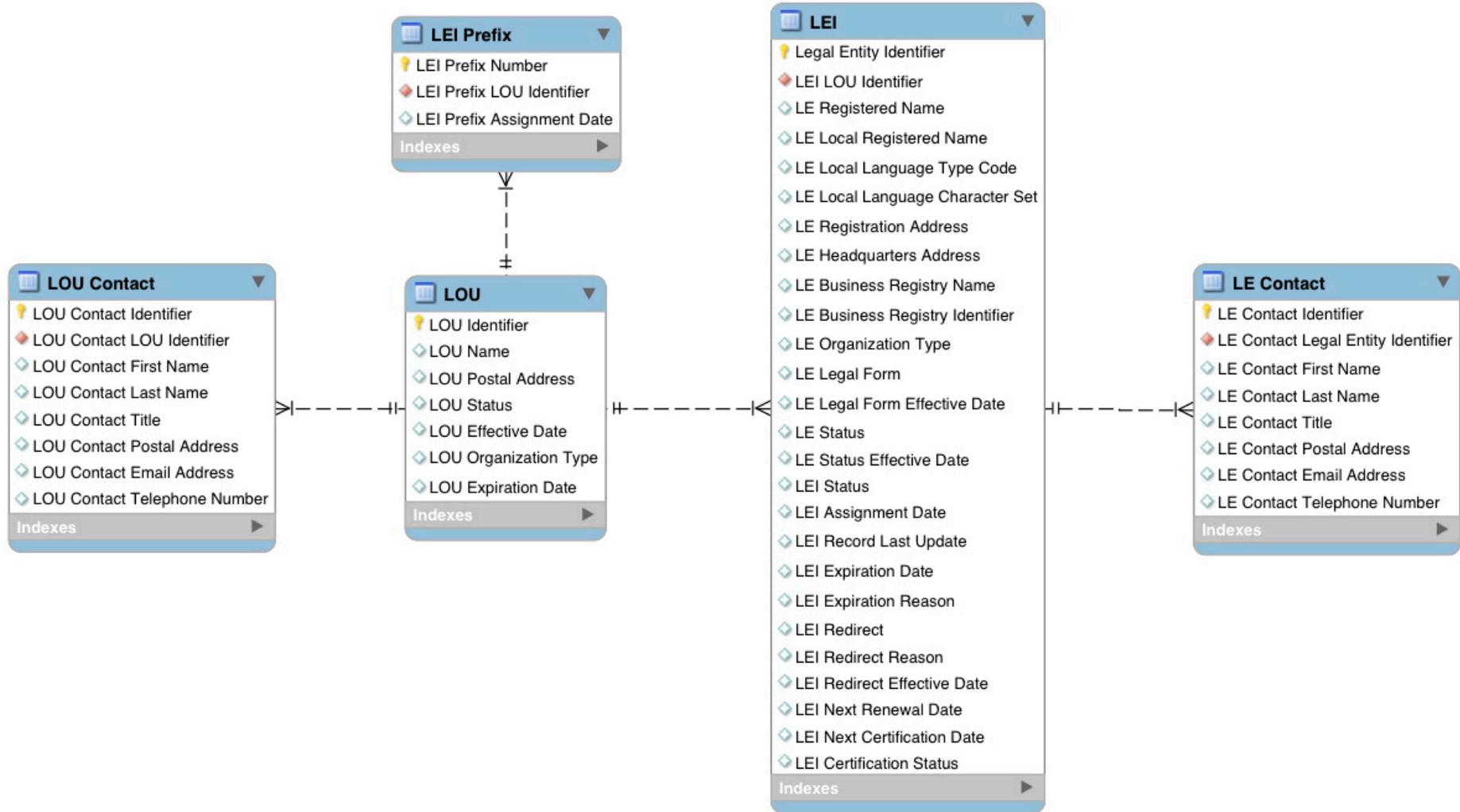


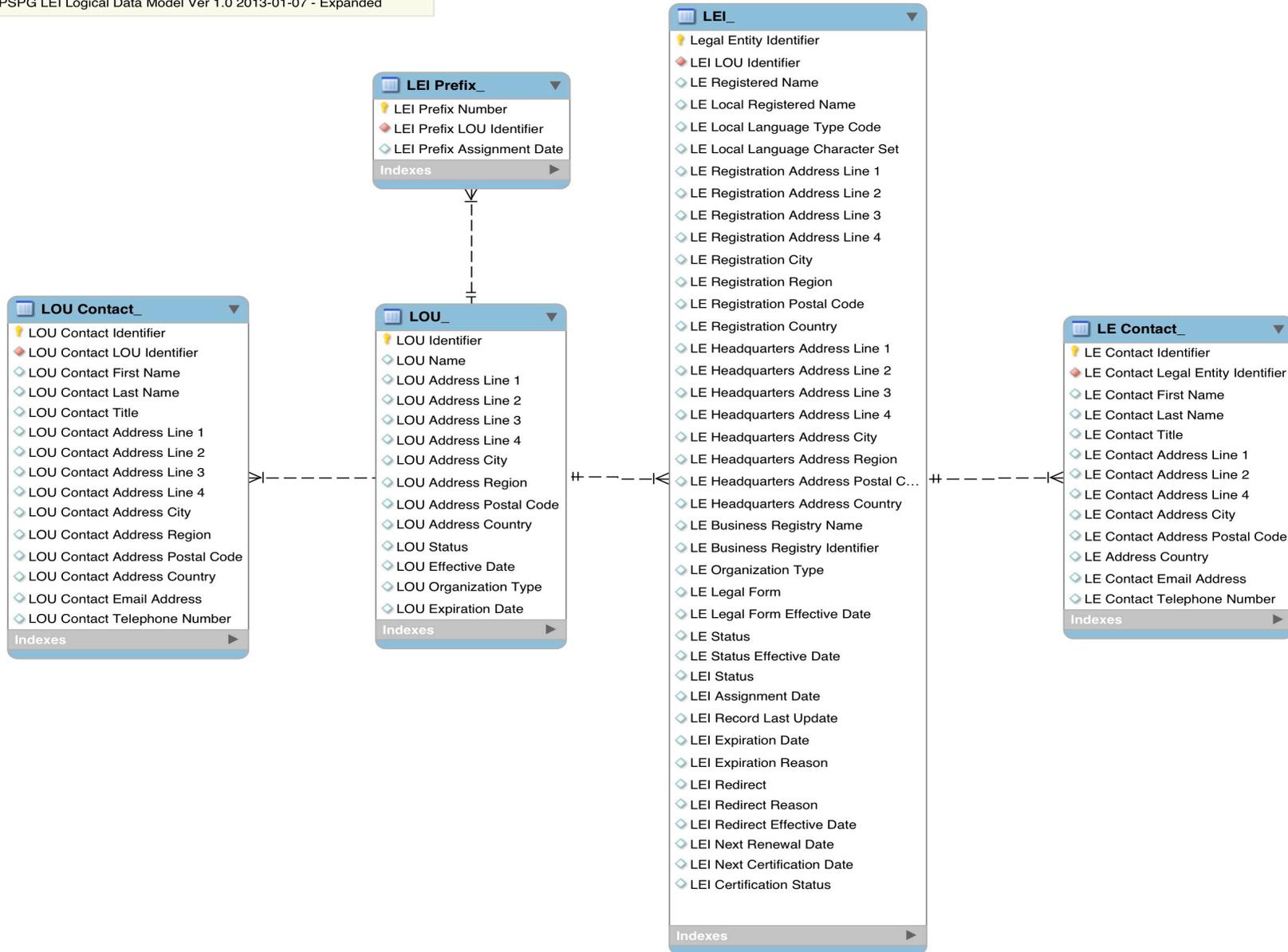
3.2.2 LEI REFERENCE DATA LOGICAL MODEL (short form)

