AMR Data Hub

Architecture

Work Package 6.1.5: Enterprise Application Implementation Scenarios for Electricity Market

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Table of Contents

AMR Data Hub

1 Introduction

The purpose of this document is to provide a high level description of a future AMR Data Hub scenario for storing and managing energy measurement data.

An AMR Data Hub can be defined as a common solution to some or all market operators that manage meter value information and the delivery of services based on that information.

1.1 Principles of Data Hubs

Several models for Data Hubs have been proposed and considered by different parties. The models tend to vary based on distributed vs. centralized data storage and distributed vs. centralized data exchange.

It seems that a centralized information service is needed in order to support the more advanced, efficient and flexible solutions. NordREG acknowledges the need for a common register of metering point IDs. This service can be provided as a feature of a centralized Data Hub or as a separate entity providing a common service for single or multiple Data Hubs.

1.2 Benefits of centralized Data Hubs

Centralized information services or registers add value. The registers are always up-to-date. Market operators can perform actions based on the latest correct data. Exceptions are handled in one place instead of negotiating them between operators. Examples where this is relevant include supplier switching processes and move-in processes. Anonymous treatment of suppliers in a centralized database can provide better supplier equality.

Both Centralized and Individual Data Hubs can provide a better service and lower the operating costs for their subscribers. Small operators can share development costs through collaboration. Large players can also select the appropriate level of developing own systems and outsourcing the operations to an external provider.

Ovum report on smart meter data services acknowledges that monopoly markets can manage without centralized data services. The Finnish and the Nordic market in general have a large number of market operators. Also NordREG has proposed national Data Hubs that can communicate with different market parties and among themselves.

1.3 Benefits of distributed Data Hubs

The Ovum report discusses the conspicuous absence of flexibility from mandated Data Hubs. Some services offered by centralized Data Hubs need only be implemented in one place and would therefore support the building of a centralized mandated Data Hub.

However, some market players may benefit from a differentiated service. Benefits from competition among service providers may also be beneficial for example by encouraging innovation. The Ovum report makes a distinction of services that should be provided as monopolized data services and additional data services. This distinction differs among markets.

1.4 Three Data Hub models presented by NordREG

The three proposed theoretical models provided by NordREG are briefly described here.

1.4.1 Web service search tool

According to NordREG "*The search tool helps to give the supplier relevant customer information, metering point ID in particular, by collecting the data from DSOs databases.*" This approach would make the supplier switching process more manageable for suppliers and network companies.

The search tool provides the supplier with information needed to send a message to the correct network company when initiating a supplier switch process. NordREG considers the relevant information to be: Metering point ID, Meter address, Billing address (can be acquired from the consumer also) and the balance settlement method.

The search tool operator would not be responsible for the data it provides. Instead the network companies would be responsible for the metering data. The search tool operator could be different in every country or it could be run as a single service for the Nordic market. The operator(s) should be placed under some regulation because they would operate in a natural monopoly.

1.4.2 Simple Centralized Data Hub

In central Data Hubs all metering points have unique IDs that correspond to other information about the meter and the consumer. In this scenario the Data Hub would contain information about metering points, customers and both present and historical metered data.

This model would not change the network companies' mode of operating to a great degree. The companies obtain metered values, maintain information in their own databases and upload it to a centralized service.

The degree of suppliers' control over customer information in a central Data Hub must be considered. Network companies would still require a customer database of their own for invoicing new connections, cable positioning, disconnection, reconnection and so on. However, regular consumption invoicing and maintaining the customer data on a centralized Data Hub can be done in the role of the supplier only.

1.4.3 Extensive Centralized Data Hub

In this model there are no local databases. The supplier and the network company operate by utilizing a centralized service. This model provides the

opportunity for a pure supplier centric mode. Even meter reading processes could be handled by the supplier.

Several challenges also arise. This would be a fundamental change in the market affecting network companies and suppliers the most. Also data security and privacy issues must come under scrutiny. The initial cost for building such a vast centralized system may also prove to be too great.

