSO Sonata-based buy/sell model.

Benefit 1: Accelerate Service Delivery. A target goal for those implementing or planning to implement both LSO business APIs and operational APIs is to bring the typical time it takes to order and provision a service down from 60 to 90 days to 60 to 90 seconds when the physical infrastructure is in place (or perhaps a few weeks when infrastructure must be deployed).

LSO Sonata APIs are delivering on their part of this picture with reports of an average 25% reduction in order cycle times for those who have implemented address validation, POQ, quote, and order APIs. As one SP buyer has stated, pre-validation of orders is saving a "huge amount of time" and human resources by reducing/eliminating order rejects and reworks without disturbing end-customers. On the sell side, we have heard similar comments about "absolutely faster" service delivery with increased operational efficiency, with much time being saved in the pre-sales department by eliminating manual activities.

A separate buyer told MEF that the ability to order services that are consistently delivered at least a month earlier than in the pre-LSO Sonata era enables them to be more strategic in how they run their business.

Going forward, we expect to see continued improvements in order cycle times as buy/sell partners fine-tune their implementations and strive to overcome persistent industry challenges with things like addressing, which is an important area of ongoing MEF work.

In coming quarters, we will see combined use of LSO business and operational APIs to speed both the ordering and provisioning of inter-provider services end-to-end. One Tier 1 SP recently stated that they already have been able to achieve a 2-minute cycle time in a lab environment for provisioning an inter-provider service with an LSO Interlude API – an important step for the standards-based automated ecosystem.

Benefit 2: Accelerate Time to Revenue. Closely tied to the first benefit is the ability to consistently get revenue earlier on every single LSO Sonata-enabled order. Faster service delivery translates into faster revenue for both the buyer and downstream supplier partners – a win for everyone involved.

Benefit 3: Boost Revenue Opportunities. It goes without saying that SPs who are able to deliver services more rapidly are going to win favor with customers in a digital environment that highly values speed, agility, and quality experiences. In many cases this is likely to modestly boost revenue opportunities for LSO Sonata-enabled sellers at least during a period when they stand out versus competitors who are not using standardized plug-and-play APIs.

Multiple buyers have told MEF that LSO Sonata-enabled sellers will be preferred partners who move to the top of the list. We would not be surprised if some sellers receive a premium for using LSO Sonata APIs, especially given that faster service delivery helps maximize opportunities for the enterprise-facing sales teams of their buyer partners.

The other side of this coin is that SP sellers who do not adopt LSO Sonata APIs are likely to be at a growing disadvantage as more competitors with footprints in their regions become LSO Sonata-enabled. Wholesale sales teams need to be made aware of this possibility if they are not already.

Benefit 4: Improve Customer Experience. Buyers want to do business with SPs who can give them the most cloud-like, on-demand, frictionless experience possible. Shorter order cycle times with LSO Sonata-enabled automation obviously helps move toward this goal.

As one carrier management executive at a Tier 1 SP stated, "I tell my suppliers, it's not that I don't want to talk to you, but I really don't want to talk to you." Buyers like that fact that LSO Sonata facilitates a more seamless ordering process that reduces human interaction and potential errors and enables them to reallocate personnel resources to other important tasks. We have heard that service delivery professionals especially appreciate automated order milestone functionality that provides them real-time insight into what is happening on the supplier side that they can share with end customers who want to understand how orders are progressing.

Benefit 5: Migrate Toward More Competitive, Dynamic Services. LSO Sonata implementation covers a critical step on the migration path toward dynamic services that span multiple provider networks – something that could realistically be quite commonplace by 2025. As numerous SP executives, MEF's CTO, and others have observed, LSO Sonata APIs are the foundation that needs to be in place at the business process level before the community can get to an on-demand infrastructure.

Multiple SPs who offer on-demand services are interested in menu-driven functionalities that will be supported in the Fergie LSO Sonata and LSO Cantata SDKs in July 2023. New product offering availability discovery and price discovery APIs will enable customers to ask what various services are available at a particular location, find out prices for these services, and then choose them from a menu instead of having to know up front the specific products to ask about. This functionality not only is important for SP but will be of particular interest to enterprises as well.

As covered earlier, the migration also involves implementation of LSO blockchain for billing and settlement and LSO operational APIs for rapid provisioning, end-to-end performance visibility, etc.

Benefit 6: Quickly Implement & Transact Via LSO Sonata APIs. Now is not only a good time to implement LSO Sonata APIs because the market is in a boom stage, but an expanding set of LSO resources, more mature SDKs, and the growing experience of LSO community professionals are translating into much faster development, test, and implementation times compared to 18 months ago. As an example, LSO API implementers have helped cut the typical implementation time for multiple LSO Sonata APIs from 9.5 to 12 months to just a few months from budget approval to production with a partner. And multiple LSO business application vendors now claim they can help SPs evolve their BSS and to get up and running with LSO Sonata APIs in an average of three to six months.

To be sure, multiple factors can impact development, test, and implementation times. For example, LSO API implementation typically is much faster – and the realized benefits are much greater – depending on how modern a service provider's back-end systems are. In fact, we often hear that a commitment to implementing LSO Sonata APIs not only requires a modernization strategy but often is the catalyst for investing in BSS transformation. As an API expert at a Tier 1 European seller noted, the biggest part of the LSO Sonata journey is reinvesting in the wholesale business process, along with workforce education on the APIs.

***Benefit 7: LSO Sonata Provides* Cost-Effective Plug-and-Play API Scalability.** In our earlier discussion of the LSO standards-based buy/sell model, we highlighted the benefit of cost-effective, plug-and-play scalability with MEF LSO Sonata and other LSO APIs. We will not belabor this here but want to highlight a few related points.

Summarizing the words of a CTO at Tier 1 SP: "Every carrier in the world recognizes the need to create a digital experience for their customers, and to do that you have to automate. Investing time and effort in automation is inevitable. You have to automate with APIs and might as well do it with standardized MEF LSO APIs rather than pairwise APIs."

The very good news for large SP buyers who may have moved slowly up until now is that they can take advantage of a lot of the heavy lifting that already has been done to establish the strong and growing LSO Sonata market. These buyers have an extraordinary opportunity to get up and running with potentially dozens of sellers within the next couple of years in a fraction of the time – and at a fraction of the cost – it would take with proprietary/customized APIs.

An executive at a large SP buyer put LSO Sonata investment in perspective when speaking to a room of executive peers from other large international SPs. The executive noted that the cost spent by one SP supplier to move from a legacy eBonding platform to a new eBonding platform (for the automatic exchange of data between business applications) was more than it would cost the supplier to implement LSO Sonata APIs as both a seller and buyer.

***Benefit 8: Globally Recognized LSO API Standards Help Avoid Regulatory Issues*.** An API expert at one of the world's largest SPs in Europe recently brought to light an additional benefit of LSO Sonata that has not been highlighted much up until now. This expert stated that the fact that LSO Sonata APIs are based on global standards and are open for all companies to implement can help avoid any regulatory concerns that might normally be encountered in the case of proprietary APIs implemented by an incumbent operator.

LSO Sonata Adoption is a Question of When, not If, for Many SPs

As one Tier 1 buy-side expert recently noted, the market has now reached a tipping point in favor of LSO Sonata adoption after accelerating in 2H 2022 and continuing to charge ahead in 2023. Or, in the words of Daniel Bar-Lev, VP of Strategic Programs, MEF, for many service providers, it is now a question of when will they adopt the APIs, not if they will adopt them.

Driving home this point, an expert at one large Tier 1 buyer said their biggest challenge this year is resourcing supplier onboarding, testing, and production migration in order to keep up with demand from seller partners who want to implement LSO Sonata APIs. The buyer's goal is to have more than 50% of order volume outside of the United States transacted via LSO Sonata by the end of 2023, up from about 20% in 2022. The company is targeting to at least double suppliers from 21 in 2022 to 40+ by the end of 2023 and to expand the number of countries served with automated partners from 27 to 49 in the same period.

LSO Sonata APIs Can Be Implemented in a Phased Approach
Most SPs are adopting a phased implementation of LSO Sonata APIs, starting with a mix of BSS integration and manual handling and then automating additional business processes over time.

Companies have a wide variety of options available from LSO solution providers to help them get moving on their LSO Sonata journey, regardless of their starting point. These are covered in the *LSO Solution Providers & Implementation Scenarios* section of this report.

One point worth noting here is that members of the LSO community recognize the need to address the concerns of smaller SPs who want to participate in the automated ecosystem but may be struggling with the business case due to limited order volumes. LSO solution providers currently are exploring options to keep upfront investment costs minimized so the smaller SPs can get into the game.

MEF LSO API OIT Service Accelerates Implementations and Upgrades
The MEF Onboarding and Interop Test (OIT) service is a popular resource available to MEF member companies that can significantly accelerate LSO Sonata implementations, save developer time, and make it easier to upgrade to new SDK releases and add support for new business functions or product and service payloads.

Details on the OIT service are found in the *LSO Implementation Resources* section of this report.

MEF Offers a Robust Set of Popular LSO Sonata SDKs with Maturing APIs
One of the great characteristics of the LSO Sonata market is that we now have a robust set of popular SDKs with maturing APIs. These SDKs and APIs are solid to the point that many of the world's largest service providers are making them core to their automation strategies.

Companies in production have implemented a variety of SDK releases – including Dolly, Billie, R4, R3, and R2. During 2022, there was a heavy level of activity associated with Billie. In 2023, we have seen an increased focus on Dolly and emerging interest in Ella. Many companies who implemented pre-Billie releases either have upgraded or are expected to upgrade to Dolly or Ella.

The most popular functions in terms of LSO Sonata implementations thus far are address validation, POQ, quote, and order, with quote and order being the top functions.

Expect LSO Sonata API Implementations Supporting Many Product Payloads
Almost all LSO Sonata implementations up to now have been in support of CE Access E-Line services, but the market is poised to see the APIs supporting a wide variety of product payloads over the next several years. In 2022, nearly 30 companies told MEF they intend to implement or may implement LSO Sonata APIs in support of Internet Access (DIA) services, and we suspect that number is much higher now. Many SPs also have expressed interest in using the APIs to support wavelength, dark fiber, and other services. MEF intends to conduct further research in the coming months to gain insight into payload plans across the community.

MEF Offers Many Resources to Help Accelerate Adoption of LSO APIs
See the *LSO Implementation Resources* section for details.

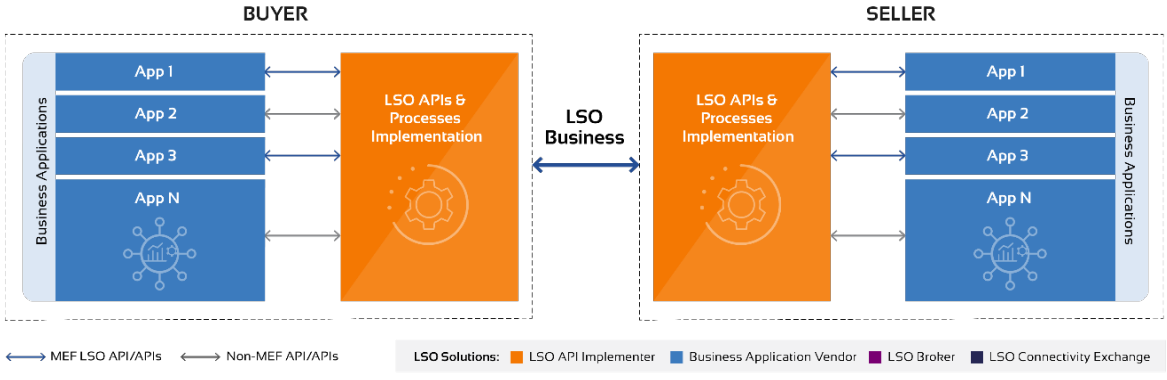
LSO Solution Providers & Implementation Scenarios

Overview of LSO Solution Providers
A growing community of LSO solution providers has emerged to assist service providers, enterprises, and other ecosystem participants in developing, implementing, and transacting via MEF LSO APIs. They offer solutions that fulfill roles in six general categories listed below. This report explores solutions in the first five categories offered by companies that have publicly committed to supporting LSO Sonata and Cantata business APIs or LSO Blockchain. Solutions in the sixth category are expected to be covered in a future report with a greater focus on operational automation.

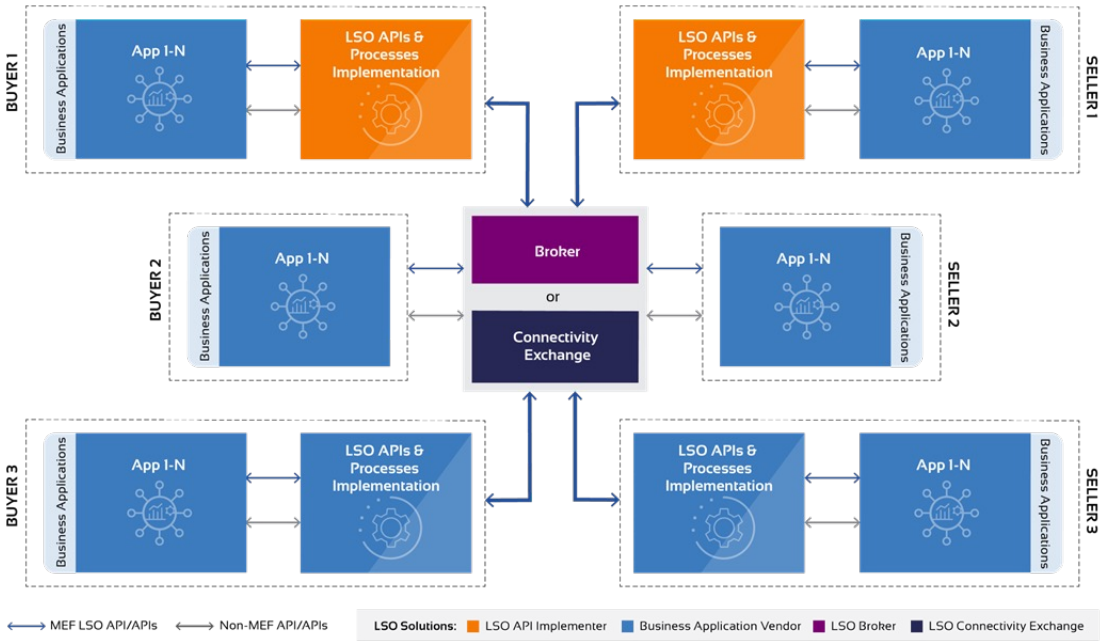
- LSO API implementer
- Business application vendor
- LSO broker
- LSO connectivity exchange
- LSO Blockchain vendor
- Service orchestration vendor (OSS application vendor)

Primary Implementation Scenarios: Direct and Indirect Negotiation
LSO solution providers fulfill important roles in two primary implementation scenarios between buyer and seller partners: direct negotiation and indirect negotiation. These scenarios often involve multiple solution providers, as illustrated in the diagrams below.

