Technical Annex to the Call for Input on The Future of Distributed Flexibility: Preliminary considerations for a common energy digital infrastructure

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Introduction

This technical annex accompanies the Call for Input: The Future of Distributed Flexibility. The purpose of the annex is to provide readers with visibility of further, though non-exhaustive, information and considerations that have gone into the development of common digital energy infrastructure archetypes put forward in the Call for Input.

Section one of the annex provides further explanation of the processes presented in each of the archetypes. This will enable readers to compare and analyse the functional options under the archetypes. The archetypes are explained using the functions: information provision; market coordination of operations and access; trust and governance.

Section two outlines wider considerations and design choices, including: process variations under each archetype; architectural considerations on data transfer and transformation; data standard and communication protocol choices; market coordination and deconflicting functions; governance roles; and security requirements.

There is much work needed to across industry to develop a common energy digital infrastructure. The Call for Input highlights the need for industry to engage and coalesce around a case for change. The intention here is to outline some preliminary thoughts on these technical challenges and provide interested readers a structure on which to develop further analysis.

Whilst we do not ask specific questions on the content of this technical annex, stakeholders may wish to share their insights when responding to the call for input.

Section one: The archetypes in more detail

Overarching process mapping

In order to provide more detail on the actual archetype functions we draw on the flexibility service delivery 'chain' which represents the inter-linking systems for data exchange required for 'end-to-end' distributed flexibility delivery.[1]

This chain is segmented into three different stages of flexibility service delivery: procurement, operations and reporting, as outlined in *Figure 1*.

Note that the specific information exchanged will vary across system operators (and other flexibility buyers), and the specific commercial and technical requirements expected are dependent on the flexibility product. The diagram intends to provide a high level overview of generalised existing data exchanges within the system, across different flexibility services.

[1] Future Insights Series: Flexibility Platforms in electricity markets; Ofgem; Ofgem's Future Insights Paper 6 - Flexibility Platforms in electricity markets | Ofgem

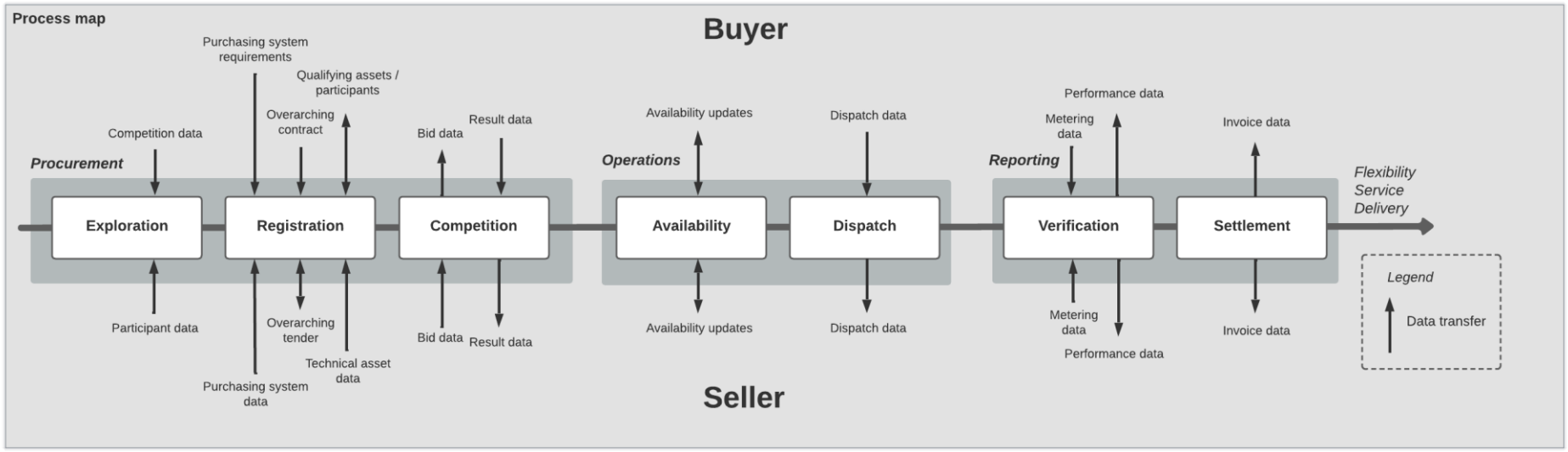

Figure 1. Generalised data transfers for the end-to-end process of existing flexibility service delivery. Note: Data transfers may vary by system or market operator and will depend on the flexibility product. This diagram intends to provide a high-level overview of existing data exchanges across various systems, to provide context for the CDEI archetypes.