1.5 Architectural representation of a dynamic Data Hub scenario

As NordREG states combinations of the different solutions may occur on a national level. NordREG states that *"It is important that the CDB version chosen is constructed in a way that makes it possible for expansions and improvements in the future without forcing the actors to make new large investments. Instead improvements of the CDB should be made as additional modules to the existing model making the adaption easier for the actors, and thereby making the solution long-lasting and effective."*

This document presents the architecture of one possible real world AMR Data Hub and connections to external systems from the Data Hub.

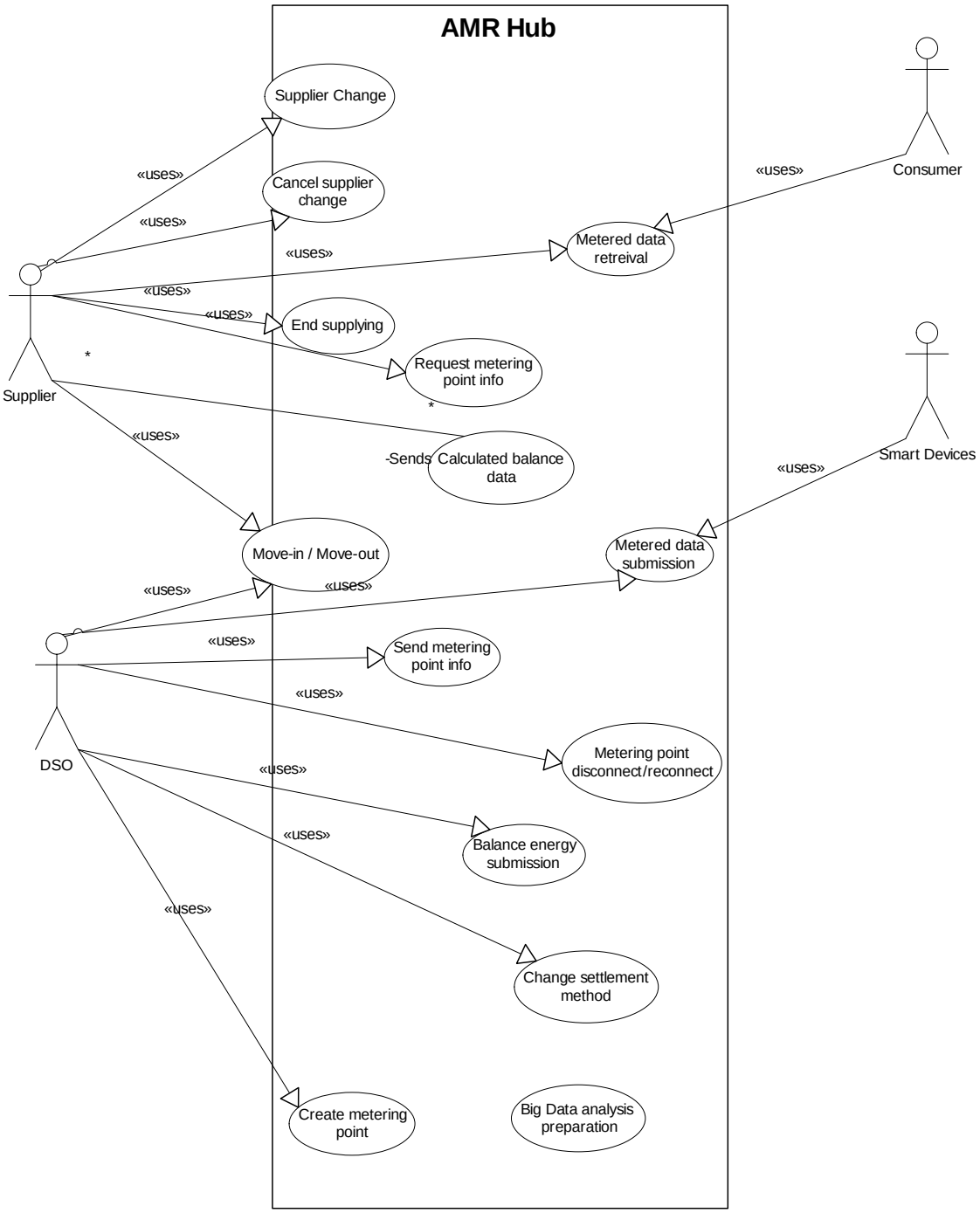
First the high level use cases are described and then a logical view to the whole market scenario is provided from the AMR Data Hub point of view.