Direct Negotiation
Service providers either build their own LSO business APIs or rely on LSO solution providers to empower them to directly interface via LSO Sonata or Cantata APIs with their buyer or seller partners. The diagram below highlights the option for each partner to use a standalone LSO API implementer along with one or more BSS application vendors. For further explanation, see *Scenario - Direct Bilateral Negotiation Using LSO API Implementer + BSS App Vendors* on page 46.



Indirect Negotiation
Service providers may indirectly automate transactions with their buyer or seller partners based on LSO standards through LSO brokers or LSO connectivity exchanges. The diagram below highlights various options for buyers and sellers to interface with a broker or connectivity exchange. For further explanation, see *Scenario - Indirect Bilateral Negotiation Using LSO Broker or Connectivity Exchange + LSO API Implementer + BSS App Vendors* on page 47.



Questions to Consider When Evaluating LSO Solution Providers
Some important questions to ask when evaluating LSO solution providers include:

- In what ways can the LSO solution provider help buyers/sellers implement and conduct automated business transactions within a standards-based ecosystem?
- What LSO SDK release(s) and business functions does the LSO solution provider support or plan to support in the future?
- How rapidly can the LSO solution provider get a company up and running with LSO-based automated business transactions?
- What are the economic and time benefits/costs of choosing between direct bilateral negotiation versus indirect negotiation? And how do these benefits/costs differ when considering different volumes of transactions a company has with various buy/sell partners?
- How does working with a particular LSO solution provider help a company scale the ability to automate business transactions with many buy/sell partners and for multiple services?
- What level of commitment does an LSO solution provider have to interoperate with other technology players within an automated ecosystem?

LSO Solution Provider Matrix

This matrix summarizes current and planned support of LSO solution providers for MEF SDKs, LSO business APIs, and LSO Blockchain as well as non-MEF support of various functions. In the future, we intend to expand the matrix to include a larger list of MEF member companies committed to supporting LSO operational APIs as well.

	LSO Solution Provider Roles					SDK Releases				LSO Sonata & Cantata Business Process APIs											LSO Block-chain	LSO Op APIs
Company	LSO API Implementer	Business Application Vendor	LSO Broker	LSO Connectivity Exchange	LSO Blockchain Vendor	Pre-Billie	Billie	Dolly	Ella	Address validation	Site query	Product catalog	POQ	Quote	Product order	Product inventory	Trouble ticket	Appoint-ment	Work order	Billing & invoicing		
Amartus	■	■					■	■	■	■	■	■	■	■	■	■	■					■
Blue Planet		■								■	■						■		■			
CloudSmartz	■	■					■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Console Connect				■		■	■			■			■	■	■		■			■		
CSG	■	■							■	■	■	■	■	■	■	■	■		■	■		
Enxoo	■	■					■		■	■	■	■	■	■	■	■	■	■	■			
Orchest				■			■	■		■	■		■	■	■							■
NEC/Netcracker		■							■	■		■	■	■	■	■	■			■		
Sage		■			■									■	■	■	■			■	■	
Salesforce*		■								■	■	■	■	■	■	■	■	■	■	■		
ServiceNow**	■	■					■	■	■	■	■	■	■	■	■	■	■					■
Synchronoss	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■
TransUnion	■	■	■				■	■	■	■	■	■	■	■	■	■	■					

Key

■ Currently provide MEF standards-based solution

■ Plan MEF standards-based solution

■ Non-MEF support of function

*Salesforce - (1) Plan MEF LSO support for outbound/buyer side address validation, site query, product inventory, and billing, (2) Plan MEF LSO support for inbound/seller side product catalog, POQ, quote, product order, trouble ticket, appointment, and work order.

**ServiceNow - Provided in partnership with Amartus, where ServiceNow is providing the business and operational workflows and Amartus is providing LSO API support.

LSO API Implementer

LSO API implementers are technology vendors who provide pre-built, standalone buyer and seller implementations of LSO APIs to augment and extend a provider's BSS or OSS. This enables SPs to quickly transition from manual processes, portals, or proprietary and customized APIs to scalable, standardized LSO APIs without IT experts having to read through various standards documents and develop software from scratch.

LSO API implementers are responsible for exposing MEF LSO APIs and coordinating multi-step negotiation across multiple BSS applications. They interact with BSS applications that expose non-MEF or MEF LSO APIs for various individual functions and update BSS apps as needed.

LSO API implementer solutions are available that reportedly have enabled SPs to cut typical implementation time for multiple LSO Sonata APIs by 68% - 75% (from 9.5 to 12 months down to three months) when measured from budget approval to production with a partner. This type of speed is particularly advantageous in responding to buyer requests for sellers to directly transact via LSO Sonata APIs or risk losing business to competing sellers who do.

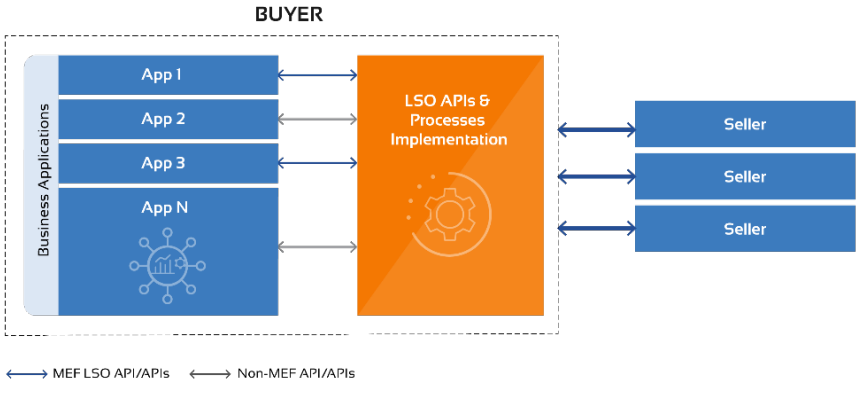
LSO API implementers are a valuable option for SPs who want to outsource transformation of inter-provider business and operational automation. Many SPs are severely constrained in terms of IT development and DevOps resources. Outsourcing implementation and maintenance of LSO APIs may be make-or-break for many providers.

LSO API Implementers offer providers the freedom to plug into a rich automated ecosystem of customers and suppliers, including enterprises, solution vendors, cloud, cybersecurity, retail, wholesale, interconnect, and vertical providers in a truly decentralized manner.

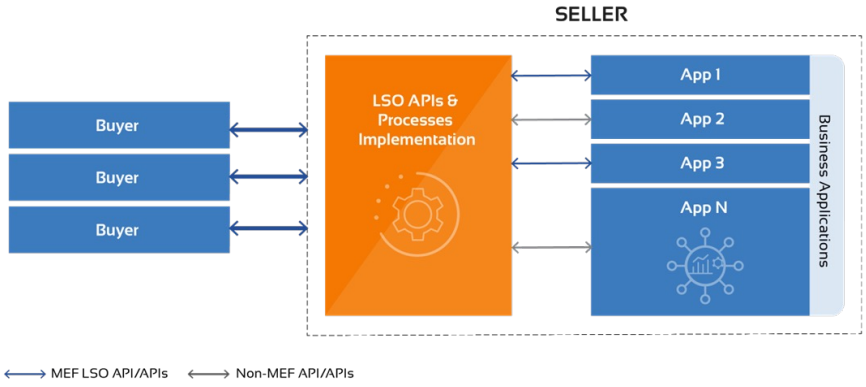
This flexibility opens up opportunities to introduce new, disruptive business models beyond that of the traditional telco which put SPs in the driver's seat. These might include delivering cross-sell or bundle-sell offerings, a one-stop-shop experience with one bill, a single network view, or a holistic approach to connectivity and services operations or automated capacity and performance management.

LSO API Implementer Scenario 1 – Buyer

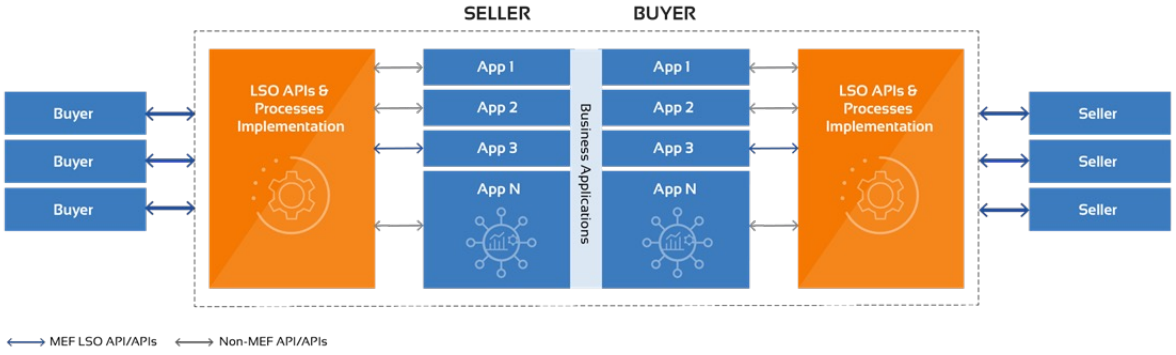
A service provider or enterprise buyer implements pre-built LSO business APIs with multiple seller partners. The SP buyer implements LSO Sonata APIs, and the enterprise buyer implements LSO Cantata APIs with their respective partners.



LSO API Implementer Scenario 2 - Seller
A service provider seller implements pre-built LSO Sonata APIs with multiple SP buyer partners or LSO Cantata APIs with multiple enterprise buyer partners.



LSO API Implementer Scenario 3 – SP Acts as Buyer & Seller
A service provider acts as both a buyer and seller. On the buy side, the SP implements pre-built LSO Sonata APIs with multiple seller partners. On the sell side, the SP implements pre-built LSO Sonata APIs with multiple SP buyer partners or LSO Cantata APIs with multiple enterprise buyer partners.



Business Application Vendor

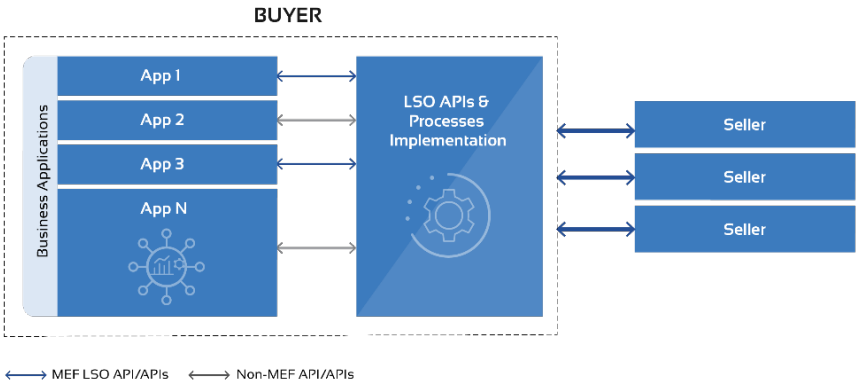
Business application vendors offer a full or partial suite of software components and capabilities to enable one or more LSO business functionalities. These companies are a valuable option for SPs looking for outsourced solutions to help them incrementally transform their BSS to support inter-provider and provider-to-enterprise automation with LSO Sonata and Cantata APIs, respectively. Multiple business application vendors have partnered with other LSO solution providers to offer more competitive, efficient, and scalable standards-based solutions.

Often, SPs will use a combination of BSS vendors alongside a standalone LSO API implementer, but it is possible for a single BSS vendor to take on the implementer role as well if the vendor supports LSO business APIs for all the required functions, harmonizes and coordinates across all the functions, maintains software releases, and acts as a single source of truth. The next few diagrams below, for example, illustrate the LSO API implementation role being handled by a BSS application vendor.

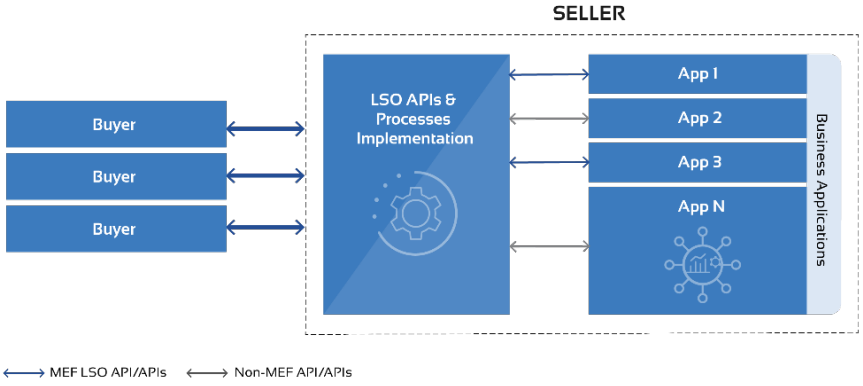
Outsourcing implementation and maintenance of an incrementally transformed BSS can significantly accelerate new business workflows and resulting business opportunities. In addition, new microservice approaches to BSS transformation are a valuable tool providing multi-tenant interfaces to partners and customers.

Business App Vendor Scenario 1 – Buyer

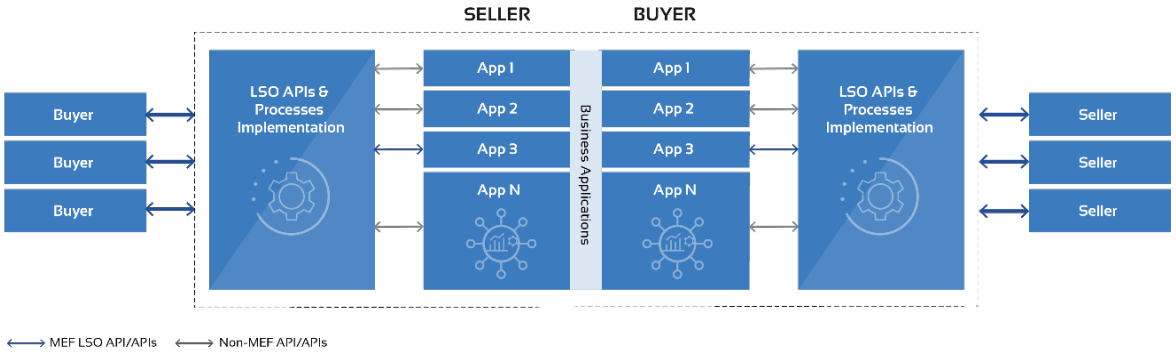
A service provider or enterprise buyer outsources the evolution of their BSS to support LSO business APIs with multiple seller partners. The SP buyer implements LSO Sonata APIs, and the enterprise buyer implements LSO Cantata APIs with their respective partners.