Buyers (i.e. Market Operators (MOs)), and sellers (i.e. Flexibility Service Providers (FSPs)) need to exchange data with one another at each of these stages in order to transact flexibility.

Various stages of the chain may be facilitated by independent market platforms that support system operators in their commercial activities.

Procurement:

The procurement stage comprises of three systems: Exploration, Registration and Competition.

- Exploration refers to the common user-interface which MOs use to indicate their flexibility needs and FSPs use to appraise assets under their control pre-registration.
- Registration refers to the commercial and technical eligibility procedure required for initiating a transaction.
    - The commercial eligibility procedure includes MOs and FSPs exchanging the data required for accessing the purchasing system, meeting utility contract regulation compliance, accepting terms and conditions and providing billing details. This may include digital contracting.
    - The technical eligibility procedure includes MOs and FSPs exchanging asset characteristics, which may include: asset location, technology type, tendered peak capacity (MW), minimum/maximum operation duration.
- Competition refers to the trading procedure used to award a contract to a registered and qualified FSP. This includes the exchange of bidding information.

Operations:

The operations stage comprises of two systems: Availability and Dispatch.

- Availability refers to API visibility and monitoring of asset availability.
- Dispatch refers to relaying API instructions between MOs and FPSs to modulate the asset output, and provide confirmation of action and acceptance between MOs and FSPs.

Reporting:

The reporting stage comprises of two systems: Verification and Settlement.

- Verification refers to verification of service delivery. This includes exchanging metering data, asset baseline profiles and dispatch data (usually via APIs).
- Settlement typically involves the generation of performance and earnings reports and the exchange of invoice data.

Thin archetype

The thin archetype describes a *directory* that aims to help FSPs and MOs find one another. All other flexibility market data exchange is bilateral or via third parties. The common digital energy infrastructure does not play any role in improving any stage of procurement, operations or reporting.

As shown in Figure 2, the data exchanges are bilateral between MOs and FSPs. The process is repeated for multiple MOs and FSPs on a needs basis, with no direct coordination mechanisms across markets.

Information provision

The directory helps FSPs and MO find one another so they can initiate procurement. This could take the form of a simple public-interest independent website that companies can use to identify value streams. FSPs and MOs would be able to register and become accredited users of the directory, enabling them to search for other market participants within a unified experience. Prospective FSPs or other third parties could potentially benefit from this service to develop a basic understanding of market operator requirements; market operators could use the service to seek out possible FSP able to meet their needs.

Market coordination of operations and access

There is no mechanism for improvements based on a common energy digital infrastructure. Coordination remains down to bespoke arrangements between any market participants.

Trust and governance

The directory would require some governance arrangements. However, there is no governance structure for market operations.