2 Use-Case View

NordREG has identified the main business processes in relation to the retail market as follows:

- Making and ending contracts
- Billing
- Supplier switching
- Moving
- Balance Settlement
- Metering
- Information exchange during supply
- Access to customer data

The data contained in Data Hubs could also be utilized in several other ways. NordREG also notes the importance of empowering customers acting in the market. Significant Use-Cases concerning the functionalities for an AMR Data Hub are described here.



2.1 Supplier Change

According to NordREG the customer interface model in the harmonised Nordic retail market should be supplier centric.

The customer initiates the supplier switching process negotiating with the new supplier. After a contract is made, the supplier starts the actual supplier change process with the Data Hub. Data Hub should provide a supplier change service for the supplier. This service should be accessible using EDIEL messaging or it can be offered as a web service.

The Data Hub also has to manage notifications for other involved parties and send a meter reading request for the network company. After receiving the reading information from the network company a final settlement must be handled with the current supplier company.

Data Hub must handle cases where an incorrect supplier change has been made. It must be possible to revert back to the original correct state.

2.2 Cancel supplier change

The supplier must be able to cancel the change of supplier. However, applicable time limitations must be applied.

2.3 End Supplying

If a contract between the current supplier and the customer is about to end and a new contract has not been negotiated, the current supplier has to notify the Data Hub that supplying will end. The Data Hub could notify a supplier (that is required to provide energy for the customer by default or choose the appropriate supplier by some other means) to start the negotiation process with the customer. The process here is similar to the supplier change.

2.4 Request metering point info

The supplier must have a way of obtaining information about the metering point. The Data Hub should be able to provide the data on different levels. These levels can include information the current supplier must be able to view, information that any potential supplier is able to view and possibly information that the customer is able to view.

2.5 Calculated balance data

The Data Hub should be able to provide balance settlement functionality for balance responsible parties. The process will be explained by parties involved in defining the Nordic balance settlement system.

The Data Hub should be responsible for sending the calculated balance time series data for balance responsible parties.

2.6 Move-in / Move-out

As stated earlier NordREG strongly recommends a supplier centric model for supplier switching. The customer negotiates a start of electricity supply from the effective move-in date. The supplier then will initiate the move-in process by utilizing the move-in / move-out service provided by the Data Hub. The Data Hub then notifies the network company and sends a reading request.

The Move-out process is similar. The network must be informed concerning an end of supply. A reading request is made so that a final settlement can be made.

2.7 Metered data retrieval

The supplier should be able to retrieve two kinds of measured data: measured data from previous month(s) for invoicing purposes and historic data for quotation purposes.

2.8 Metered data submission

Both hourly measured data and other measured data can be sent by the network company to the Data Hub via EDIEL messaging or a web service. Correction of measured data must also be made possible.

In order to take into consideration future data submission needs the design of this service should not prevent or cause difficulty of adding new interfaces for data submission.

Data Hubs could facilitate clearing house functionalities that are needed in the electric car charging market.

2.9 Send metering point info

The network company must be able to maintain information about metering points. The updating service should be provided by the Data Hub via EDIEL messaging and through a web service. The Data Hub must notify the supplier about the update to the metering point information accordingly.

2.10 Metering point disconnect/reconnect

Meters in Finland often have capabilities for remote disconnect/reconnect. The Data Hub should be informed about the current status of a metering point by the network by updating the metering point info accordingly.

The supplier should be able to request for a disconnect/reconnect via the Data Hub. The Data Hub then relays the request to the network company's information system that will then either proceed with according to the request or reject the request.

Certain legal considerations should be applied.

2.11 Balance Energy submission

The network company is responsible for calculating the consumption for all profile-settled metering points. A consumption statement for a profile-settled metering point is used in many of the business processes, such as move-in/move-out and change of supplier.

Correction of balance energy must be taken into consideration here as the Nordic balance settlement regulations are set.