Business App Vendor Scenario 2 - Seller
A service provider seller outsources the evolution of their BSS to support LSO Sonata APIs with multiple SP buyer partners or LSO Cantata APIs with multiple enterprise buyer partners.



Business App Vendor Scenario 3 – SP Acts as Buyer & Seller
A service provider acts as both a buyer and seller. On the buy side, the SP outsources the evolution of their BSS to support LSO Sonata APIs with multiple seller partners. On the sell side, the SP similarly evolves their BSS to support LSO Sonata APIs with multiple SP buyer partners or LSO Cantata APIs with multiple enterprise buyer partners.



LSO Broker

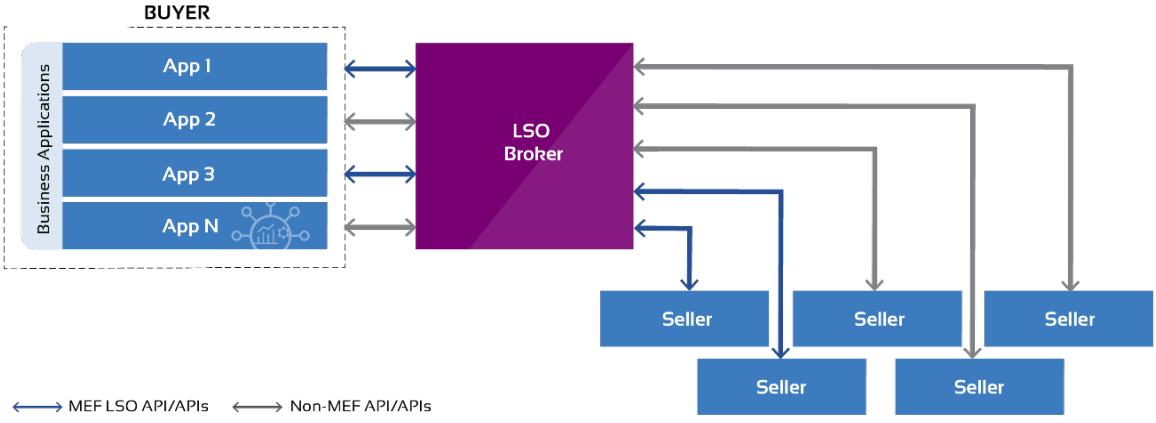
LSO brokers are fee-based information platforms connecting buyers and sellers but are not party to the contract between them. LSO brokers are a valuable option for SPs who want to outsource interactions with many seller or buyer partners for specific business workflows. Brokers may support standardized LSO APIs for multiple functions like address validation, POQ, quote, and perhaps order also in the mix. In short, brokers take the headache out of managing business workflows with potentially hundreds of partners.

Brokers differentiate around such factors as the number of buyer and seller companies engaged in their platform, the number of network operators profiled at a location level, accuracy of location data, associated methods to reduce fallout in locations, analytics, market intelligence, and other support to improve speed of transactions and user experience on their platform.

By using an LSO broker, SPs of all sizes can get quickly up and running with LSO API-based transactions, increase efficiency, and improve the customer experience. Brokers prefer to have buyers and sellers using standardized LSO APIs in order to minimize API maintenance work by the broker, but they support non-MEF APIs as well – thereby hiding the complexity of proprietary APIs from partners. For example, in the case of a Tier 3 seller using a non-LSO approach, a broker will translate their input and send relevant information via LSO Sonata APIs to buyer partners on their behalf. This enables the seller to participate in the standards-based ecosystem without having to invest in their own LSO API development at the beginning of their journey.

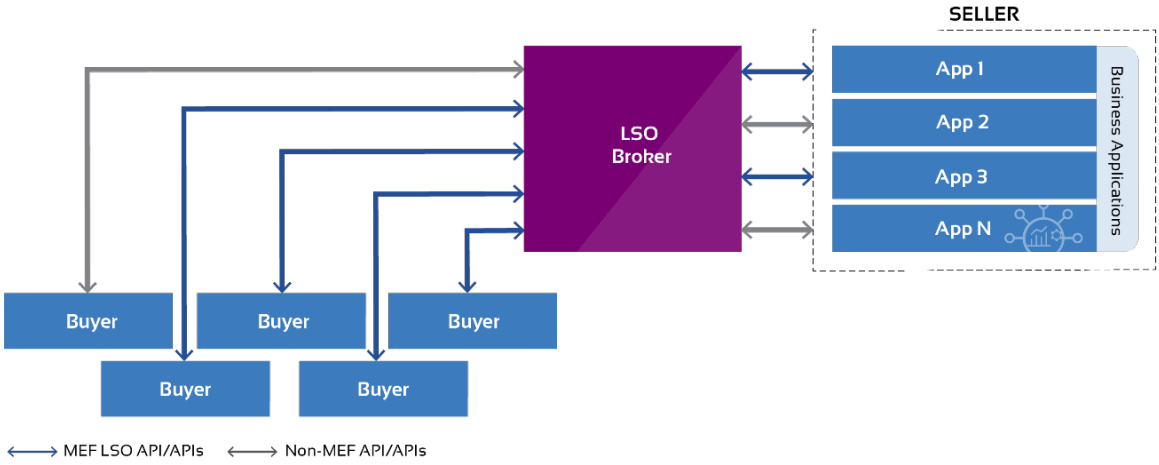
LSO Broker Scenario 1 – Buyer

A service provider enterprise buyer uses an LSO broker to make it simpler to validate addresses, qualify product offerings, get quotes, and place orders with a large range of sellers. The buyer might initially interface via their own LSO business APIs or non-MEF APIs, but the trend over time would be for an increasing number of buyers to interface via LSO business APIs. The broker manages the relationship with sellers who may or may not be using LSO business APIs and makes appropriate translations between non-MEF and LSO APIs where needed.



LSO Broker Scenario 2 – Seller

A service provider seller uses an LSO broker to interact with a large number of SP or enterprise buyers, many of whom use LSO business APIs. The seller may interact with the broker via LSO APIs or non-MEF APIs. Regardless of how the seller interfaces, the broker exposes seller information in the form of LSO Sonata or Cantata APIs for buyers who have adopted MEF standards.



LSO Connectivity Exchange

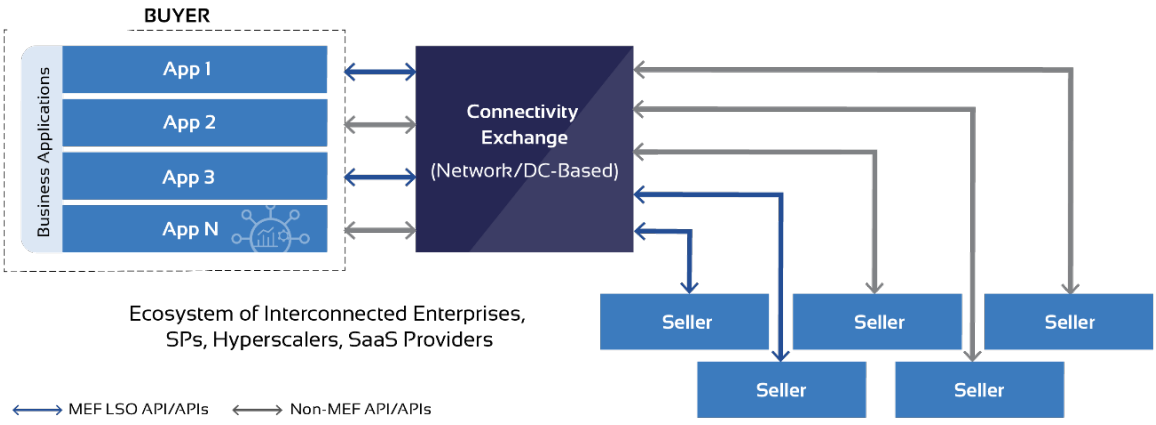
LSO connectivity exchanges are platforms that connect buyers and sellers via LSO business APIs and potentially non-LSO APIs and are involved in the contract between them. LSO connectivity exchanges are a valuable option for SPs who want to quickly expand their pool of buyer and/or seller partners. Exchanges take on the burden for SPs of managing business and operational APIs for potentially a large number of partners.

On the partner front, LSO connectivity exchanges are primarily differentiated by the range of LSO APIs and services supported, the size of their SP partner footprint, and the partner user experience. Like brokers, exchanges prefer to have buyers and sellers use standardized LSO APIs, but they typically will translate between LSO APIs and non-MEF APIs as well.

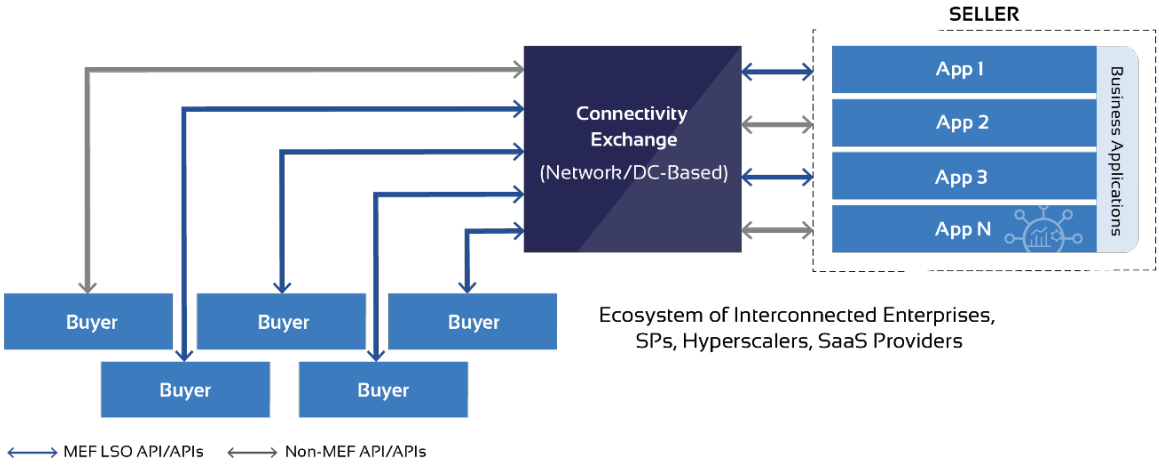
Today's most sophisticated LSO connectivity exchanges interconnect a wide variety of players within automated ecosystems that include enterprises, hyperscalers, SaaS providers, retail and wholesale service providers, and others. Over time, exchanges powered by LSO business and operational APIs have the potential to play critical roles in accelerating the shift toward automated services with real-time provisioning, dynamic bandwidth, performance visibility across multiple networks, pay-as-you-go terms, LSO blockchain-based billing and settlement, and more.

LSO Connectivity Exchange Scenario 1 - Buyer

A service provider or enterprise buyer uses an LSO connectivity exchange to make it simpler to validate addresses, qualify product offerings, get quotes, and order from a large range of sellers. The buyer might initially interface via their own LSO business APIs or non-MEF APIs, but the trend over time would be for an increasing number of buyers to interface via LSO business APIs. The exchange manages the relationship with sellers who may or may not be using LSO business APIs.



LSO Connectivity Exchange Scenario 2 – Seller
A service provider seller uses an LSO connectivity exchange to interact with a large number of SP or enterprise buyers, many of whom use LSO business APIs. The seller may interact with the exchange via LSO APIs or non-MEF APIs. Regardless of how the seller interfaces, the exchange exposes seller information in the form of LSO Sonata or Cantata APIs for buyers who have adopted MEF standards.



LSO Blockchain Vendor
LSO Blockchain vendors enable SPs to implement LSO Blockchain for automated billing and settlement of inter-provider commercial transactions, which are critical to offering on-demand services. See pages 20 & 21 for diagram and discussion of LSO Blockchain.

Scenarios with Combinations of LSO Solution Providers

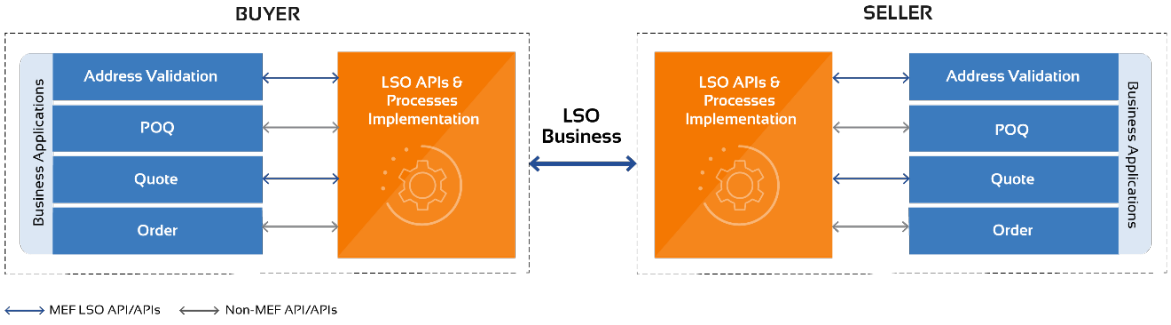
Often, two or more LSO solution providers will be involved in the process of enabling buyers and sellers to transact using LSO business APIs. Below we elaborate on how multiple solution providers can be used in both direct and indirect negotiations.

Scenario - Direct Bilateral Negotiation Using LSO API Implementer + BSS App Vendors

The buyer and seller use an LSO API implementer plus their own BSS application vendors for direct bilateral negotiation via LSO business APIs. BSS application vendors expose LSO APIs or non-LSO APIs for specific functions that they support. Frequently, multiple vendors will be used to support a variety of BSS applications. The implementer is responsible for coordinating multi-step negotiation across multiple BSS applications and exposing standardized LSO APIs between the buyer and seller.

Even in cases where multiple BSS application vendors support LSO business APIs for all the functions that require automation with a given partner, there is still a need for the implementer role to be performed across the applications. For example, when a product order is completed, a quote needs to be updated to indicate that a product is no longer orderable. Information has to be harmonized and coordinated between various functions to ensure compliance with LSO Sonata and Cantata standards.

Consider the case in which a buyer and seller wish to use LSO Sonata APIs to automate address validation, POQ, quote, and order functions, as illustrated below. The buyer may only enjoy LSO Sonata support for the order function from its BSS application vendor(s), so the buyer can benefit by using an LSO API implementer for address validation, POQ, and quote functions. Meanwhile, the BSS application vendor(s) used by the seller may support address validation, POQ, and quote, but not order. The seller could therefore benefit by using an implementer to handle the order function. And both the buyer and seller would need an implementer solution to coordinate negotiation across their four BSS applications.