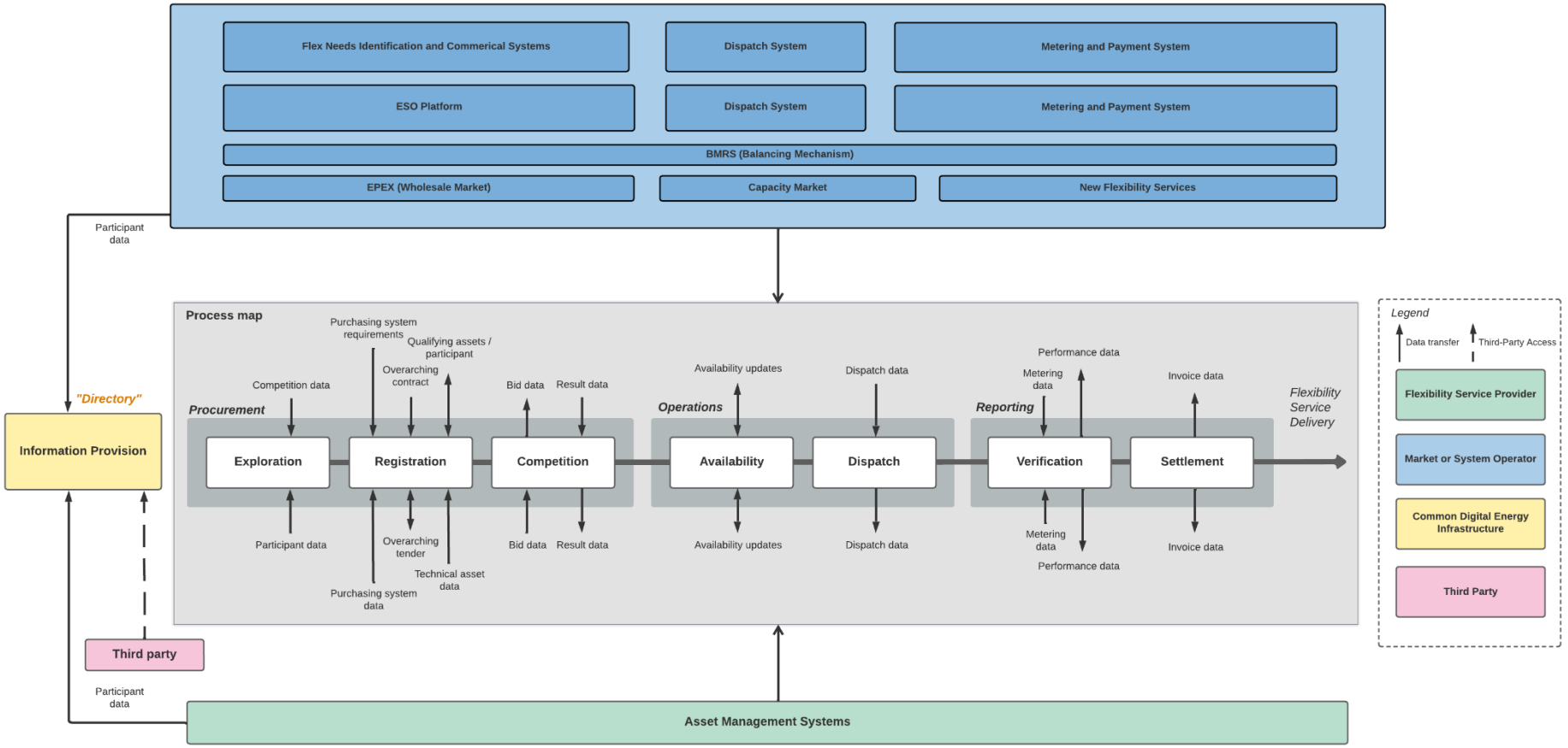

Figure 2. Thin archetype diagram. Note that the 'process map' includes all activities taking place across the full transaction. Existing data transfers from MO and FSP systems are not affected by the presence of a 'directory' style common digital energy infrastructure. The directory acts only to provide information on the MOs and FSPs present.

Medium archetype

The medium archetype describes a flexibility exchange. Here, data transfer relevant to procurement, operations and reporting stages of delivery is made visible via the exchange to coordinate more market activities and enable improved visibility on asset performance.

As shown in Figure 3, the flexibility exchange acts as a layer, coordinating the data transfers in one place, creating a trusted 'single source of truth' for flexibility services. The exchange acts to coordinate activities across many markets[2], and by focussing on the data transfers, can accommodate changes to these markets. Activities themselves, such as auctions, dispatch, settlement, and payment continue to take place via established institutions, with the exchange model providing a means to coordinate and share this data to improve market outcomes.

Information provision

The exchange model improves information provision based on the implementation of a multi-purpose data warehouse, used for registering participant asset[3], product[4] and participant[5] data.

- All FSPs register the technical prequalification information during the procurement stage (first time only registration).
- MOs can share visibility of markets and product eligibility requirements using the platform.