2.12 Change settlement method

The network company must be able to change the settlement method of a metering point from load-profile based settlement to hourly based settlement and vice-versa. In Finland 80% of all metering points should be hourly measured by the end of 2013. Load-profile based settlement remains an option for smaller metering points if for example there is considerable difficulty in obtaining hourly measured data.

2.13 Create metering point

The network company must be informed of a new metering point.

As the metering point has been physically created the network company must be able to use the metering point creation service provided by the Data Hub. This service should be provided either EDIEL messaging or as a web service.

Both consumption and production metering points must be taken into consideration when implementing this service.

2.14 Big Data Analysis preparation

The Data Hub should also provide the data it contains for a larger purpose. To fully seize the potential of smart metering and other future scenarios the Data Hub should be able to provide information to Big Data analytical services. Some of the preparation of the data may be done by the Data Hub. For example, the Data Hub could reformat data to better suit analysing needs.

NordREG acknowledges the need to provide data for analytical purposes for energy consultants, authorities or syndicates of consumers.

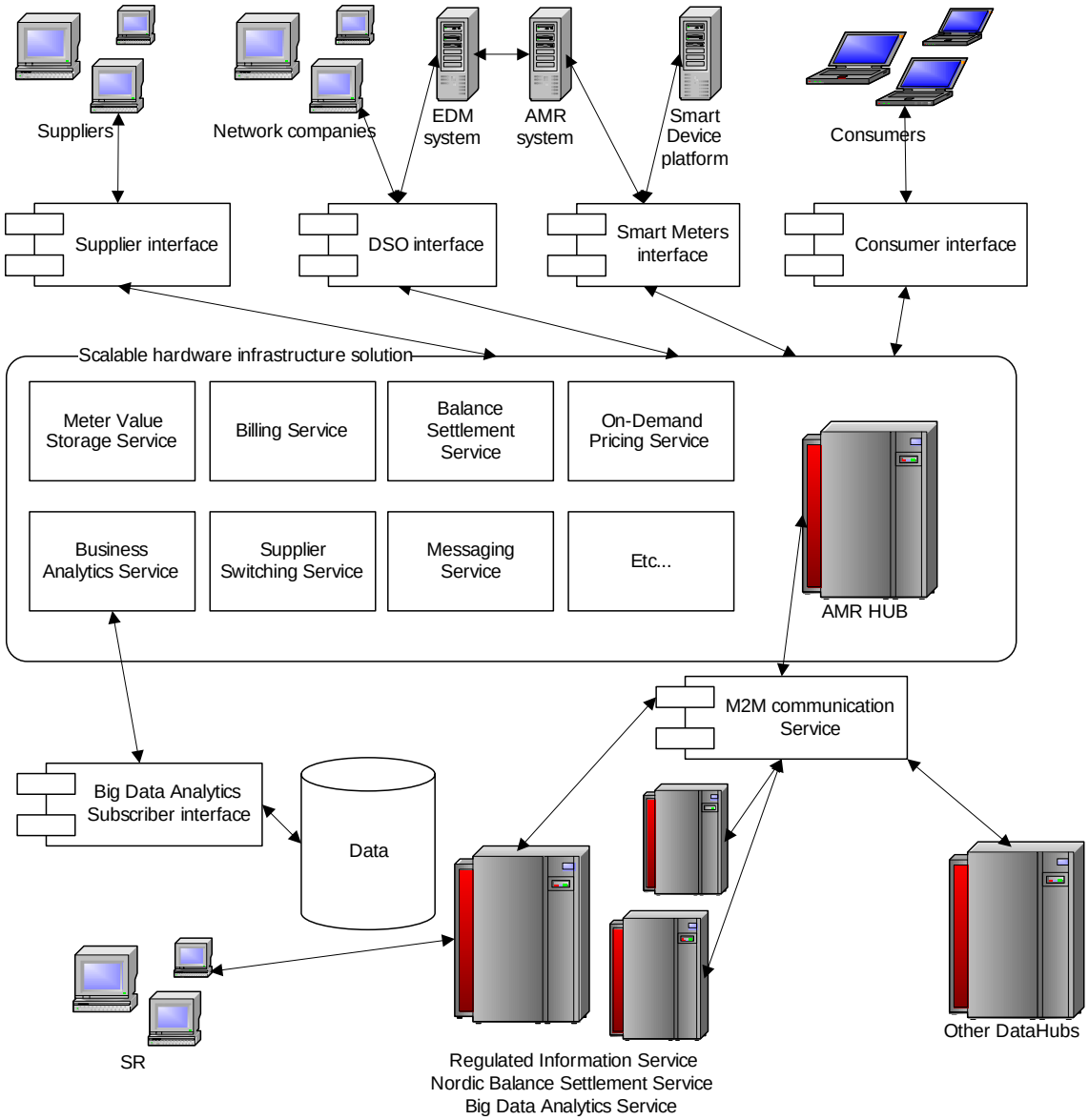
3 Logical/deployment view

The figure below demonstrates the platform on which the AMR Data Hub will function. Multiple Data Hubs can operate in the energy measurement market. Each can offer different services and their implementations may vary. However, a standardized way of communication between Hubs should be encouraged.

To gain the full potential of smart metering a Smart Grid Big Data service is needed. The AMR Data Hubs should provide the Big Data service a major part of the data that will be utilized.

To fully support the AMR Data Hub market model a Regulated Information service is needed. The service can be implemented as a part of the Nordic Balance Settlement system or as a separate service. The information service is responsible for providing a common database for metering point IDs.

The interfaces should be provided using EDIEL messaging and web services.



3.1 DSO interface and supplier interface

As described in the use cases earlier in this document, network companies and suppliers will need to access the services the AMR Data Hub provides during several different processes they manage.

A single point of entry should be provided that will handle all the required use cases. Both web services and web portal interfaces can be offered to users of this interface.

The services provided by the system should enable the Supplier Centric Operating Model and combined billing.

3.2 Consumer interface