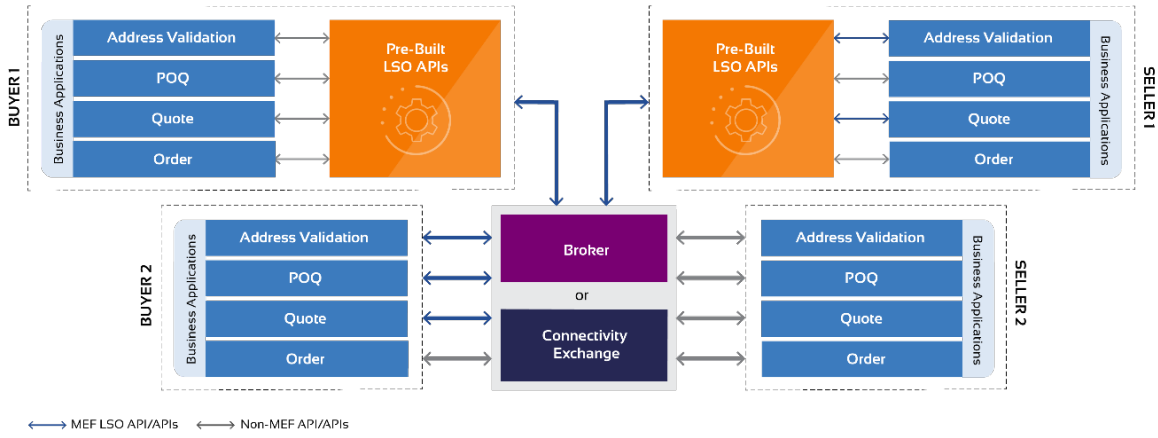
Scenario – Indirect Bilateral Negotiation Using LSO Broker or Connectivity Exchange + LSO API Implementer + BSS App Vendors
Multiple buyers and sellers use an LSO broker or connectivity exchange for indirect bilateral negotiations with their partners. In this case, we are considering a broker or exchange that offers LSO support for address validation, POQ, quote, and order. Each buyer and seller approaches the situation with a different level of support for LSO business APIs and/or non-MEF APIs.

- Buyer 1 uses an LSO API implementer to ensure their ability to transact via LSO business APIs for the set of functions supported by the broker or exchange. The implementer interacts with the buyer's BSS applications that expose only non-MEF APIs for various individual functions.

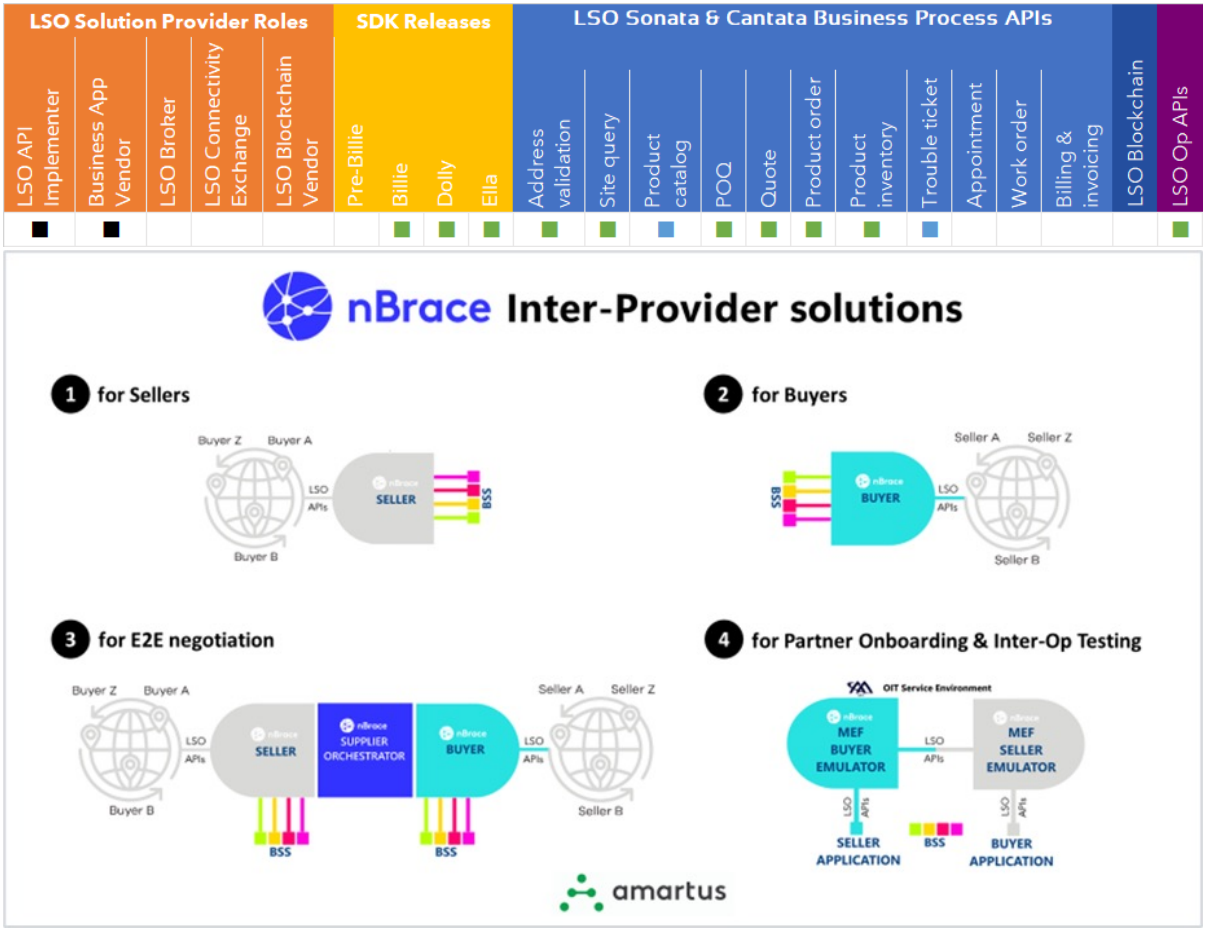
- Seller 1 also uses an LSO API implementer to ensure their ability to transact via LSO business APIs for the set of functions supported by the broker or exchange. In this case, the implementer interacts with BSS applications that expose LSO APIs for address validation and quote but non-MEF APIs for POQ and order. The implementer harmonizes and coordinates across all the functions.

- Buyer 2's BSS system provides LSO business API support for address validation, POQ, and quote but not order. Buyer 2 relies on the broker or exchange to take order inputs via a non-MEF API and expose information in the form of an LSO order API for sellers who have adopted MEF standards.

- Seller 2 starts with no support for LSO business APIs. The broker or exchange offers an adapter that enables them to interface using their own non-LSO APIs but still transact with partners via LSO business APIs supported by the broker or exchange.



Amartus Profile



Solution – nBrace™

Amartus' nBrace harmonizes and coordinates across the set of diverse BSS applications a provider has in order to deliver a consistent set of MEF LSO processes and APIs for plug-and-play interop with customers and suppliers. It is a modular, cost-effective solution that can be quickly deployed to support different service provider roles:

1. **nBrace Seller** is designed to help you increase sales and expand reach by offering products and services to a global ecosystem of buyers via MEF LSO APIs.
2. **nBrace Buyer** enables you to use MEF LSO APIs to buy services from supplier partners, allowing you to offer a broader portfolio of products and services to customers as well as expanded coverage into partners' networks.
3. **nBrace E2E Solution** enables you to automate the entire E2E product and service negotiation between customers, internal sources, and matching suppliers to provide end-customers with the best offer for their needs.
4. **The MEF OIT Service** offers cloud-hosted, fully configurable, subscription-based LSO emulators built on the nBrace engine. The service is the only MEF-authorized Onboarding and Interop Test (OIT) service available which provides SPs with an efficient, predictable, and scalable solution to test their LSO Sonata/Cantata implementation and perform interop testing with their partners – serving as a "gold standard."

nBrace currently supports serviceability, quoting, and ordering and also offers initial support for LSO operational processes and APIs. Key characteristics:

- Proven solution deployed in production with leading Tier 1-3 providers.
- Provides you with your own LSO Sonata/Cantata API implementation, allowing you to negotiate directly with your partners, as if you had built it yourself.
- Enables you to quickly introduce LSO business APIs and processes on top of your BSS applications and APIs, harmonize them with your BSS and fill any necessary gaps.
- Independent LSO Sonata/Cantata implementation allowing you to maintain a consistent interface for your customers as you evolve your BSS.
- Supports any type of product, allowing you to introduce new product models through configuration at runtime.
- Includes timely support for the latest releases of LSO Sonata/Cantata standards.
- Backed by Amartus' team of industry-recognized experts with in-depth knowledge of industry standards and best practices.

Customer Activity
nBrace is currently being used by Tier 1-3 SPs based in Europe, North America, LATAM & APAC for both implementation and testing of their LSO Sonata/Cantata APIs and processes. These include typical buyers and sellers as well as those requiring more sophisticated automation involving third party off-net suppliers.

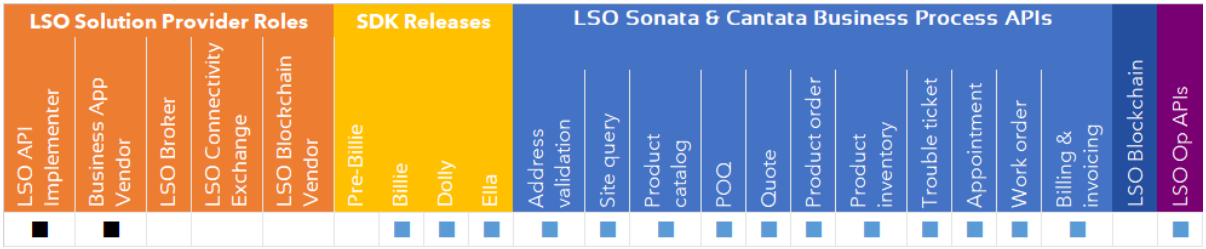
In addition, Amartus is partnering with leading providers and solution providers to facilitate faster, smoother adoption of the standard. Partners include AT&T (buyer) whom we work closely with to accelerate implementation and onboarding of its ecosystem of MEF LSO-compliant suppliers and ServiceNow whom we have integrated nBrace with to offer industry-standard MEF LSO processes and APIs on the top of their BSS/OSS solutions.

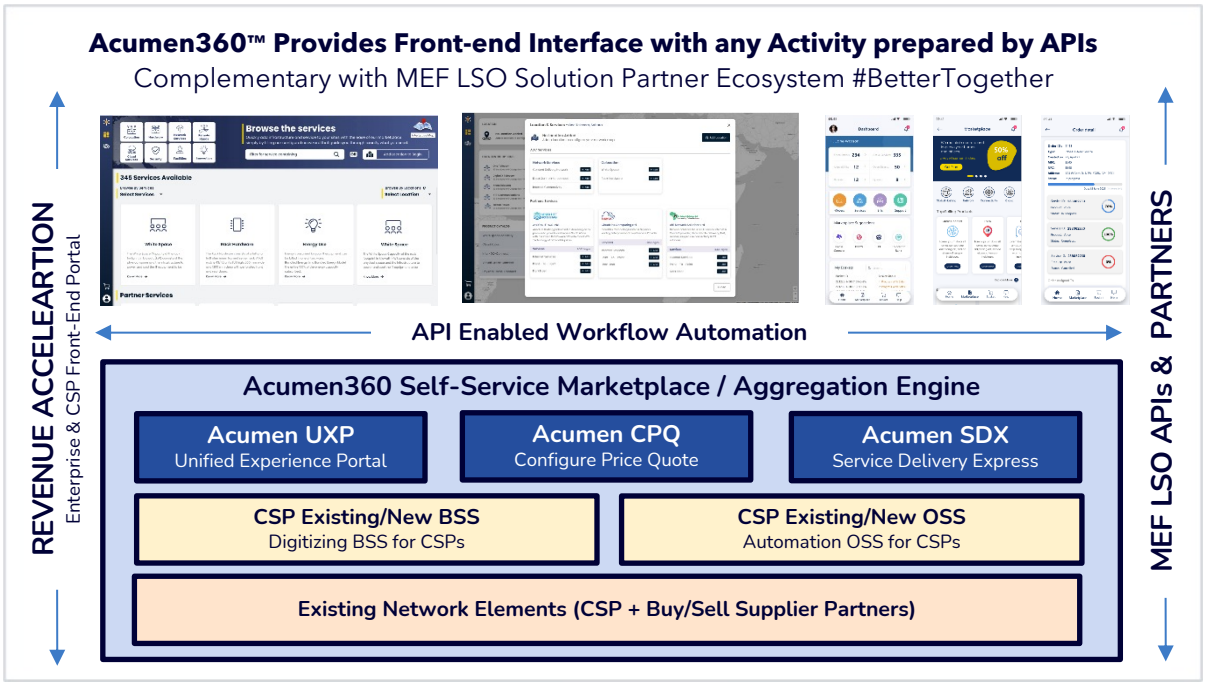
Many SPs we collaborate with lack expertise on MEF LSO APIs and processes, and they currently use a combination of multiple BSS systems and manual processes. We work closely with them to identify the most efficient, cost-effective path to get them into production. Our objective is to find a solution that harmonizes and coordinates LSO Sonata/Cantata standard processes with those of the provider. We have extensive experience integrating with different vendors' and in-house systems: Address Validation services, Pricing engines, Quoting and Order Management systems, as well as API Gateways that provide some or all of the functions. nBrace can also provide alternative features in case the current systems do not support functionality required by the standard. For example, it can calculate prices and margins to provide real-time quoting capability, offer manual support for certain process steps in the GUI, or deliver a service for automatic verification of the installation address by using advanced algorithms and local address databases.

The delivery of nBrace usually occurs in phases. It can start with minimal or no BSS integration. Subsequent phases involve increasing levels of automation by connecting with more B/OSS systems using whatever APIs are available (MEF, TM Forum, or proprietary) and streamlining more inter-partner processes. Using this evolutionary approach, nBrace ultimately provides a fully automated bridge that seamlessly connects your BSS with your partners' BSS systems. Furthermore, MEF's OIT service utilizes nBrace to provide any-time hosted compliance and partner interop testing. This service leverages nBrace's flexibility and configurability to help providers accelerate and succeed in their LSO adoption journey.

Contact
www.amartus.com. Please contact Amartus at sales@amartus.com.