The consolidation of historic data[6] and market rules[7] on the data warehouse would provide opportunities to allow market participants to learn more about historical activities and improve their decision-making. Historic data would also enable other users, for instance, financial parties, to examine market activities and better understand opportunities to offer finance to consumers based on asset performance. The discoverability of participant, asset, and product data for other purposes, in alignment

[2] The markets shown in the diagrams are illustrative examples only.
[3] Asset data for example: location, technology type, energisation status, tendered peak capacity, minimum/maximum operating duration
[4] Product data for example: service requirements, terms and conditions
[5] Participant data for example: company details, invoices
[6] Historic data for example: prices and volumes
[7] Market rules for example: exclusivity agreements, reporting requirements

with Data Best Practice,[8] would be drastically improved, far beyond the capabilities of siloed market administrators.

Information provision could include prices and volumes that were sold, broken down by product and asset type that would support analysis of market trends. This visibility would support both asset valuation and risk calculation strategies for all participants, and third-party observers.

The SFE would actively maintain the common taxonomy of asset, product, and market participant definitions that are used to categorise, describe, and harmonise data across multiple markets.

Market coordination of operations and access

Market coordination takes place during the procurement and operation stages. In both stages, the implementation of a rules engine[9] enacts complex stacking and primacy rules. This could take the form of competition and dispatch conflict notifications, which are further considered in section two.

- MOs and FSPs would benefit from efficient market-clearing without conflicts.

Central registration and automation for FSP assets across flexibility markets is a key service that the exchange model would provide, reducing the burden of otherwise complex and manual repetition.

- In the long run this would lead to more optimal contractual requirements (such as rationalising baselining requirements across markets) and enable any asset to automatically understand eligibility across markets.

Trust and governance

Trust and governance is improved by introducing new functions that have significant advantages, or are only possible, when provided by a sole independent public-interest entity:

- Clear management processes (such as for markets, standards, taxonomy, and rule changes) that participants follow to communicate change across the system.

[8] Data Best Practice Guidance; Ofgem; https://www.ofgem.gov.uk/sites/default/files/2021-11/Data_Best_Practice_Guidance_v1.pdf

[9] A rules engine is a software component designed to evaluate and apply a set of business policies. It provides a way to automate decision-making based on specific conditions, resulting in streamlining and consistent behaviour. In the context of flexibility markets, a rules engine would ensure agreed entry of flexible assets to market and mitigation of conflicts. A rules engine would need to be developed and agreed by industry.

- New enforcement processes, such as impartial routes to recourse for FSPs/MOs in case of disputes around exchange processes.
- Transparency of MOs disclosure on the rationale behind asset-dispatch decisions.
- Rating the performance of participants' assets across markets.
- Consolidate and make visible of historic product/asset/participant data to enable the identification of regulatory issues, market faults and security issue.