Smart metering will likely provide new scenarios in which consumers can manage their subscriptions, metering data etc. Also several scenarios might enable suppliers to incentivise consumers to change their consumption behaviour. Being able to influence demand and supply can have positive effects even on a global scale.

The system should provide both push notifications and detailed sophisticated information such as on-demand pricing for consumers. The interface should provide the possibility to subscribe to a web service and offer web portal services.

3.3 Smart Meters and devices interface

The number of smart meters and devices will increase in the future. The data they provide should be utilized to maximize their potential. The AMR Data Hubs may be viable candidates to facilitate the growing amount of data from smart meters and devices.

As described earlier the remote disconnect/reconnect is already possible for several smart meters. Several business scenarios can be implemented by different remote control features of smart devices. Remote controlling of meters and devices may be a function that in the future can be done via a centralized service.

3.4 Analytics subscribers interface

Smart Grid Big Data service is able provide a multitude of data on different scale, precision, degree of refinement etc. This information can be used in various forms and it may inspire new business models or services. Examples are peak load forecasting, price forecasting, real time reporting, trend forecasting and consumer behaviour analysis.

3.5 Scalable hardware infrastructure solution

The service as a whole as well as the AMR Data Hub should be implemented on a scalable infrastructure. The amount of data will only increase. Majority of the data the AMR Data Hub handles is sensitive. Scalability is key when considering isolation requirements and at the same time flexibility and the increase of data.

3.6 M2M communication Service

EDIEL messaging may be the standard in communication between different parties in the energy industry at the moment. More efficient ways of messaging should be considered. Centralized Data Hubs allow the development of such new ways of communicating between different parties and certainly between different Data Hubs.

3.7 Services provided by the AMR Data Hub

The Data Hubs can offer a variety of services depending on the needs of each operator. Some examples are offered here.

3.7.1 Meter Value Storage Service

The amount of data will increase dramatically even if we don't consider possible new metering needs of the future. Management and processing of huge data amounts can prove to be quite a challenge especially for smaller market operators. Centralized Data storages may provide significant cuts to operating costs.

Obtaining this function as a service may provide large benefits for market operators and help lower barriers of entry to new players.

3.7.2 Billing Service

The Data Hub could function as a central storage for billing information between the network and supplier companies. A centralized model for implementing combined billing can provide efficiency and better data quality.