PSPG LEI Logical Data Model Ver 1.0 2013-01-07

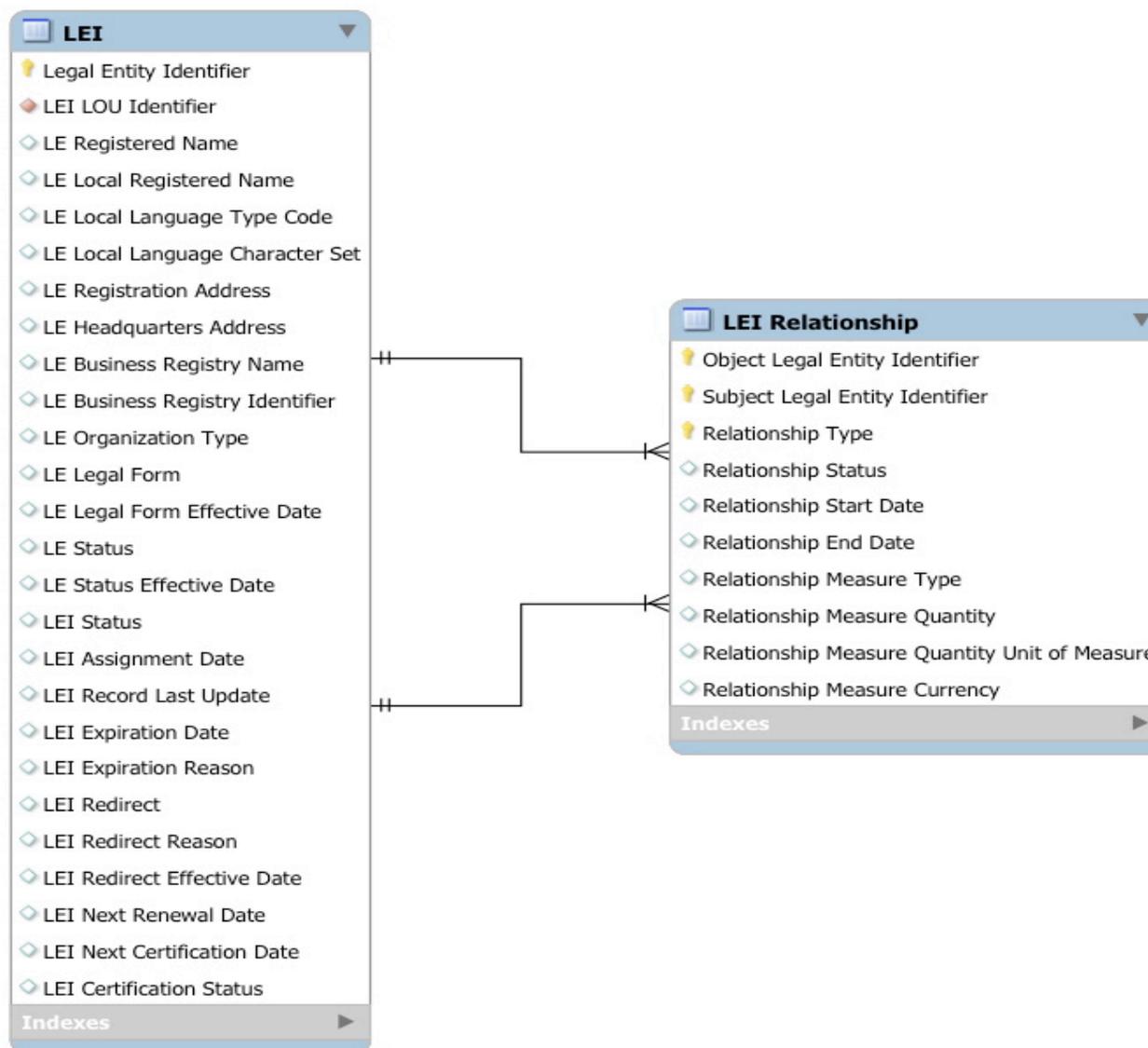


3.2.3 LEI REFERENCE DATA LOGICAL MODEL (expanded form)

PSPG LEI Logical Data Model Ver 1.0 2013-01-07 - Expanded



3.2.4 LEI RELATIONSHIP DATA LOGICAL MODEL



Class	Attribute Status	Population	Entity	Attribute	Description
Rel	Recommended	Required	Relationship	Object LEI	The object, or child, legal entity identifier
Rel	Recommended	Required	Relationship	Subject LEI	The subject, or parent, legal entity identifier
Rel	Recommended	Required	Relationship	Relationship Type Code	The type of relationship. Examples include economic interest, controlling interest and guarantor.
Rel	Recommended	Required	Relationship	Relationship Status	The status of the relationship (active, inactive).
Rel	Recommended	Required	Relationship	Relationship Start Date	The date the relationship was established.
Rel	Recommended	Optional	Relationship	Relationship End Date	The date the relationship was terminated.
Rel	Recommended	Optional	Relationship	Relationship Measure Type	The type of measure being recorded in the relationship. Examples include owned shares, owned share options, voting shares, voting share options, guarantor limit.
Rel	Recommended	Optional	Relationship	Relationship Measure Quantity	The number or quantity of the financial measure being recorded, qualified by the unit of measure.
Rel	Recommended	Optional	Relationship	Relationship Measure Quantity Unit of Measure	The unit of measure with qualifies the quantity being measured. Examples include number, percentage, currency amount.
Rel	Recommended	Optional	Relationship	Relationship Measure Quantity Currency	The currency identifier.

4 APPLICATION ARCHITECTURE

4.1 LOU Applications

4.1.1 Legal Entity Registry

4.1.2 HTML/HTTP Web Service

4.1.3 E-mail

4.1.4 Message Queue

4.1.5 Workflow Scheduler

4.1.6 Performance Reporting

4.1.7 Transaction Accounting

4.2 COU Applications

4.2.1 LOU Test Bed / Certifier

In order for the COU to accredit organizations who wish to be LOUs, the COU must do more than just send out documents and agreements that a prospective LOU would simply nod their head, promise to uphold, and sign. The COU must, in particular, be able to operationally test and vet the ability of the LOU to be an LOU and participate electronically in the LEI system. Hence, even if it is just a reference implementation or a test bed, the COU must have the ability to fully exercise the behavior, activity, and interactions with a prospective LOU.

4.2.2 COU Federated Services

The COU will need to provide a default home for certain communication services on behalf of the federation.

Namely:

4.2.2.1 *Seamless LEI 'whois'*

The 'whois' LEI seamless point of contact from the HTTP-based public Internet access is one such function (even if the inquiries were passed on to the appropriate LOU).

4.2.2.2 *Publish and Subscribe Service*

The publish and subscribe service that would provide event-driven update messages to LOUs (e.g., based on LEI additions and updates at each LOU and that the rest of the LEI system would need to track and possibly react to).

4.2.2.3 *Federated LEI Reverse LOU lookup index*

At a minimum, the Federated LEI Index to identify LEI ==> LOU association.

4.2.2.4 *Other COU potential services and applications*

4.2.2.4.1 Interfaces for other Internet-based financial information identification and integration facilities
Such as the Handle System and Digital Object Identifier (DOI) system.

These facilities have the potential to integrate the entity identifiers of the LEI system with global financial system data such as financial market transactions, financial instruments, balance sheet positions, credit ratings, public sector regulatory reporting data and economic data.