CloudSmartz Profile





CloudSmartz Acumen360™ Marketplace Automation Solution

CloudSmartz, a leading automation and LSO solution partner, is dedicated to delivering carrier-grade customer experiences through its unified experience and marketplace platform, Acumen360. This comprehensive automation and partner ecosystem solution provides a seamless end-to-end framework and tailored user experiences for various end-user roles and personas. This enables communications service providers (CSPs) to offer a wide range of value-added services to their end customers – including self-service buying experience, real-time notifications, and proactive issue resolution.

By interfacing with MEF LSO APIs, Acumen360 enables carriers to accelerate revenue, enhance customer loyalty with reduced churn, automate quote-to-cash, and streamline service delivery, providing them with a competitive edge in today's rapidly evolving marketplace.

Acumen360 is scalable and open to integrate with existing LSO solution partner solutions and other best-of-breed solutions underscoring CloudSmartz' Better Together alignment with MEF:

- **Acumen Unified Experience Portal (Acumen UXP)**
- **Acumen Configure Price Quote (Acumen CPQ)**
- **Acumen Service Delivery Express (Acumen SDX)**

CloudSmartz provides a unique blend of expertise, agile development, and vendor-agnostic approach, making them a valuable partner for service providers seeking to automate and optimize their business processes, and ultimately, enhance the end-user customer experience. Their core focus is on enabling end-to-end marketplace automation and service orchestration across multi-vendor systems and networks, which aligns perfectly with the MEF LSO framework. This makes CloudSmartz a dependable choice for operators looking to implement MEF-LSO-compliant solutions, ensuring seamless and efficient service delivery across complex networks.

- **Acumen Unified Experience Portal (Acumen UXP):** The Acumen UXP module provides a carrier-grade customer experience for 360-Customer visibility, enterprise self-service customer care & service performance, customer & operations analytics, and integrated network performance – API-driven through the Acumen360 Engine.
- **Acumen Configure Price Quote (Acumen CPQ):** The Acumen CPQ module provides a carrier-grade CPQ solution for wholesale & enterprise services, marketplace enablement, product catalogue, guided quoting, service order management – including integration with access aggregators LastMileXchange and ConnectBase, and TruContact Universal Order Connect, powered by Neustar.
- **Acumen Service Delivery Express (Acumen SDX):** The Acumen SDX module provides a carrier-grade and task-based Workflow Engine to accelerate service delivery & activation through a centralized vendor-neutral multidomain service orchestration – empowering carriers with an orchestrator of orchestrators in their own platform.

Customer Activity
CloudSmartz delivers award-winning automation and marketplace solutions for global CSPs. Acumen360 provides carrier-grade functionality to Tier 2 and 3 providers seeking the same transformational capabilities as their Tier 1 counterparts. For over a decade, CloudSmartz has helped leading CSPs like GTT, GCX, Segra/COX, HGC, Telstra, Africa Data Centres, and others accelerate their transformation journey through automation.

CloudSmartz' Acumen360 platform aligns with MEF LSO Sonata APIs, enabling direct and open integration with existing B/OSS providers, partners, IT, network, and infrastructure platforms. The solution supports a variety of use cases, including unified platform interface, guided quoting and ordering, task-based service delivery, and multi-vendor orchestration of digital services. Acumen360 can be deployed on-premise or in private cloud environments.

As a result, of its standards-based, prebuilt API integration; existing use case support; and flexible deployment capabilities Acumen360 can provide instant transformation benefits with maximum ROI in under six months. And, due to Acumen360s superior scalability, it can provide the same functionality to CSPs, enterprises, and institutions of all sizes.

MEF LSO Support
Acumen360 includes open, RESTFUL, and standards-based API support for MEF LSO APIs and any non-standard API required in the stack. For MEF LSO Sonata, CloudSmartz acts as an aggregation partner as well as an LSO API implementer and LSO API business application provider - enabling a path for marketplace & connectivity exchange for the service provider customers we work with.

Contact
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Console Connect Profile

LSO Solution Provider Roles					SDK Releases				LSO Sonata & Cantata Business Process APIs											
LSO API Implementer	Business App Vendor	LSO Broker	LSO Connectivity Exchange	LSO Blockchain Vendor	Pre-Billie	Billie	Dolly	Ella	Address validation	Site query	Product catalog	POQ	Quote	Product order	Product inventory	Trouble ticket	Appointment	Work order	Billing & invoicing	LSO Blockchain	LSO Op APIs
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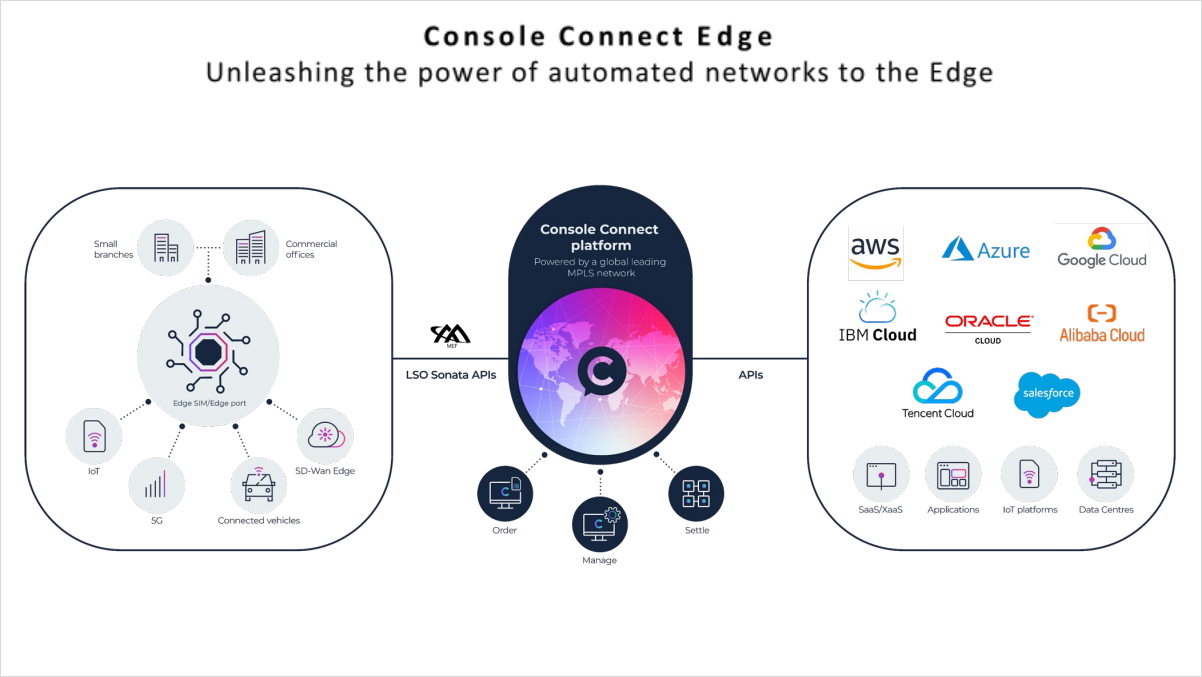


Overview of Console Connect

Console Connect is one of the world's leading global Network-as-a-Service (NaaS) platforms. By bringing together advancements in SDN technology with our own global network infrastructure, the platform provides users with cloud-like agility and control over their connectivity, and delivers greater levels of security, speed, and performance for mission-critical workloads and applications.

A range of on-demand services are available through a single access port, enabling customers to self-provision connections to:

- **Data centers:** Metro, regional, and international Layer 2 and Layer 3 connectivity between 900+ data centers in 50+ countries worldwide (WAN-as-a-Service).
- **Clouds:** Our platform is directly integrated with all major cloud providers, delivering direct Layer 2 and Layer 3 connections to 120+ cloud on-ramps.
- **Devices:** Global IoT connectivity and SIM/eSIM management across 180+ countries.
- **Internet Exchanges:** Connect and peer with many of the world's leading Internet Exchanges.
- **IP transit:** On-demand business internet access delivered via our leading IP Tier 1 network (IPv4 & IPv6 block allocations available on-demand).
- **Applications:** Direct Layer 2 and Layer 3 connectivity to major SaaS, UCaaS & security partner platforms.

By leveraging standard-based APIs, such as TM Forum Open APIs and MEF LSO Sonata APIs, to expose data and functionality to its partners, Console Connect aims to create a more open and collaborative ecosystem. Partners can create new applications and services that integrate with Console Connect's NaaS platform, providing more value to customers.

MeetingPlace
MeetingPlace is where our users can meet, interact, and interconnect with one another over a fully secure, private, and resilient network. MeetingPlace enables Console Connect users to:

- **Discover** products and services from some of the world's leading tech brands.
- **Engage** with new digital partners and suppliers from across our global community.
- **Buy** using a secure and trusted digital platform.
- **Interconnect** their infrastructure, services, and applications through one private, global network.

Through MeetingPlace, our partners resell a range services, such as UcaaS, security solutions, collaboration tools, backup and recovery tools, IoT services, and more.

CloudRouter®
Launched in 2022, CloudRouter is our award-winning multi-cloud connectivity solution that takes away the pain and complexity of network configuration and management, enabling users to:

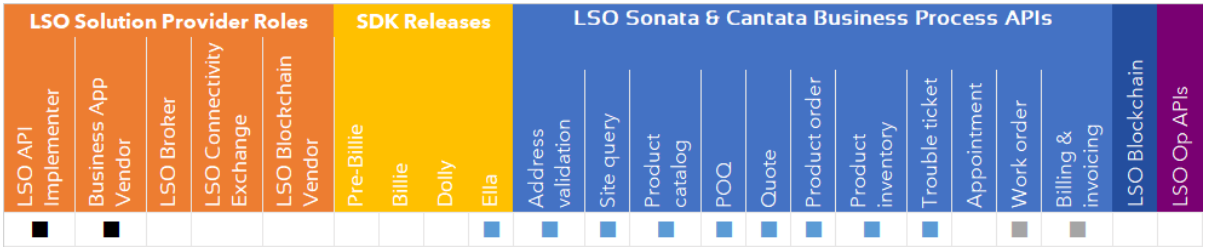
- Instantly connect to and between any cloud using a private Layer 3 connection – without the need for dedicated hardware.
- Dynamically route traffic by creating a virtual "full mesh" between different cloud providers and regions.
- Automate data backup and recovery between clouds with reliable and redundant connectivity.
- With the addition of an access port, users can also route traffic between their office locations, data centers, clouds, and other network endpoints.

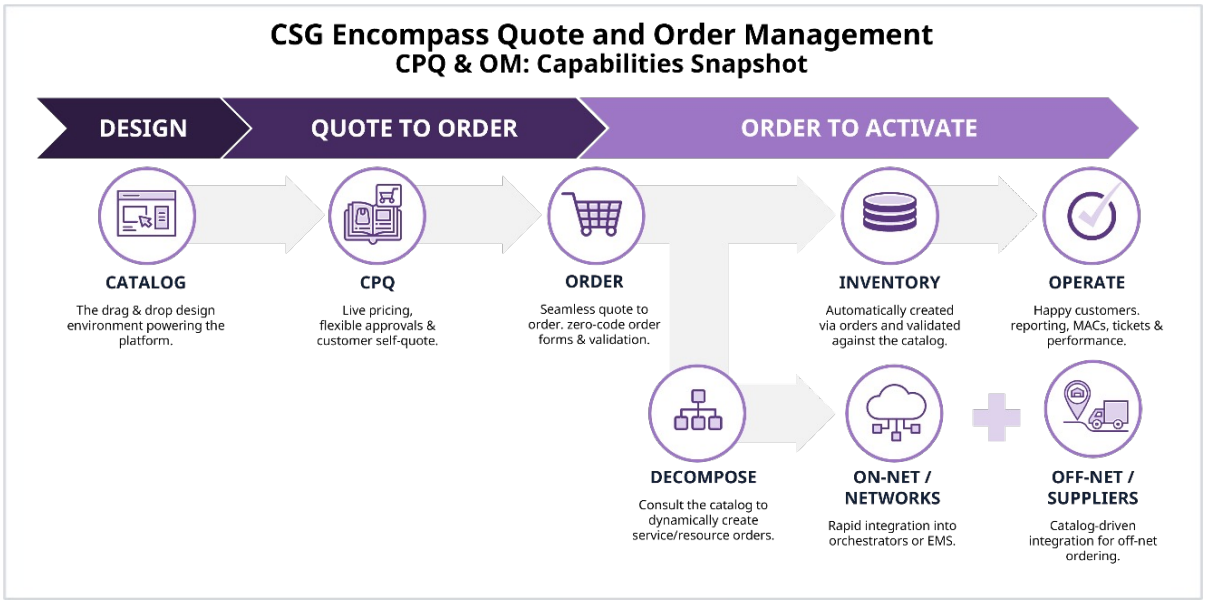
Edge Port & Edge SIM
In 2023, Console Connect is launching two innovative new ways to access the platform.

- **Edge Port** provides businesses with a dedicated connection to the Console Connect platform and network from their office location. Businesses can order an Edge Port to their office location in 10 markets and manage their Edge Port service via the Console Connect management portal. Once their Edge Port is set up, they can access Console Connect's full range of on-demand connectivity services. *Buy-side integration* with our regional and local downstream connectivity partner is being achieved by leveraging open and standards-based **MEF LSO Sonata APIs**. With this integration, Console Connect is able to automate its pre-order and order business processes, cutting down the turn-around time from months to days.
- **EdgeSIM** enables businesses to connect devices to the Console Connect platform, and dynamically and securely route traffic directly between devices, clouds, office locations, data centers and more – without traversing the public internet. With coverage across over 180 countries worldwide, Edge SIM provides secure access between devices and clouds, meeting the needs of global IoT projects or a remote workforce.

Contact
www.consoleconnect.com Talk to us: sales@consoleconnect.com

CSG Profile





Solution

Managing a growing number of diverse partners and their associated offerings is the biggest challenge for CSPs as they continue to execute their 5G and B2B growth strategies. CSPs need new capabilities to support multi-party innovation—from zero-touch onboarding and telco-specific configure, price, quote (CPQ) solutions to catalog-driven, end-to-end service orchestration and complex multi-partner settlements. CSPs need powerful catalog-driven architectures to dynamically orchestrate, quote, sell, and deliver complex enterprise and wholesale products and services. They need telco-specific CPQ and order management (OM) solutions that are configurable, repeatable, and scalable. CPQ solutions from other verticals do not work.