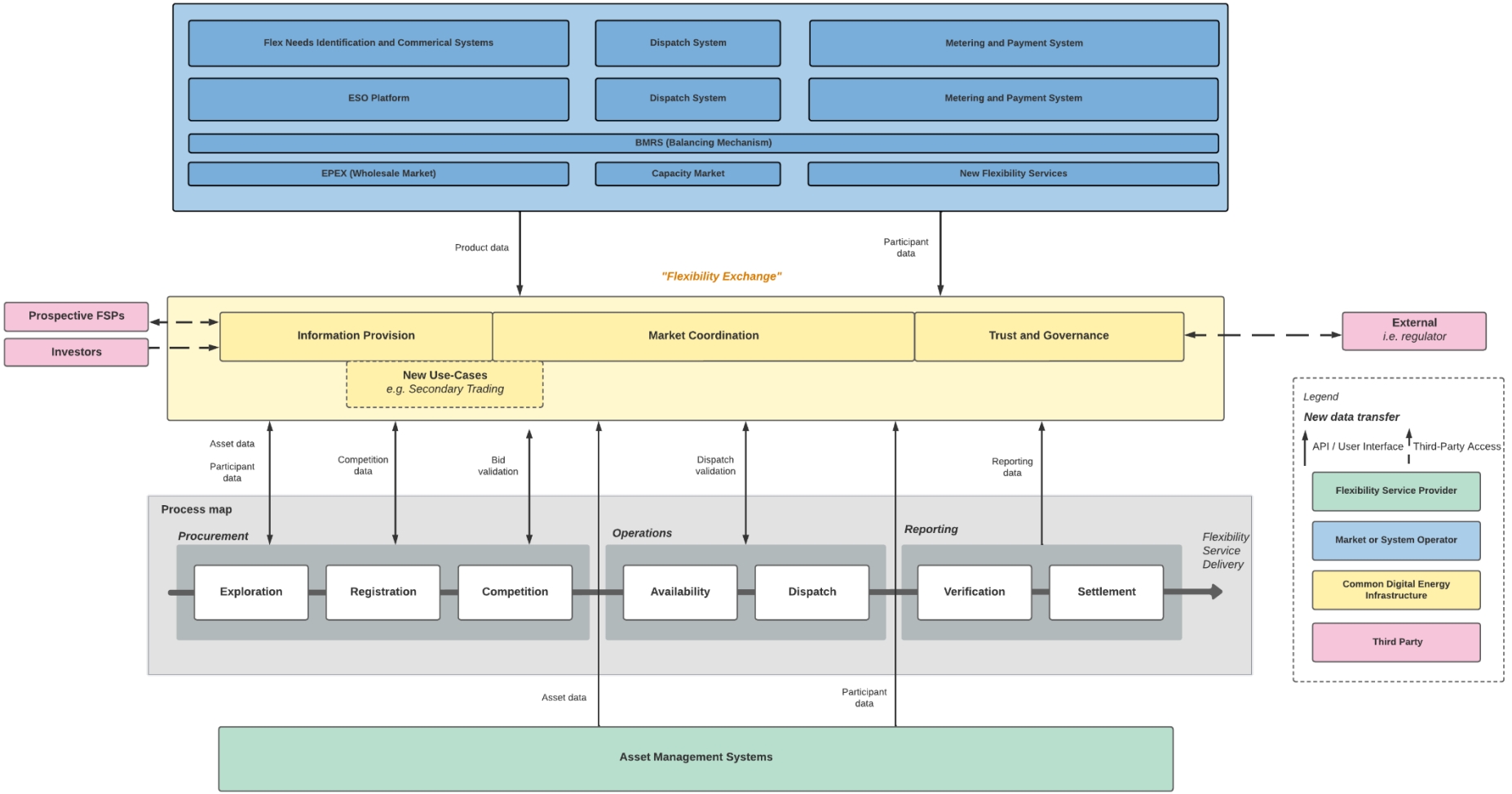

Figure 3. Medium archetype diagram. New data transfers occur between the common digital energy infrastructure and the process steps (i.e. activities happening 'off exchange'); and between the common digital energy infrastructure and the MOs (top) and FSPs (bottom). The data flows are not related to specific functions in this diagram; however, the overall approach demonstrates that there are data flows both to the exchange and between alternative parties delivering functions. Further exploration is required to determine the exact data flows and responsible parties. External 'third party' actors are able to access information from the common digital energy infrastructure.

Thick archetype

The thick archetype describes a single, central platform for all flexibility markets,[10] enabling end-to-end delivery of market activities. This would be enabled by ingesting functions across commercial interfaces, dispatch and metering systems and settlement and payment systems. The role for independent market platforms across flexibility service delivery remains unclear in this archetype.

Figure 4 shows the data flows for the central platform. The common energy digital infrastructure integrates data across many markets and flexible assets, and provides optimised outcomes based on the internal algorithms of the platform.

Information provision

The central platform would provide advisory information to assist FSPs understand the best deal for their assets and the best products to bid for at any point in time, based on the complete visibility of needs and availability, and the capacity to calculate an optimal solution. This is discussed more with regard to trust and governance.

Market coordination of operations and access

The central platform undertakes data transfer, registration, competition, availability, dispatch, verification and settlement, allowing these processes to be coordinated. A central optimisation algorithm would introduce the possible service of system-wide market coordination.

Market coordination could include facilitating secondary trading markets and supporting probabilistic delivery of services.

Trust and governance

The central platform services could improve visibility of the procurement and operations process. The central platform could:

- Consolidate historic product/asset/participant data and undertake analysis activities to enable the identification of regulatory issues, market faults and security issues.
- Provide greater visibility of carbon intensity of flexibility markets.

[10] The markets shown in the diagrams are illustrative examples only.

Some of the above functions assume some kind of optimisation algorithm. However, this needs to be both feasible, and to solve for a preferred outcome, for example, carbon, costs, security of supply. Introduction of optimisation also introduces a bias in what exactly is being solved for and the relative weighting of different parameters.