4.2.2.5 Other operational capabilities that may be domiciled at the COU

4.2.2.5.1 Providing an "LOU of last resort" if needed

4.2.2.5.2 Possibly providing an integrated corporate actions feed for LOUs,

4.2.2.5.3 Possible home for LEI relationship data management

4.2.3 Right-sizing the application functionality of the COU

An optimal strategy for planning and launching the right-sizing of the LEI Foundation may be to aim at as "lean" an organization as possible, but one that included the ability to scale and ramp-up to the appropriate level of operational services, with an underlying policy of only taking on functions and operations that cannot be performed by a federated network of LOUs.

It is important to distinguish between time-frames that pertain to implementation phases and stages, on the one hand, and time frames regarding when planning, design and requirements analysis of those stages occur, on the other.

It is completely prudent to defer the implementation of certain functional objectives -- even to the extent these objectives are actually requirements -- until such time as it is either possible or feasible to take on project phases that can not be tackled all at once. However, to defer too much the anticipation, planning or analysis of longer-term implementations until a later time carries with it risks that are commensurate with the degree to which those considerations are deferred and left unaddressed in the foundational planning.

Taking note of corporate actions are currently the primary means for the financial industry to be appraised (in a relatively organized fashion) of changes in the structure and organization of businesses. And yet, it is not possible to open up and delve into an adequate discussion or consideration of the details of how corporate actions could be integrated into the LEI system in the short strokes that remain in the current phase

of wrapping up the PSPG discussions on relationship data.

It is appropriate to recognize that being able to integrate "corporate actions", in one way or another, is and will (eventually) be an important process for ongoing GLEIS data management (for both LE reference data as well as LE relationship data). The -- whether by:

- (a) Encouraging an LOU to subscribe to territorially relevant corporate action services;
- (b) Aggregating existing disparate commercial corporate actions territorial feeds;
- (c) Having regulators take on the topic of how to agree on procedural and data standards to drive towards a globally federated but standardized mechanism; or
- (d) Putting the onus entirely on legal entities to maintain their respective LEI system information contemporaneously along with meeting regulatory reporting of changes in organizational status.

In the context of the scope restriction to not address the subject of corporate actions, the framing of the discussion constraint could perhaps be stated as "what are the means and practices to ensure ongoing data quality and maintenance that do not rely on corporate actions".

5 TECHNOLOGY ARCHITECTURE

5.1 FEDERATED LEI SYSTEM: LOU/COU INTERACTIONS⁵

5.1.1 Introduction

In the PSPG operations workstream it has been noted that in the federated LEI system there will need to be standardized interactions between peer LOUs and between the LOUs and the COU. This document outlines a minimum set of interactions that are likely to be required. The material here builds upon the paper “Federation in the LEI System” previously submitted by GS1 to the PSPG (<https://knowledgecentral.federalreserve.org/CommunityBrowser.aspx?id=3363>), as well as postings to the Knowledge Center by Jeff Braswell of Tahoe Blue (<https://knowledgecentral.federalreserve.org/CommunityBrowser.aspx?id=4210>).

5.1.2 Operation of a Federated System

5.1.2.1 Principles of Federation

The starting point for the analysis herein are the principles of federation affirmed in June 2012 FSB report “A Global Legal Entity Identifier for Financial Markets” (Section VI).