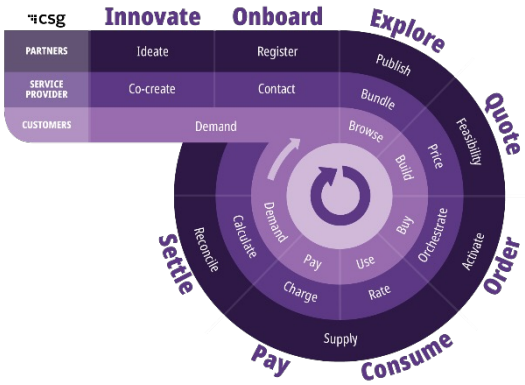
CSG Encompass Quote and CSG Encompass Order Management accelerate time to market and time to revenue by streamlining service delivery, improving process speeds, leveraging reusable integration, and elevating wholesale and enterprise customer experiences. These solutions revolutionized how CSPs buy and sell with each other by leveraging MEF LSO APIs to simplify how CSPs order and provision each other's services, removing proprietary barriers.

CSG Encompass was designed specifically for the telco B2B and wholesale markets by telco B2B experts. It provides a modular and integrated solution for catalog-driven CPQ and OM in a single platform, enabling unparalleled automation, orchestration and control across the entire quote-to-order process. Real-time inventory management coupled with deep domain expertise means CSG Encompass delivers the multi-faceted business models that will ensure CSPs capture the full revenue potential from their B2B and Wholesale customer segments.

CSG Encompass Quote
- Simplifies CPQ processes with catalog-driven order workflows
- Enables seamless lead-to-quote generation
- Combines multi-line, multi-site orders, and add-ons into a single quote with customer-specific pricing and discounts
- Cloud-native microservices-based

CSG Encompass Order Management
- Orchestrates the end-to-end quote to order lifecycle with standardised, automated workflows
- Supports real-time active inventory
- Seamlessly integrates to downstream systems (fulfilment, inventory, workforce below)
- Cloud-native microservices-based

CSG Encompass uses TM Forum and MEF LSO APIs to offer an open, interoperable, catalog-driven solution that features patented product specification rules. These rules define the parameters and characteristics of each product and offer. This powers dynamic screen rendering, which means that the catalog can render the UI in real time based on the definitions held within the catalog. The catalog also defines how a product is delivered, including all the required underlying entities and relationships. CSG's solution means that a bundled offer can be built from CSP components and ingested partner components and then quoted, ordered, and managed with zero-code integration by streamlining a traditionally time-consuming process.



CSG Encompass drives catalog-driven orchestration coupled with automation across the entire concept-to-cash lifecycle. CSPs get new products to market in hours, not weeks or months. The platform adheres to the TM Forum Open Digital Architecture (ODA) principles, enabling dynamic interoperability and orchestration across distributed architectures and deployments leveraging TM Forum and MEF APIs. CSG Encompass brings rich, multi-party customer and partner monetization and settlement capabilities, enabling everything from basic consumption models to sophisticated revenue-share collaborations.

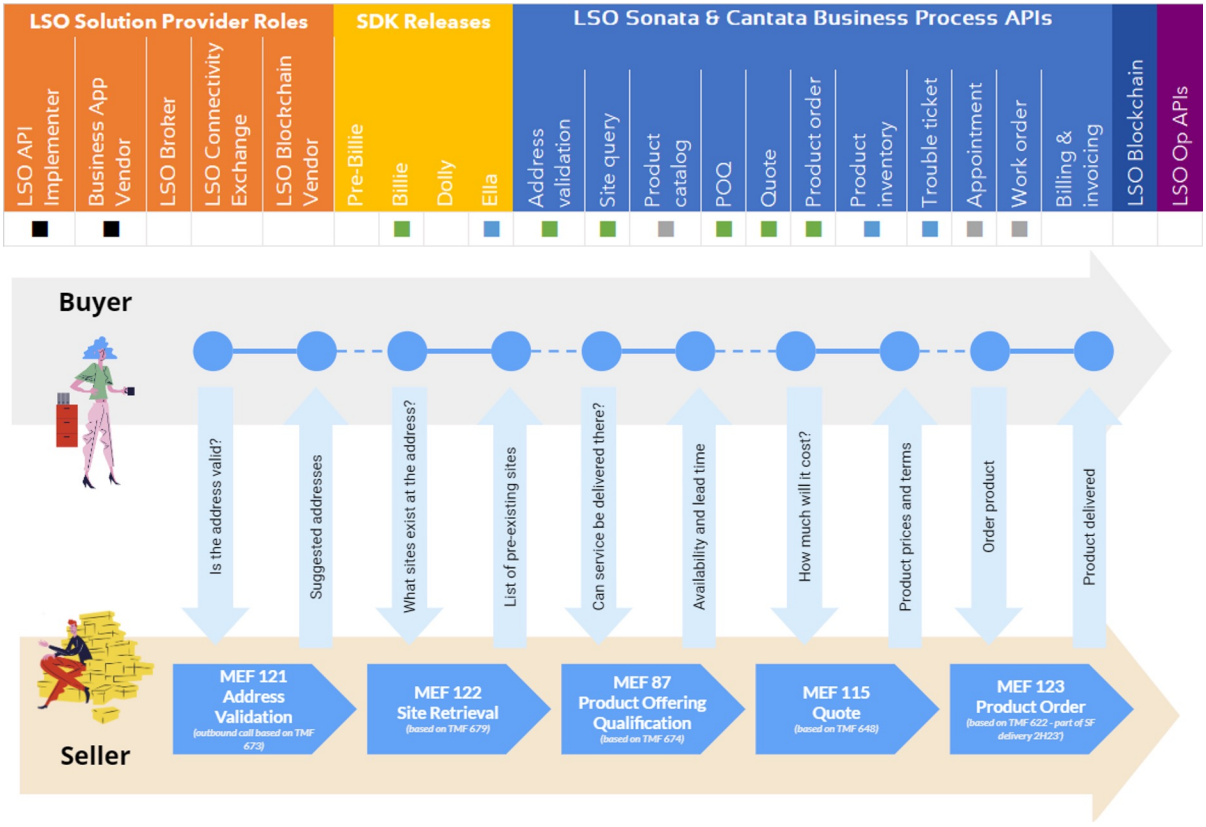
Customer Activity

In line with One New Zealand's "digital first" strategy and based on requests from customers, the company's wholesale division pledged to enable customer self-service. This was a big shift away from ordering by phone, text, or templated emails. Their vision was to ensure when a customer ordered a product, they would have the tools to track the order to delivery and deployment at a glance. The company deployed CSG Encompass Quote and Order Management to expose MEF LSO Sonata APIs to its wholesale customers. This enables customers to query inventory, qualify and order, and track the MEF products through the LSO Sonata interfaces. Some of One New Zealand's smaller customers use the self-service portal while larger customers make use of LSO Sonata APIs to automate catalog, order, and inventory integrations. Both small and large customers, using different channels to interact with CSG Encompass Quote and CSG Order Management, can generate instant quotes with customer-specific pricing – with orders fulfilled by CSG Encompass Order Management. By eliminating manual legacy processes based on spreadsheets and emails, One New Zealand have successfully streamlined their quote-to-cash cycle and elevated their wholesale customers' experience.

Contact

http://www.csgi.com Contact us at info@csgi.com

Enxoo Profile



Overview of Enxoo

Enxoo / en-ex-oh / is a global boutique Salesforce Partner and expert systems integrator for the communications industry, specializing in the delivery of digital transformation projects.

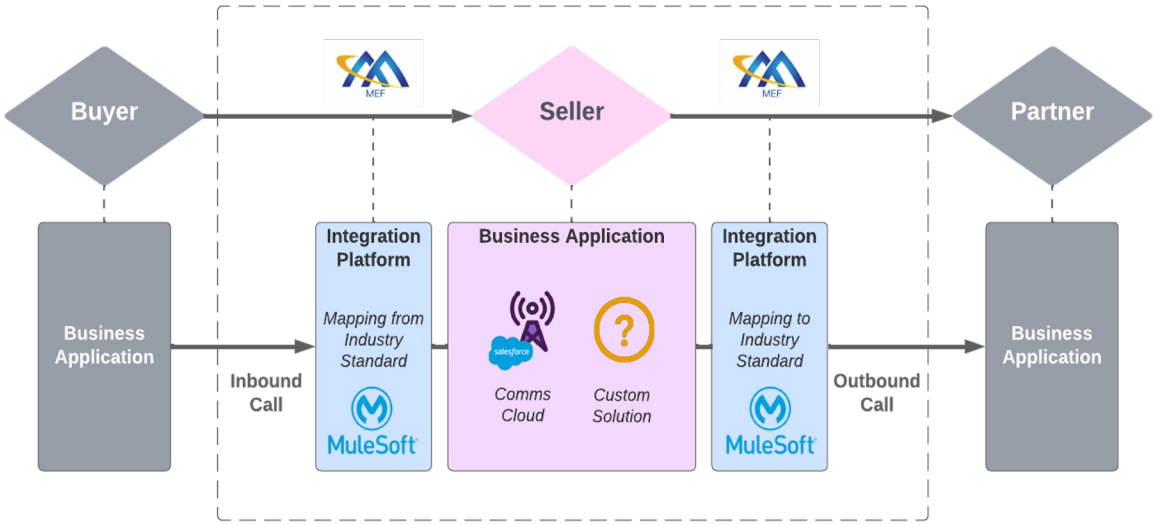
We not only help traditional CSPs to accelerate their transformation to better meet modern customer expectations, we also help emerging digital service providers (DSPs) to automate processes and standardize their business models through business support systems (BSS). Our industry-specific digital transformation solutions are tailored to wholesale carriers, next generation FTTx network operators, and enterprise connectivity service providers.

Our mission is to help transform telecom businesses into efficient, agile, and customer-centric organizations, ensuring you stay competitive in the future. We partner with our customers to increase revenue, shorten sales cycles, and achieve cross-departmental alignment to build a foundation for continuous growth.

Our solutions combine more than 15 years of experience, extensive telecommunications knowledge, and technical expertise that ranks among the best in the industry. We deliver comprehensive BSS/OSS transformation projects with Salesforce® technology that include Salesforce Clouds, Salesforce Industries & MuleSoft®, market leader for Integration Platform as a Service worldwide (according to Gartner's Magic Quadrant), as well as a variety of partner solutions.

Enxoo's LSO API solution is built leveraging the MuleSoft platform and enables:

- Flexibility – connecting any API to any API
- Declarative approach – building & deploying APIs with clicks, not code
- No-Vendor Lock-In – MuleSoft & Salesforce ecosystem has a multitude of partner options



Customer Activity

Enxoo has delivered some of the most complex Salesforce implementations for CSP's globally. Our customers typically want APIs to support multiple products and migration to ensure operational efficiency. Take a look at our success stories from our international customers and learn how we are transforming the communications industry globally: enxoo.com/customers.

How we helped a Tier 1 International Carrier deploy an LSO API solution:

- **Strategy** - Digitized customer experiences (automation and self service) to gain a competitive advantage and win new customers
- **Clients** - Addressed customer requirements for certified services
- **Time** - Enabled faster interconnection with partners by rapid service turnup
- **Cost** - One time investment needed. API deployed and reused anywhere without having to retest
- **Easy of Use** - The end user learns once and applies the knowledge to all products and services
- **Scalability** - Customer can connect as many partners as needed for any service

Enxoo Offices & Experience

Enxoo is headquartered in Warsaw, Poland, and has offices in the UK, Germany, Canada and the Czech Republic. We have proudly delivered 200+ successful projects for 100+ customers internationally

Contact

Learn more at enxoo.com and on our Salesforce AppExchange listing.
contact@enxoo.com +48 22 1151500

Sage Profile

LSO Solution Provider Roles					SDK Releases				LSO Sonata & Cantata Business Process APIs											
LSO API Implementer	Business App Vendor	LSO Broker	LSO Connectivity Exchange	LSO Blockchain Vendor	Pre-Billie	Billie	Dolly	Ella	Address validation	Site query	Product catalog	POQ	Quote	Product order	Product inventory	Trouble ticket	Appointment	Work order	Billing & invoicing	LSO Blockchain	LSO Op APIs
	■			■									■	■	■	■			■	■	

Solution - inFuse

Sage's inFuse is a self-funded blockchain-based solution for telecom ordering and billing. inFuse proactively corrects the errors (avg. 20%) in ordering and billing which eliminates disputes, back billings, and accrual issues. We utilize a 3-phased approach to drive value:

- Phase 1 – Rating of all historical orders for current embedded base of off-net telecom assets.
- Phase 2 – Real-time rating and correction of orders.
- Phase 3 – Blockchain solution using MEF LSO APIs to order and mutually endorse off-net assets.

Benefits

- Impact on gross margin
- Impact on operations (digital operating model)
- Proactive dispute mitigation – no more time and energy wasted only to settle for a % later
- Retire/decrease cost associated with legacy support systems
- Streamline staff and processes
- Improve accrual process (point of order to financial statement)

Sage Serves Telecom Service Providers, Enterprise, Government

- $4 billion+ in savings delivered on behalf of our clients over 18+ years.
- Sage provides a self-funded path to blockchain to achieve your organizational initiatives, streamline operations, and compete better.
- Our blockchain solution includes preemptive order correction, real-time rating of orders, and SLA management.

Solve Real Problems with Blockchain

- Retire antiquated business systems.
- Replace inefficient and error prone ordering and billing processes.
- Allow for financial assurance at the time of order.
- Improve accrual process, allowing for a clean slate of accruals.
- Eliminate disputes, back billing, and costly & untimely resolution and settlements.
- Streamline staff and focus on growth and competing better.

The current telecom contract, billing, and dispute environment is rife with inefficiencies. These inefficiencies can largely be resolved by instituting smart bilaterals and omnilaterals. The legacy billing systems being utilized by the carriers today were built to bill a Time Division Multiplexing (TDM) network. Newer technologies do not fit into the same mold of the legacy networks as designed. Services like Ethernet and Voice over Internet Protocol (VoIP) products have contractual pricing that is largely unregulated. The lack of regulation has created a considerable disparity across carriers and their products, both from a pricing and billing practices perspective. The combination of antiquated billing systems and unregulated contracts has contributed to perpetual billing and ordering issues.

Telecom carriers have operated for too long with outdated back-office systems and costly revenue assurance and dispute processes extending beyond normal course disputes, accrual mishaps, and revenue blockage to complex legal, regulatory, and compliance issues. The reactive patchwork method of approaching change by layering swivel-chair fixes to processes and systems has created a whole new set of problems at every turn. The financial and operational impacts on all parties dealing with issues stemming from this environment constrict growth and innovation.