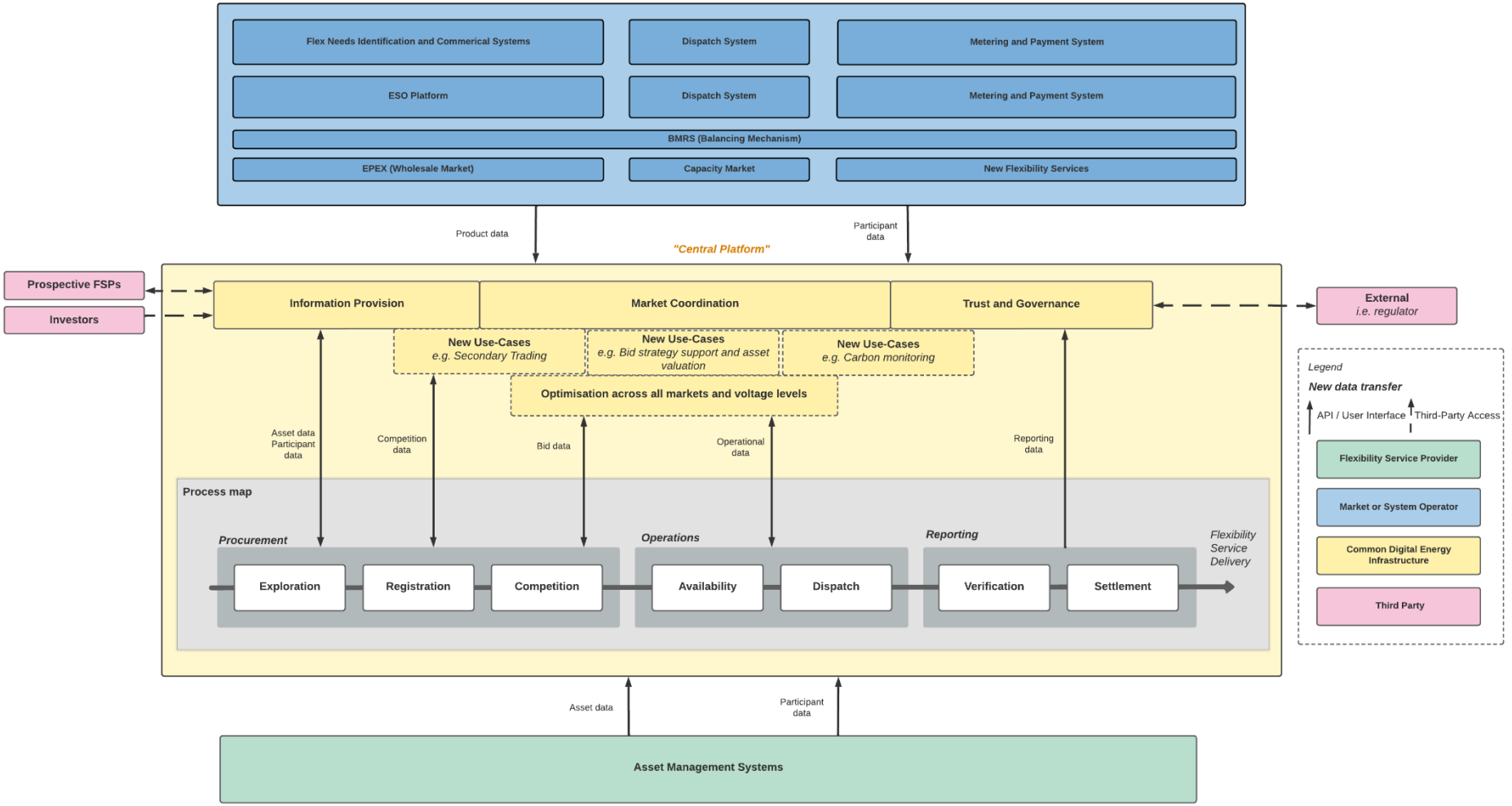

Figure 4. Thick archetype diagram. The common digital energy infrastructure is visualised as encompassing the full 'process map'. This indicates that data flows from MO and FSPs are to the central platform only, with data transfer within the platform completing the process steps. The arrows from MOs and FSPs are not related to specific functions in this diagram, but are to highlight the overall data flows. External 'third party' actors are able to access information from the common digital energy infrastructure.