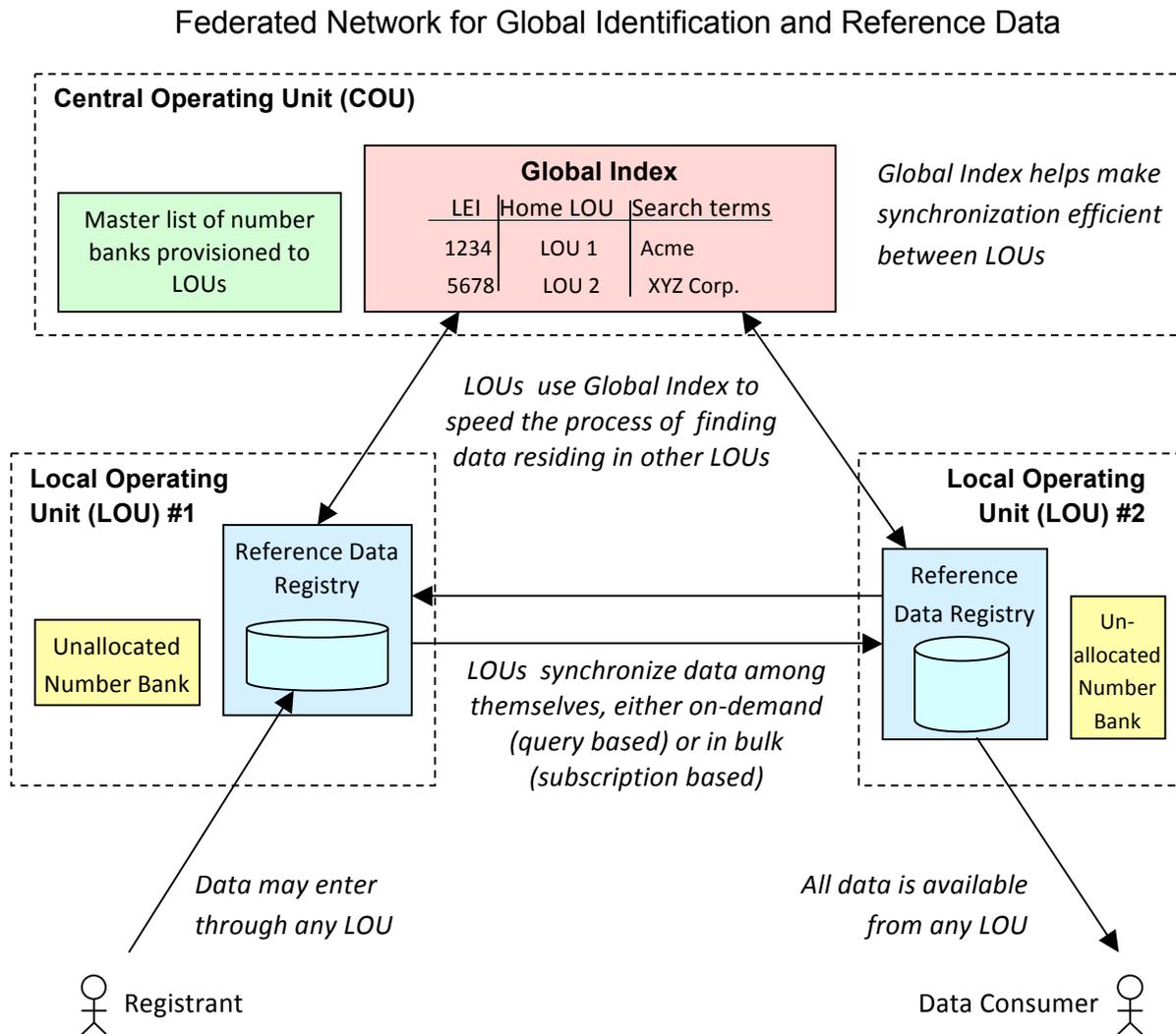
- A service is provided that appears to end users to be a single, global service – the same data is available anywhere in the world, regardless of where it was entered.
- Internally, the service is actually deployed as a network of multiple service providers (each a “node”), whose individual deployments collaborate to provide the appearance to end users of a single seamless service.
- If any one node becomes isolated from the rest of the federation, the services provided by that node continue to function for the node’s end users, at least as far as business transacted within the geographic scope of that node.

In practical terms, this means, for example, that if there is a node of the federation that serves Country A, then no other country can take any action to disrupt business taking place entirely within Country A, even if Country A’s node becomes completely isolated from all other nodes. This is a very high architectural standard, but in our experience it is required to provide sufficient confidence to a country to fully adopt the system, especially a country that feels vulnerable because of its size, emerging status, or other concerns.

⁵ (“LOU/LOU and LOU/COU Interactions in the LEI System”, <https://knowledgecentral.federalreserve.org/CommunityBrowser.aspx?id=4306>)

5.1.2.2 Federated Network for Global Identification and Reference Data

The following diagram depicts at a high level the architecture of a federated LEI system:



In this architecture, there are multiple LOUs which collectively comprise the primary system of record for LEI data. Each LOU registry offers services for issuance of new numbers, for registration of reference data, and for lookup of data including lookup by number and lookup by other attributes (searches). Issuance of new numbers is handled by a set of technical components (yellow and green in the diagram) that are entirely separate from the components responsible for registration and lookup of reference data (blue and pink in the diagram).

For registration and lookup of reference data associated with an LEI, each LOU maintains a local registry (blue box in the diagram) which is the system of record for LEIs registered with that LOU. Each LOU registry also communicates peer-to-peer with other LOU registries, so that it has access to data that is registered elsewhere. There are several options here: one possibility is that each LOU registry keeps a copy (cache) of data obtained from peer LOU registries; it is also possible to have a similar architecture where peer data is only queried peer-to-peer upon demand. (GS1 has examples of each method among the several federated registries that it operates.)

The “global index” (pink box in the diagram) maintains a list of all the identifiers that are registered across the system, and records which LOU registry is the system of record for that identifier. It may also maintain a subset of reference data attributes for each identifier, to aid in global searches. The global index is used to mediate the peer-to-peer interactions; e.g., if a data consumer makes a request to LOU registry #2 for an identifier that was not registered with LOU registry #2, the latter consults the Global Index to discover that it should contact LOU registry #1 to find that data. This allows the system to scale, as there are no “broadcast” operations required to respond to queries.

Also, although it is not shown in the above diagram, it is anticipated that the Global Index, and even the Global Reference Data, could be redundantly replicated at each LOU. This would first of all be possible because of the relatively small size and footprint of not just the Global Index but also the Global Reference Data itself. (For example, a million legal entities with 1,000 bytes per entity would yield a Global Reference Data collection that was on the order of 1 gigabyte. This means that the entire global LEI reference data could easily fit in the random access memory (RAM) of a medium-sized laptop.)