Sage helps carriers implement an LSO Blockchain solution by building a rated embedded base inventory (rating and optimizing all historical orders), implementing real-time rating at the point of order, and establishing a blockchain solution that utilizes MEF LSO APIs and standards going forward. First movers will capture early synergies and be able to strategically position from a reactive mode to a proactive mode to change and complexity – two constants in the industry.

Contacts

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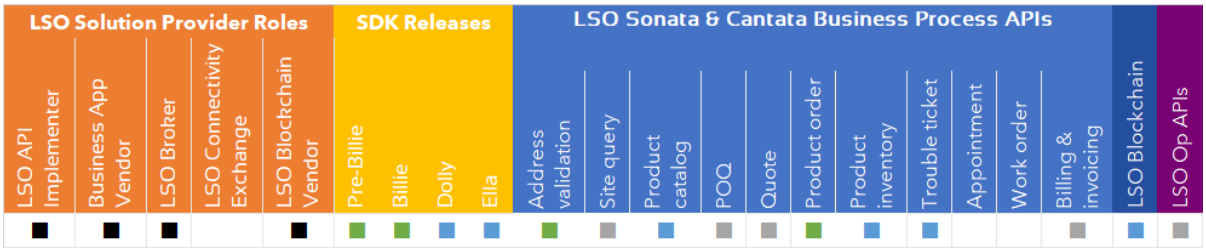
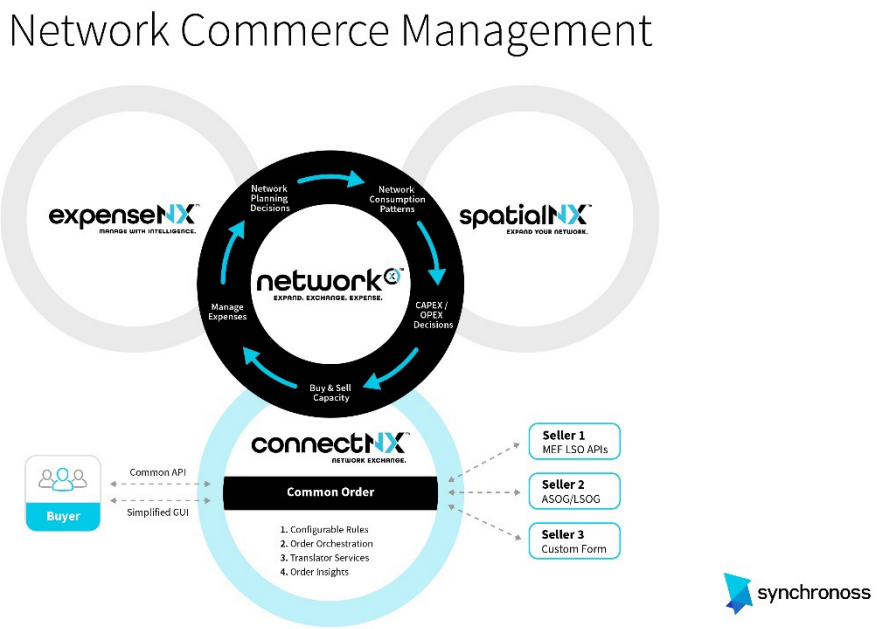
Synchronoss Profile





Platform – NetworkX

Synchronoss Technologies, Inc. is a global leader in telecom OSS, cloud, messaging, and digital products serving the technology, media, and telecom (TMT) industry and over 3 billion subscribers worldwide. Synchronoss' key platform in the TMT space is NetworkX, which is an integrated suite of OSS software solutions that enable service providers to automate and manage numerous aspects of network operations, including expanding physical network footprint, exchanging and fulfilling third-party capacity orders, and validating and managing associated network expenses.

The **NetworkX** platform is comprised of:

1. **ConnectNX**: This product suite provides a secure and scalable platform for buying and selling network capacity and connections across telecom carriers and enterprises. It enables service providers to quickly provision and manage network connections and services via an automated gateway, configurable business rules, and an intuitive user interface to reduce the time and cost of deploying new services and products. ConnectNX provides a single interface and repository to manage the full order lifecycle across buyers and sellers irrespective of order format (i.e. MEF LSO Sonata, ASOG/LSOG, custom/carrier specific), eliminating the need to maintain multiple/disparate trading partner connections.

The platform seamlessly integrates across inventory management, quoting, order fulfillment, billing, and other systems as an integral part of the OSS ecosystem and blockchain infrastructure.

2. **ExpenseNX***:* This product suite is designed for service providers to manage and optimize their network expenses. It provides real-time visibility into network spend, usage, and cost drivers, allowing service providers to identify areas where they can reduce costs and improve efficiency. It includes automated workflows and configurable business rules to provide a true procurement-to-payment management of network expenses and disputes across the organization. It provides a single repository of expenses across all vendors and service types which drives comprehensive accounting, validation, audit/savings, and payment governance with analytics to help service providers address cost anomalies and optimize their network spend. Additionally, integration between ConnectNX and ExpenseNX provides automated validation of circuit-related expenses with one-click access to order lifecycle content to support dispute management.

3. **SpatialNX***:* This product suite is a network design and management platform which provides a comprehensive view of the physical network infrastructure, including equipment and other assets, across the entire network. It enables service providers to manage their network assets more efficiently and proactively, reducing the risk of network downtime and improving service quality. Its automated fiber design capability streamlines the design process from hour/days to minutes which empowers the service provider to make effective network decisions. The platform includes multiple modules that provide access to network data across the organization – whether in the field to manage a repair or in the office to plan a new build. The SpatialNX suite provides the single source of truth for comprehensive and optimal network management.

These products are designed not only to operate independently, but also to complement each other and offer a complete and unified Network Commerce Management platform. They leverage advanced technologies such as artificial intelligence and machine learning to provide real-time insights and analytics, enabling service providers to make data-driven decisions and stay ahead of the competition in the fast-paced world of telecommunications and technology.

Synchronoss adopted MEF LSO Sonata within ConnectNX as it provides a flexible ordering format with common attributes across service types combined with service type-specific payloads. MEF brings order standards to markets that traditionally did not have any (i.e. ordering broadband or international wholesale telecom services) which positions ConnectNX as a platform which helps carriers broaden the addressable markets they are serving. That said, a primary challenge domestic US carriers face in fully adopting MEF APIs is their legacy ASOG and LSOG 'back office' infrastructure to complete the order process. Synchronoss is helping carriers to address this challenge by leveraging the MEF LSO SDKs to accommodate nuances to the ASOG/LSOG order lifecycle and systematic translators to convert orders and responses to maintain compatibility with upstream OSS systems. This flexibility helps carriers to bridge the gap across formats by using ConnectNX as a single platform to buy and sell capacity leveraging MEF LSO, ASOG, LSOG, and/or custom forms.

Synchronoss was founded in 2000 and is headquartered in Bridgewater, New Jersey.

Contact

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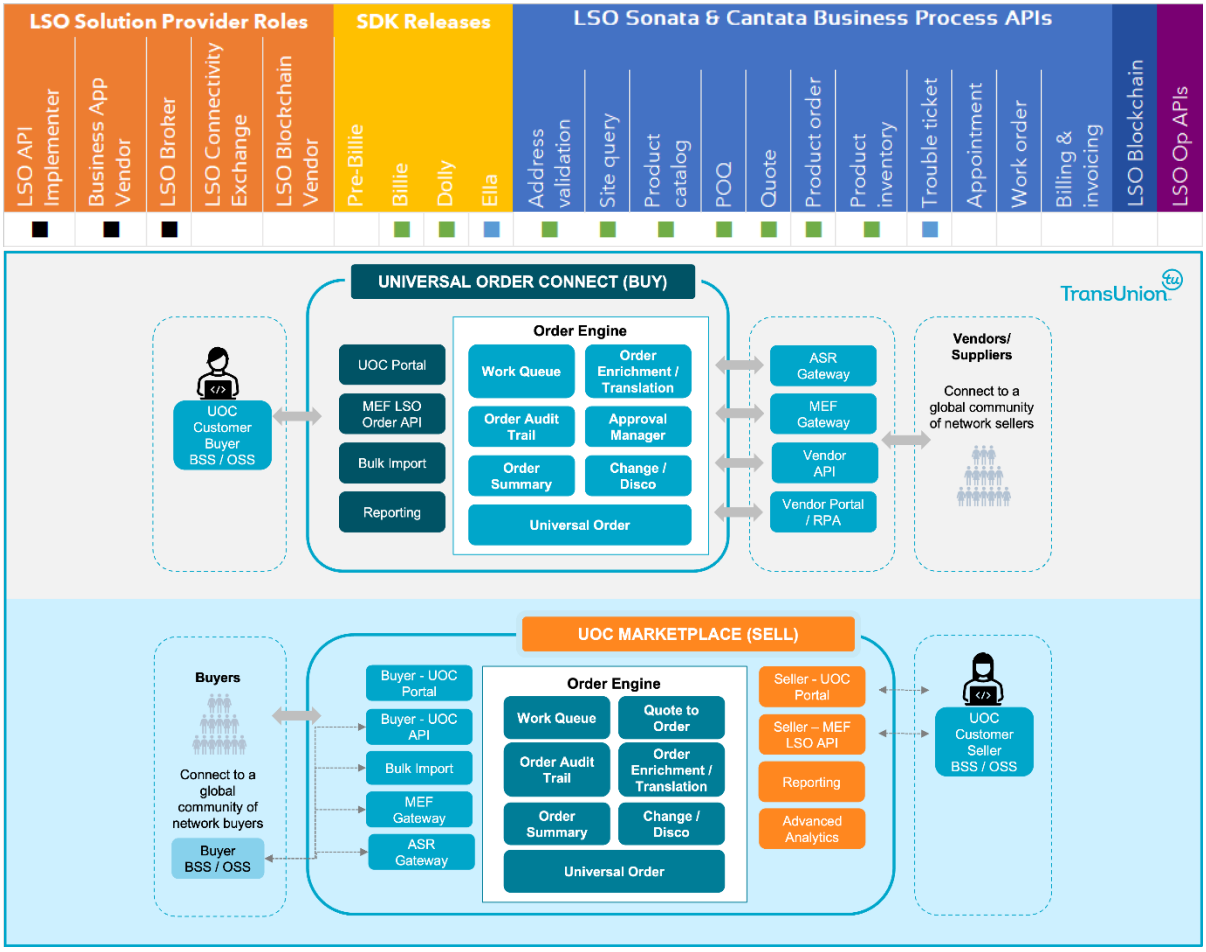
TransUnion Profile



Solution - TransUnion's TruContact™ Universal Order Connect, Powered by Neustar®
Universal Order Connect (UOC) is a cloud-based platform that automates and streamlines the inter-provider process of buying and selling wholesale network services, creating a more frictionless retail-wholesale ecosystem.

The UOC platform addresses the growing need for service providers to deliver connectivity to their business customers faster and more efficiently than ever before.

UOC comes equipped with MEF LSO Sonata APIs. It's the "easy button" for carriers interested in becoming LSO Sonata compliant without the "build" investment time and cost, opening the door for providing dynamic, high-margin, differentiated inter-provider services.

UOC can connect MEF LSO Sonata enabled and non-MEF enabled buyers and sellers together. It's a simpler way for communication service providers (CSPs) to do business with each other in an automated format, regardless of their API or standards implementations.

For network connectivity buyers:
Universal Order Connect streamlines the entire order management process for wholesale access, transport, and broadband services – seamlessly connecting buyers to hundreds of suppliers.

UOC's workflow automation removes the complexity of buying off-net connectivity – even broadband. Transport and access orders can be created and managed with ease. A shared online portal keeps buyers and sellers on the same page, with up-to-date circuit inventory for improved tracking and financial assurance, automation to report and manage trouble tickets, and analytics and reporting for supplier and service performance insights.

- **Simplified ordering** – Global support for orders, with a product catalog that lets you efficiently build each product specific to each order type. Orders are automatically translated into the proper format, with some data fields pre-populated to save time.
- **Better supplier management and visibility** – UOC automatically captures data that enables reports based upon supplier workloads, with analytics that improve claim/dispute wins.
- **Inventory accuracy** – Instantly identify active leased circuits, track circuit information, dates, and MRC/NRC, and integrate with existing inventory systems.
- **Supports multiple formats** – MEF LSO Sonata, ASOG, TM Forum, non-standard.

For network connectivity sellers:
UOC Marketplace improves how wholesale connectivity services are marketed and sold. Once an order is received, UOC Marketplace allows sellers to provide automated order updates and notifications to buyers, with an online portal providing an enhanced, real-time view. This reduces order inquiries up to sixty percent and improves order-to-cash timelines. UOC Marketplace makes it easier for buyers to do business with your organization – and keeps customers coming back.

- **Automated order receipt** – Automated workflows for order creation, validation, and submission speed up the order receipt process and reduce order fallout.
- **Improved customer communication** – Automated notifications, enhanced status updates, and online portal reduce order inquiries.
- **Streamlined service assurance** – Automated exchange of trouble ticket data with pre-submission validation reduces errors and delays.
- **Supports multiple formats** – MEF LSO Sonata, ASOG, TM Forum, non-standard.

Customer Activity
TransUnion is engaged in a number of opportunities with CSPs in different parts of the world around the implementation of MEF LSO Sonata via the UOC platform. Currently, the activity includes working with CSPs in Europe, Middle East, Latin America, and North America. As one example, TransUnion is working with North American Tier 1 service providers to replace the legacy ASOG ASR ordering process between them with the MEF LSO Sonata API. This represents one of the first deployments of its type in the industry.