3.7.3 Balance Settlement Service

Outsourcing the Balance Settlement Service is something that a lot of the market operators already have experience with. With centralized handling of balance settlement data new tools can be provided to more efficient balance settlement.

3.7.4 On-demand Pricing Service

Pricing in the market is something that is of interest to a lot of the parties involved. Demand response and dynamic demand re-distribution can have benefits on a global scale.

- Retailers and wholesale companies will benefit from more accurate forecasts that can be provided through analysing large quantities of market related data.
- Suppliers companies can provide better service through interesting products and tempting campaigns.
- Network companies may offer services for spot priced products offering remote management of certain smart devices and smart programmable appliances.

- Consumers can utilize real time information concerning pricing and consumption to guide their own consumption habits or incentivise in investing in energy saving services or devices.

3.7.5 Business Analytics Service

Big Data analytics services can be utilized in single AMR Data Hub solutions or they can be provided as solutions of their own. Data Hubs can provide data for Big Data services or subscribe to them and utilize the analysed date in the Hubs' own functions.

3.7.6 Supplier Switching Service

As described earlier the Data Hubs should provide implementations for the use cases described in this document. Basic principles were supplier centricity and combined billing.

As an extension to this the Data Hubs could provide the means for suppliers to promote their services and provide comparison information directly to the consumer. This could drive the market to accelerated competition.

3.7.7 Messaging Service

Every Data Hub should implement a Messaging Service. Services should include EDIEL messaging and web services based messaging. Many operators are involved in the processes of Data Hubs and need specific ways to obtain the information and services they require.

3.8 Other Data Hubs

Integration to other Data Hubs should be done in a standardized way if possible. Messaging services implemented in Data Hubs can communicate with each other via EDIEL messaging or by offering web service interfaces.

Other Data Hubs can also implement AMR Data Hub features or they can specialize in some other functionality (for example a Data Hub for wholesale markets or clearing house features for charging of electronic vehicles).

4 Information architecture

Several types of information are distinguished that the AMR Data Hub must handle.

The Hub handles public data that can be viewed by anyone without authentication. Such public data provided can be for example spot price information or some forecasts.

Customer sensitive data can only be viewed by the customer herself and the companies that have a contract with said customer. Some data may however be made available for parties involved in a quotation process with the customer or the customer may be given the chance to make her data available to an energy

advisor or broker. Security issues must be considered early in determining the information architecture.

Balance settlement data must be made available to only the parties involved.

Big Data Analytics data is considered highly valuable. This data must also be secured in order to avoid misuse.

Data harmonisation needs will present themselves when considering integration between Data Hubs and other applications in the market. Nordic Balance Settlement may provide some relief to the major differences in handling energy data between countries. National Data Hubs can communicate via EDIEL messaging that is considered a standard in the market. In order to maximize efficiency and eliminate operating costs, alternative communication methods of shared data should be considered. Data Hubs would benefit greatly if standard communication between Hubs could be agreed upon.

5 Conclusions

This document described basic principles of Data Hubs. Three theoretical Data Hub models were discussed based on a report by NordREG. As NordREG stated a combination of these models is one option for achieving the potential benefits the Data Hubs can provide.

The services and some architectural considerations of a combined model were then described.

Tieto would like to bring up some key points for further discussions of Data Hubs. Centralized Data Hubs architecture should be developed as function based, open and modular to account for future needs.

The architecture should include secured data highways between centralized Data Hubs to ensure that master data is not duplicated. New technologies like Big Data enable even more consolidation between emerging centralized Data Hubs. Dynamic and effective integration standards should be advocated to enable connections between market parties' business systems to Data Hubs and ensure high quality hub-2-hub traffic.

6 Change history

Version	Date	Author	Reviewed by	Approved by	Change history
V0.1 Draft	2012-10-08	Petri Marttinen	<name>	<name>	Document structure
V0.2 Draft	2012-10-27	Petri Marttinen			First draft
V0.3 Draft	2013-03-05	Petri Marttinen			Second draft
V0.31	2013-23-05	Sami Uotila			Visual change