There are two main reasons why keeping replicated copies of the Global Index and the Global Reference Data at each LOU would be desirable or useful. First, doing so would eliminate the additional network round-trips needed to access either the COU (for the Global Index) or another LOU (in order to, say, look for duplicates or otherwise scan the global LEI reference database). Direct LOU access of the LOU administering an LEI is of course still possible, and would most certainly be done for critical path updates of LEI reference data at the designated LOU.

The second reason is that having redundant (and current) LEI reference data at each (or designated) LOUs would provide a very robust ability to recover (or be able to simply continue operating) in the event of COU or LOU failures. Also, having distributed copies of this information would also allow the LEI network to scale better in the future should transaction, update, and lookup volumes grow. The redundant copies of both the Global Index and the Global LEI Reference Data could be kept in sync by using a publish/subscribe mechanism in which LOUs with update activity would post to a publishing service, and LOUs

would subscribe to the service in order to receive event-driven updates.

On the other hand, there are also arguments in favor of not replicating reference data at each LOU. One, if any reference data attributes are of a sensitive nature or subject to local data domiciling laws, it may be undesirable or infeasible to replicate this data at the COU or in other LOUs. This is unlikely to be the case for “level 1” reference data but is a possibility for “level 2” data. (It is for this reason that we identify a “searchable” subset of attributes as the minimum required at the COU level.) Two, not replicating data has the effect that an LOU-to- LOU interaction is required each time data from one LOU is needed by another, which in turn gives the home LOU for each LEI record more visibility as to who and how frequently its data is used.

The net of the above is that the question of whether to replicate data among LOUs has tradeoffs that will be need to be considered as the design of the LEI System is finalized

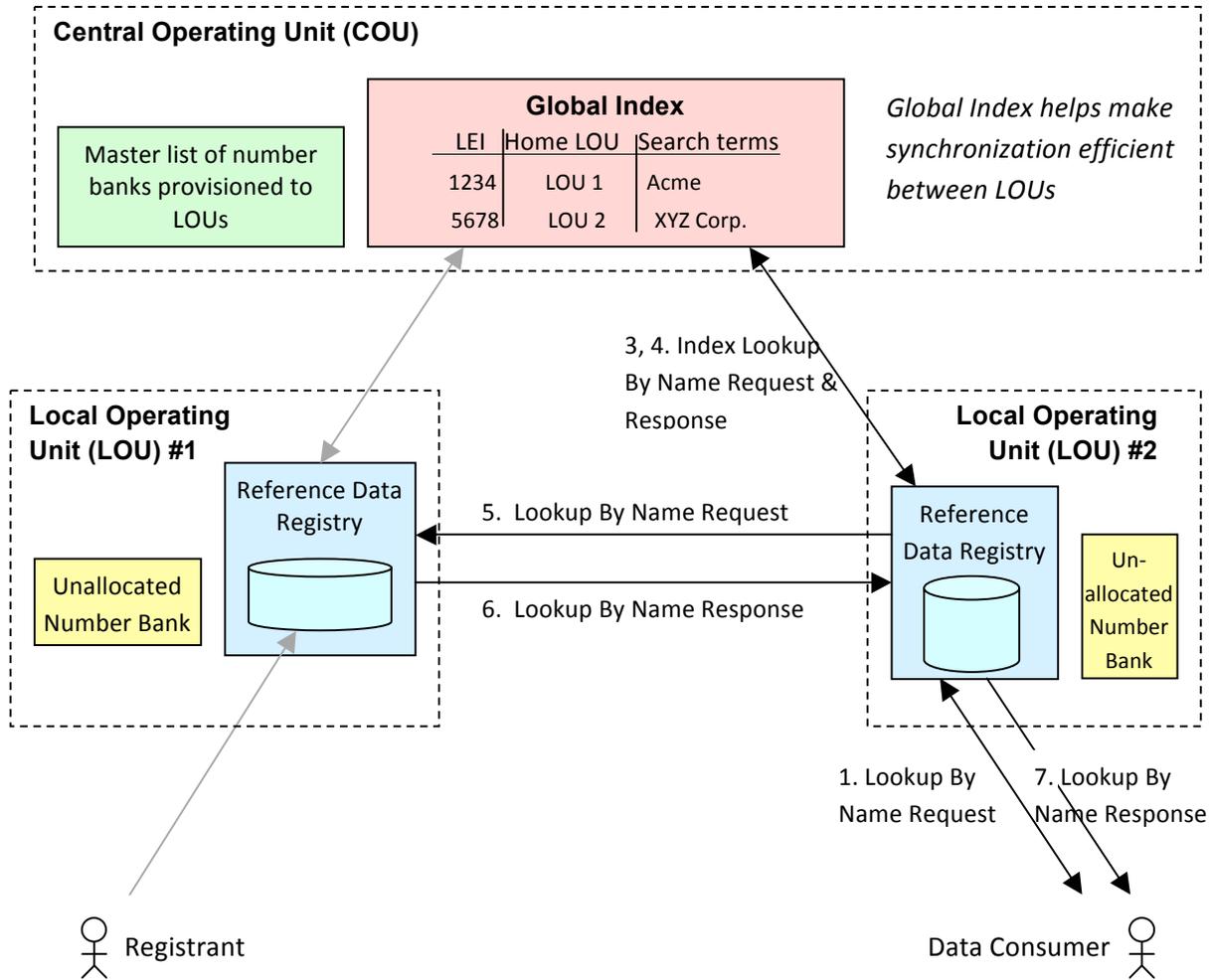
It should be noted that the LOU in which a given LEI is registered is *not* necessarily the same LOU that issued the number. In particular, an LEI registrant may at any time choose to move the registration of its LEI from one LOU to another. The LEI number itself does not change when this occurs, and the data continue to remain accessible throughout the network. This gives LEI registrants the freedom to choose their LOU either for competitive reasons or to meet regulatory requirements. (It is analogous to switching cell phone carriers while retaining your cell phone number, or selecting another domain name registrar to use to register an Internet domain name in lieu of the current registrar.)