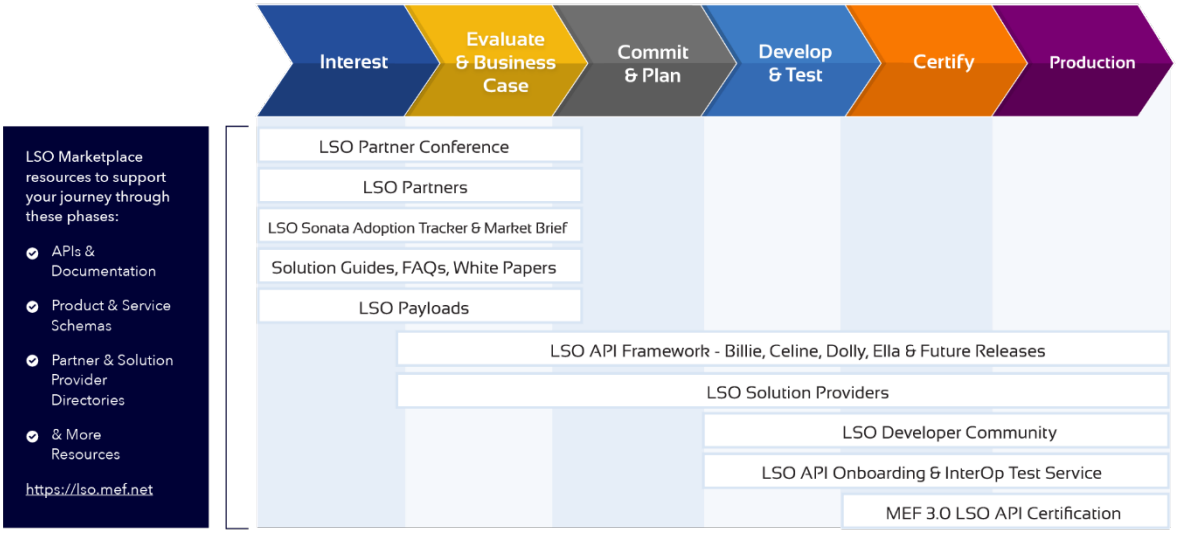
Contact
Learn more about TruContact™ Universal Order Connect (UOC), and UOC Marketplace and how they help accelerate adoption of MEF LSO Sonata APIs. Contact UOC@team.neustar

TransUnion acquired Neustar in 2021.

LSO Implementation Resources

LSO Adoption Lifecycle Resources & LSO Marketplace
MEF offers a broad range of resources, programs, and tools to make it easier for service providers to adopt LSO APIs. We already have covered LSO solution providers above. Below, we have linked to other valuable resources. On the following pages we go into detail on the MEF OIT service and MEF 3.0 LSO Business APIs Certification program.

LSO Adoption Lifecycle & Resources



LSO Marketplace – a one-stop shop site for tools, programs, groups, and resources intended to accelerate LSO API implementations.

- SDK releases
- LSO API catalog
- LSO API blending tool
- LSO payloads

LSO Community Manager – manages new SDK releases and provides support for MEF member IT departments adopting LSO APIs. Contact community_manager@mef.net.

LSO Partner Conference (video | login required for ppt & pdf) – the most recent half-day event took place in Rome in April 2023. This event featured:

- The business case for implementing LSO Sonata APIs – buyer and seller perspectives
- Service provider experiences with partner onboarding and implementation
- LSO solution providers
- LSO implementation tools
- LSO business and operational API roadmaps

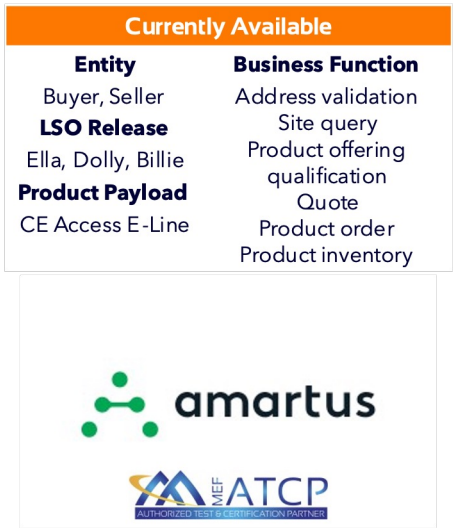
MEF LSO API Onboarding & Interop Test (OIT) Service
The OIT service offers an efficient, predictable, and scalable solution that SPs can use to test compliance of their LSO Sonata implementation, perform pre-interop testing with partners, and introduce support for new functions and product payloads with partners on an ongoing basis. It consists of software-based LSO Sonata Buyer & Seller Emulators hosted on a dedicated public cloud server for a subscriber. Key features include:

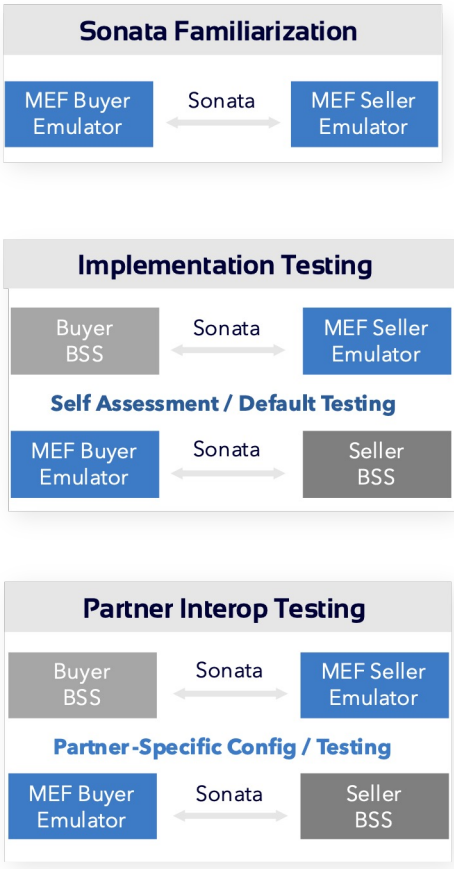
1. **LSO Sonata familiarization**. SPs can run buyer and seller emulators with default configurations (test requests/response and product payloads) to familiarize with LSO Sonata APIs.
2. **Implementation testing**. SPs can perform self-assessment testing of LSO Sonata.
3. **Partner interop testing**. SPs can (1) prepare an emulator configuration to match specific scenarios/configurations so this can be shared with partners and (2) load partner-specific configurations shared by partners for pre-interop testing.

Service providers who have used the OIT service during design and implementation have avoided costly mistakes, delays, and reworks and achieved significantly faster time to production.

For more information, email LSOOIT@mef.net and see MEF OIT - Frequently Asked Questions.

MEF OIT Service Support & Features



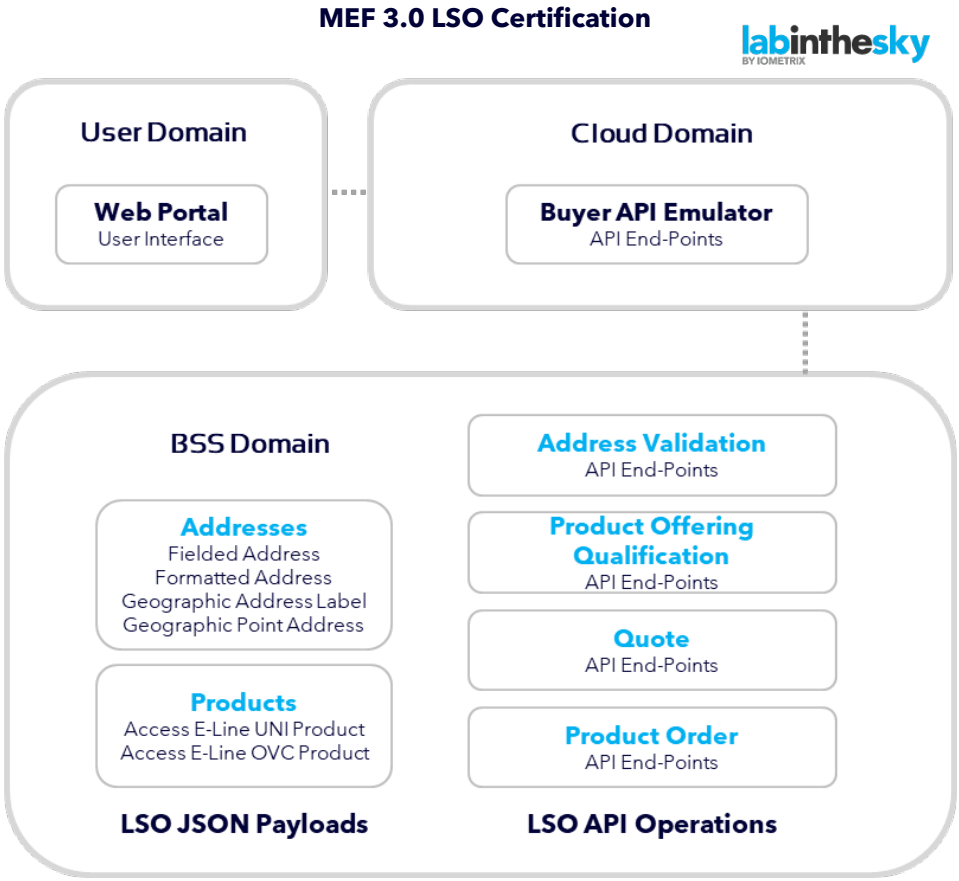


MEF 3.0 LSO Business APIs Certification

As of mid-May 2023, MEF now offers a new generation of MEF 3.0 LSO Business API certifications to support and accelerate the creation of a global ecosystem of standards-based automated networks. Service providers can now certify LSO Business APIs for four of the most popular functions that they are automating with customers and partners: address validation, product offering qualification (POQ), quote, and product order. All four are based on the Dolly SDKs and backed by an array of MEF standards: MEF 57.2, MEF 79, MEF 79.0.1, MEF 79.0.2, MEF 80, MEF 106 and the MEF LSO Developer Guides MEF 87, MEF 115, MEF 121, and MEF 123.

Building on and complementing the globally recognized MEF 3.0 certification of Carrier Ethernet services, the new LSO Business API certifications also provide a highly visible recognition of strictly validated conformity to MEF LSO APIs, giving certified providers preferred status in today's vibrant marketplace. There is also high operational value in certifying MEF LSO APIs since it ensures a proven degree of interworking with all similarly certified partners.

The certification process also provides SPs an accelerated path to conformity and market readiness. Testing is carried out on a self-service basis on the same well-known cloud-based Lab in the Sky platform developed by MEF Authorized Test and Certification Partner Iometrix. The testing environment is highly automated and comprehensively documented. It provides hundreds of error codes that pinpoint non-conformant lines of code, allowing developers to make immediate corrections during the up to six-month testing period allowed for each API before final submission for validation by Iometrix. Support is also provided through a responsive ticketing system.



To ensure market relevance, the certified MEF LSO API Uses Cases correspond to those that have proven to be the most widely used in LSO business transactions by both buyers and sellers globally.

MEF's new LSO Business API certifications build on the previous generation of LSO certifications and are designed to form the basis of an evolving scope of certifications with a strong emphasis on backwards compatibility ensuring their full value through time.

For more information, please send an email to info@iometrix.com.

Report Conclusions

Worldwide adoption of LSO Sonata APIs for automaton of business functions between service providers is strong and growing rapidly, with the number of companies in production expected to more than triple to 94 – 103+ by the end of 2025.

Many of the world's largest service providers are investing in LSO Sonata APIs as a core part of their digital transformation strategy and are encouraging their buy/sell partners to do the same.

Many of the 30 companies already in production with LSO Sonata APIs in support of CE Access E-Line services are realizing real-world benefits, including accelerated service delivery, accelerated time to revenue, and an improved customer experience.

These companies and new adopters will see increased benefits over time as the number of buy/sell partnerships expand and LSO Sonata APIs are used to support more product payloads, including Internet Access, wavelengths, dark fiber, and more.

Companies in production or committed to production with LSO Sonata APIs ultimately are laying the foundation that needs to be in place at the business process level for the industry to support dynamic services and NaaS solutions across a global ecosystem of automated networks.

Networks of the future will be fully API-driven at the business process and operational levels and require standards-based automation between ecosystem partners.

MEF offers a template for integrating the ecosystem of automated networks and extending automation to enterprises and cloud service providers. Standards-based LSO business and operational API enable SPs to efficiently scale implementations with many partners and services due to plug-and-play interoperability and other unique features.

Standards-based automation is a must. Now is the time to act if you have not done so already!

Questions & Comments?

Please feel free to send your MEF LSO-related questions and comments to Stan Hubbard, MEF Principal Analyst stan@mef.net.

Appendix 1 – Alignment Between MEF LSO Business APIs & TM Forum APIs

MEF LSO API Name	MEF LSO API/ Developer Guide	LSO Business Requirements & Use Case	TMF API
Address validation	Address management (MEF 121)	Address and service site management (MEF W150) (MEF 79)	Geographic address management (TMF 673)
Site query	Site management (MEF 122)	Address and service site management (MEF W150) (MEF 79)	Geographic site management (TMF 674)
Product catalog	Product catalog (MEF W142)	Product catalog (MEF W127)	Product catalog management (TMF 620)
Product offering qualification (POQ)	Product offering qualification (MEF 87)	Product offering qualification management (MEF W79.1)	Product offering qualification management (TMF 679)
Product offering availability discovery	Product offering availability and pricing discovery	Product offering availability and pricing discovery (MEF W110)	N/A
Quote	Quote management (MEF 115)	Quote management (MEF 80)	Quote management (TMF 648)
Price discovery	Product offering availability and pricing discovery	Product offering availability and pricing discovery (MEF W110)	N/A
Product order	Product order management (MEF 123)	Product order management (MEF 57.2)	Product ordering management (TMF 622)
Product inventory	Product inventory (MEF 116)	Product inventory management (MEF 81)	Product inventory management (TMF 673)
Trouble ticketing & incidents	Trouble ticket and incident management (MEF 124)	Trouble ticketing (MEF 113)	Trouble ticket (TMF 621)
Appointment	Appointment and work order management (MEF 137)	Trouble ticketing (MEF 113)	Appointment (TMF 646)
Work order	Appointment and work order management (MEF 137)	Trouble ticketing (MEF 113)	N/A
Billing & settlement	Billing management (MEF 141)	Billing and invoice (MEF 134)	Customer bill management (TMF 678)

Appendix 2 – Alignment Between MEF LSO Operational APIs & TM Forum APIs

MEF LSO API Name	MEF LSO API/ Developer Guide	LSO Business Requirements & Use Case	TMF API
Service provisioning & control	Service ordering management (MEF W99)	Service order (MEF WXX) – *MEF currently is discussing whether to have two separate APIs for order and control*	Service ordering management (TMF 641)
	Discussion underway	*Discussion underway*	Service activation management (TMF 640)
Service function testing	Service test (MEF W149)	Service function testing (MEF W136)	Service test management (TMF 653)
Service inventory	Service inventory management (MEF W135)	Service inventory (MEF WXX)	Service inventory management (TMF 638)
Service performance monitoring - Performance monitoring profiles	Performance monitoring (MEF W143)	Fault management and performance monitoring (MEF 133)	Performance management (TMF 628)
Service performance monitoring - Passive real-time & historical statistics	(MEF W144)	Fault management and performance monitoring (MEF 133)	Performance management (TMF 628)
Service performance monitoring - Threshold crossing alerts	Threshold crossing alerts (MEF W145)	Fault management and performance monitoring (MEF 133)	N/A
Streaming management	Streaming management (MEF W147)	Fault management and performance monitoring (MEF 133)	N/A
Fault management	Fault management (MEF W148)	Fault management and performance monitoring (MEF 133)	N/A