Section two: Architectural and functional considerations

This section outlines six overarching consideration areas for a common digital energy infrastructure, framing the discussion points for industry and outlining factors for assessment.

Role and responsibilities

Section one set out generalised market chronology steps of procurement, operation and reporting of flexibility services. Each of the steps has detailed sub-stages and data transfers between the buyer and seller.

Consideration needs to be given to where activities are delivered by the common digital energy infrastructure or by existing systems, and how the two interact to exchange data.

The archetypes help to frame options, but are not monolithic, meaning that elements of each may be valuable, and that they should be thought of as options on a spectrum containing many other options in between.

A non-exhaustive list of consideration for activities on and off a common digital energy infrastructure include the roles of existing functions:

- Independent market platforms
- Settlement processes
- Dispatch platforms

The role of new functions:

- Digital spine development
- Automated asset register development

Data access and presentation

Data could be exchanged between systems and presented centrally on a common digital energy infrastructure. This will need to consider:

- What specific data this includes (both scope and granularity):
    - Whether the data are currently available and visible elsewhere, or not.
    - If they are available already, what is the value in presenting it again?
    - If they are not available what is cost/benefit to making it available?

- Should there be centralisation or decentralisation of data i.e. should it be stored centrally, or should APIs give access to local storage.
- When, where and how data should be transformed to standards formats?
    - This could require transformation at the site of data creation (FSP, MO etc.), at the common digital energy infrastructure, or alternatives such as a further data management organisation.
- What are the access and authentication processes for data which cannot be open.
- Should any analytics be undertaken by a common digital energy infrastructure, in addition to presenting raw data.

Data standards and communication protocols

Data standards and communication protocols are likely required for common communication and data exchange across all architypes. Data standards and communication protocols should also consider the scalability of approach beyond the GB energy jurisdiction, given the similar challenges for market coordination globally, and the potential for common approaches.

Industry discussions often bring up the Common Information Model,[11] existing Open APIs and existing ontologies, from both the UK and internationally; but generally say extensions and harmonisation will be needed.

Agreement and consensus building on common data standards and communication protocols will require industry engagement and development.

Market coordination

Conflict notification and possible optimisation services are discussed across the archetypes. The mechanism to deliver these functions requires further development.

- It may be necessary to treat competition stage conflicts differently to dispatch stage conflicts.
- Conflict identification will require agreement on the validation process. The data transfer approach will need to be determined:

[11] The Common Information Model (CIM) regulatory approach and the Long Term Development Statement; Ofgem; The Common Information Model (CIM) regulatory approach and the Long Term Development Statement | Ofgem

    - The prospective FSP could send a validation requests directly to the common digital energy infrastructure or to the MO, or to both in parallel.
    - The common digital energy infrastructure would need to review and validate a request, and return data to the FSP, again either directly or via the MO.

- Consideration should be given to the nature of conflict identification:
    - an event-by-event basis; or,
    - on a timed (scheduled) basis
- An agreed rules engine is required to enable conflict identification.

Trusted governance role

As outlined in the Call for Input, there are governance roles to consider. At a technical level, thought should be given to:

- The ability to screen and authenticate participants.
- Change management processes for digital infrastructure upgrades, market change implementation, and the modification of data standards.
- Suitable market monitoring for security issues or gaming behaviour.
- How data is shared to government and the regulator.
- Data sharing to manage an independent route to recourse.

Security

Common digital energy infrastructure in the energy sector requires proportionate physical and cyber security approaches. This must conosider confidentiality, integrity, and availability, both for the digital infrastructure and all parties that interact with it.

Glossary

Term	Definition
Data Warehouse	A Data Warehouse is a system that aggregates data from different sources into a single, central, consistent data store to support data analysis, data mining, artificial intelligence (AI), and machine learning
Rules Engine	A Rules Engine is a software component that is designed to evaluate and apply a set of business rules or policies. It provides a way to automate decision-making based on specific conditions and actions, allowing organizations to streamline their processes and enforce consistent behaviour.