Each LOU is responsible for communicating with the Global Index to ensure that it is up to date. When a new LEI is registered with an LOU, the LOU makes an entry in the Global Index to indicate that the new LEI exists and that it is the “home” LOU for that LEI. If the registration of an LEI is moved to a different LOU, the Global Index is updated accordingly. In order to facilitate global searches (e.g., searching the entire system for LEIs whose company name matches a given search term) a few selected reference data attributes may also be stored in the Global Index. Those attributes require updating if the underlying reference data changes. Most other reference data attributes are held only in the LOU registries and no update to the Global Index is required if those reference data attributes change. It is likely that the searchable attributes in the Global Index will be limited to a subset of “Level 1” reference data such as company name and country of domiciling.

We now consider the operations that require interaction between the components of this diagram.

5.1.2.2.1 Look Up an LEI by its 20-character Code (“lookup by name”)

Goal: a Data Consumer wishes to obtain reference data associated with a specified LEI.



Main flow:

The Data Consumer sends a Lookup By Name request to its preferred LOU.

1. If the specified LEI is registered with that LOU, the LOU responds immediately with the reference data for that LEI. Otherwise,
2. The first LOU sends an Index Lookup By Name request to the COU
3. The COU consults its index, and responds with a pointer to the home LOU in which the specified LEI is registered
4. The first LOU sends a Lookup By Name request to the home LOU as indicated in the COU response
5. The other LOU responds with the reference data for the specified LEI
6. The first LOU responds to the Data Consumer with the desired reference data

The above narrative illustrates a process where each lookup to a peer LOU is serviced “on demand.” It is also possible to establish a publish/subscribe mechanism so that each LOU receives a copy of LEI data registered with peer LOUs, so that at query time it is not necessary to communicate with peers. The data flowing along the lines in the diagram is essentially unchanged, however: only the timing is different.

5.1.2.2.2 Look Up an LEI by one or more attributes (“lookup by attribute”)

Goal: a Data Consumer wishes to find out that LEIs match various criteria pertaining to their reference data; for example, finding one or more LEIs given a company name, an address, etc.

The flow for this use case is essentially the same as in the Lookup By Name use case, except that (a) the Lookup By Attribute request contains not an LEI but rather attributes or search terms that define the query; (b) the response may contain records for more than one LEI. When the COU responds to an Index Lookup By Attribute request, there may be many LOUs pointed to in its response.

5.1.2.2.3 Registration of a New LEI

Goal: a Registrant wishes to register a legal entity and obtain a new LEI for it

Main flow:

1. The Registrant presents reference data to its chosen LOU
2. The registering LOU verifies the submitted data

3. The registering LOU verifies that the specified legal entity does not already have an LEI assigned to it. In order to do this, it carries out the “Lookup By Attribute” use case in order to search for relevant LEI records elsewhere in the system (e.g., by doing a lookup based on the name of the legal entity being registered). If no previously assigned LEI is found, continue with the next step.
4. The registering LOU allocates an unassigned LEI code to the registering legal entity and creates a new LEI record in its own system of record.
5. The registering LOU sends a “Register New LEI” message to the COU
6. The COU updates its index. Optionally, the COU may notify other LOUs if a publish/subscribe mechanism has been established
7. The registering LOU confirms successful registration to the registrant.

5.1.2.2.4 Update Reference Data for an LEI

Goal: a Registrant wishes to update the referenced data for a previously registered legal entity. This includes changes to name, address, etc, as well as changes in status (e.g., if an LEI becomes inactive following a corporate action)

Main flow:

1. The Registrant presents an LEI and updated reference data to the LOU in which it is registered
2. The registering LOU verifies the submitted data
3. The registering LOU updates the reference data in its own system of record
4. If any of the modified attributes are the “searchable” attributes maintained in the COU’s global index, the registering LOU sends a “Update LEI” message to the COU, including the new searchable attribute values
5. If the previous step was performed, the COU updates its index. Optionally, the COU may notify other LOUs if a publish/subscribe mechanism has been established.
6. The registering LOU confirms successful update to the registrant.

5.1.2.2.5 Transfer Registration of an LEI to a Different LOU

Goal: a Registrant wishes to transfer the registration of a previously registered legal entity to a different LOU.

There are several different ways this operation can be carried out. One possibility is illustrated below, in which the LOUs play the primary role:

Main flow:

1. The Registrant makes its intentions known to the original LOU and the new LOU (the exact details of this are outside the scope of this document)
2. The original LOU sends a message to the new LOU indicating that it is requesting transfer to the new LOU
3. The new LOU responds to the original LOU indicating that it is willing to accept the transfer
4. The original LOU sends a message to the new LOU containing the complete LEI record for the LEI to be transferred
5. The new LOU stores the LEI record in its system of record
6. The new LOU sends an “Update LEI” message to the COU to update the “home LOU” pointer maintained in the global index.

An alternative possibility not illustrated here would be for the COU to orchestrate the transfer.

5.1.2.2.6 Resolving a Multiple Assignment Situation

Goal: After discovering that the same legal entity has received more than one LEI, update the system so that only one LEI survives.

This use case is really just a special case of the “Update Reference Data for an LEI”, where the non-surviving LEI is updated to indicate its new status is “inactive” and to provide a link to the surviving LEI.

5.1.2.3 Summary of Messages

The following table summarizes the messages used in the above operational use cases. *These would be likely candidates for standardization in the LEI System.*

Message	Direction	Data Content
Lookup By Name Request	LOU → LOU	LEI
Lookup By Name Response	LOU → LOU	LEI, reference data
Index Lookup By Name Request	LOU → COU	LEI
Index Lookup By Name Response	COU → LOU	LEI, pointer to LOU
Lookup By Attribute Request	LOU → LOU	Attribute values or other query
Lookup By Attribute Response	LOU → LOU	One or more LEIs with their reference data
Index Lookup By Attribute Request	LOU → COU	Attribute values or other query
Index Lookup By Attribute Response	COU → LOU	One or more LEIs with pointer to their home LOUs
Register New LEI	LOU → COU	LEI, searchable attributes, pointer to registering LOU
(optional: publish to subscribers, if replicating redundant global index or global reference data)	COU → LOUs	LEI, searchable + core attributes, pointer to registering LOU
Update LEI	LOU → COU	LEI, searchable attributes, pointer to registering LOU
(optional: publish to subscribers, if replicating redundant global index or global reference data)	COU → LOUs	LEI, searchable + core attributes, pointer to registering LOU
Transfer Request	LOU → LOU	LEI
Transfer Accept	LOU → LOU	LEI
Transfer	LOU → LOU	LEI, reference data

5.2 Operational LOU Data Interfaces

In support of the LEI Transfer process, data attributes and their values will need to be provided from the current LOU to the new LOU. Once the Transfer Initiation and Authentication processes have been completed, mechanisms must be promoted and developed to support the data exchange process. (See Section 3.1.2.3 above, for specific message set recommendations):

5.2.1 Data Exchange Message Standards

Message Standards will need to be developed to facilitate the automation of data between stakeholders, actors and involved parties in the LEI system. It is envisioned that the types of Involved Parties will be:

- Regulatory and Sovereign Agencies
- Legal Entities (LEs) – those firms which will be added and defined via LEIs
- LOUs
- Industry Firms
- The general public and everyone else

The proposed Message Standards could include the following categories of data attributes:

Message metadata attributes – metadata describing the Sender of the Message and including “Control” attributes such as Data and timestamps

“Required” attributes – attributes such as the LEI value and address attributes such as those defined in ISO 17442 (and any others deemed applicable by the IG, ROC or COU)

“Optional” attributes – attributes defined as those which exist in one or more individual LOU systems. These could include LOU Contact and LE Contact details and Event History attributes. Data security and permissioning will be utilized to control which information can be supplied on which of these optional attributes

5.2.2 Data File Export and Import

Several types of data file extracts will likely be required, including:

“**Full**” file extracts – Full file extracts should be generated at one or more time periods per day (geographic regional requirements need to be determined, if any). It may be desired to exclude selected LEIs from this extract when the LEI Status Code is Incomplete or Expired (needs to be finalized)

“**Delta**” file extracts – Daily or Weekly “change” file extracts should be generated. It may be desired to exclude selected LEIs from this extract when the LEI Status Code is Incomplete or Expired (**Question**: this needs to be finalized)

“**Custom**” file extracts – dynamic or selectable sets of desired data

Each of these capabilities will likely support and be used in any system or sub-system participating in the Global LEI universe – as well as by the general public and other end-users.

5.2.3 Manual Processes

It is recognized that involved parties that wish to participate in the Global LEI system may not have robust infrastructure or support for automated data exchange processes. Functionality and support for the Processes defined immediately above (Data Exchange Messages and Data File Export & Import) could possibly be extended to areas such as:

- Online displays of LEI data (including parameter-driven selected sets of data)
- Report Generation and Printing
- Exports to tools such as spreadsheets, XML readers, and SQL databases (as an example)

Key Question: What minimum level of Automated message processing for communications and data exchange will be required by the ROC or COU for every LOU in order for an organization seeking to be a LOU to be accredited by the COU?