NETWORKS

Operational Systems Roadmap

NATIONAL NETWORK, LOCAL CONNECTIONS PROGRAMME

DOC-230921-GYT

CONTENTS

1 NATIONAL NETWORK, LOCAL CONNECTIONS – HAVE YOUR SAY!

This document is the proposed Operational Systems Roadmap. In this document we set out:

1. A current state analysis and an overview of the capabilities and functional requirements needed to introduce the proposed flexibility services into distribution system management.
2. A technology deployment plan needed to support each successive proposed pilot / release.
3. A potential long term technology deployment plan, pending the pace, scale and targets set for the National Network, Local Connections programme.

It is critical that we implement solutions that optimally meet the wishes and needs of the customers and industry participants in Ireland. In developing these proposals, we have taken time to seek and utilise stakeholder input from round tables and focus groups, as well as to research and utilise exemplar international experiences. This has enabled us to develop the proposed approaches within this document. While we have confidence that these can meet the overall programme objectives, we are open to change and, as a result, we have prioritised this transparent and consultative approach. There were several key dimensions on which we based this document and it is important to us that we develop an understanding of your perspectives, objectives and concerns across each of those.

It may be useful to consider the below questions while reading this document. Please note when responding to this document, it is not necessary to respond to each of the below questions; responding to a specific question or a general response is welcomed and appreciated.

FUNCTIONAL REQUIREMENTS
What are the key functional requirements needed to introduce flexibility on the network?

TARGET LOCATIONS
What target locations should flexibility services be provisioned?

NUMBER OF CUSTOMERS
The Deployment Schedule in Section 8.2 includes the foundational technology required to go from supporting <100 customers in 2024 to thousands nationwide by the end of 2025. Should we proceed with this and at this pace?

TYPES OF CUSTOMERS
The Deployment Schedule in Section 8.2 includes the foundational technology needed to be able to go beyond industry / generators, and support homes, farms and communities nationwide by the end of 2025. Should we proceed with this and at this pace?

TECHNOLOGY
We set out key technology needs including a Distribution Management System (DMS), DERMS and Market Management System (MMS). Do you agree with these and/or are there other needs that you think should be included?

PILOTING TECHNOLOGY
As we proceed to full rollout do you have any input on how you would like to see pilots structured?

1 NATIONAL NETWORK, LOCAL CONNECTIONS – HAVE YOUR SAY!

It is also important to us that we optimise the overall value of the programme across our customer base. As such, we are inviting perspectives on additional considerations that we could fold into our approach:

LEARNING OBJECTIVES
What are the technological learning objectives we should pursue over the life of the technology rollout?

SUPPLY CHAIN
Are there opportunities for other parts of the supply chain to learn and develop through the technology rollout?

2

Glossary

2 GLOSSARY

TERM	DEFINITIONS
ADMS	Advanced Distribution Management System (ADMS) is the software platform that supports the full suite of distribution management, optimisation, and control. An ADMS includes functions and algorithms that automate outage restoration, optimisation, and control of the distribution grid.
AMI	Advanced Metering Infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers.
ASM	Active System Management (ASM) refers to the ability to monitor and control distribution network assets, but also connected third party assets such as generators, storage, and controllable loads. ASM is the new operational capability built and delivered as part of the National Network,Local Connections Programme.
Curtailment/ Constraint/ Dispatch down	This is the deliberate reduction in output below what could have been produced.
DER	Distributed Energy Resources (DER) refers to generator, storage or controllable load which is connected to the distribution network.
DERMS	Distributed Energy Resource Management System (DERMS) is an end-to-end automatic control system which facilitates distribution system operators (DSO) manage their grids via real-time dispatch of distributed energy resources (DER) and other controllable grid assets. (DSO) manage their grids via real-time dispatch of distributed energy resources (DER) and other controllable grid assets.
DMS	Distribution Management System (DMS) is a collection of key applications designed to monitor and control the entire distribution network efficiently and reliably.
Flexibilitiy Services	Flexibility services are used when a Distribution System Operator pays a third party to operate assets in a way that maintains power flow within network limits.
FLISR	Fault Location, Isolation, and Service Restoration (FLISR) is a distribution automation application that automatically restores the majority of customers impacted by a fault / outage on a feeder.
MMS	Market Management System (MMS) is a software platform which conducts procurement, bidding, tendering, DER selection of services required by the DSO. This platform also conducts verification and settlement of services provided by DERs.
OMS	Outage Management System (OMS) is an application which allows control engineers respond to faults as well as plan and manage network outages.
OSP	Operational System Project (OSP) refers to the design and developments of systems, applications and processes which enables newly needed network operation capabilities of a Distribution System Operator.
SCADA	Supervisory Control and Data Acquisition (SCADA) provide operators and other control systems with real-time communication to substations and field devices.

3

Executive summary

ESB Networks' control room technologies are underpinned by two core technologies SCADA and OMS. These have been the foundation for a strong operational capability for years. These are mature systems that support processes such as remote switching and control, outage management, and others that are key to keeping the network resilient and secure.

Enabling the National Network, Local Connections Programme will require that ESB Networks implements the next generation of operational and market technologies to address the network challenges of tomorrow.

3 EXECUTIVE SUMMARY

At present, the energy system in Ireland is undergoing enormous change. A key driver for this is the national Climate Action Plan setting out a target of 70% or more renewable electricity by 2030, and the continued decarbonisation of the heat and transport sectors through electrification. The result is that there is large and growing number of decentralised renewable generators and storage competing for electrical capacity on the distribution system. This is accompanied by the EU Clean Energy Package, which mandates changes to the role of the distribution system operator, including increasing use of market-based mechanisms to optimise the use of capacity on the distribution system, and measures to support the activities and market participation of active customers, energy communities and distributed renewables.

The electrification of heat and transport will drive greater demand on the electricity distribution system. The ability to meet these demands at the right pace and cost will rely in part on ESB Networks using "flexibility" from demand or generation. The National Network, Local Connections Programme will play a central part in enabling Ireland's Climate Action Plan targets. Such a mechanism requires real-time and look-ahead analysis of the load flows and network state, and optimisation of that state using both utility assets and third party Distributed Energy Resource (DER), and closed-loop SCADA control, to implement the optimisation results. This means that enabling the National Network, Local Connections Programme will require significant changes to ESB Networks' processes, organisation, skills, data, and technology.

To prepare to implement these changes, in late 2020 ESB Networks undertook an in-depth review of the current "as is" technological landscape, highlighting the systems that will need to be adapted, upgraded, or introduced to comply with the future requirements to deliver a flexible integrated network.

Following this current state review, ESB Networks undertook a review of operational technologies available in the market and ongoing developments at other utilities. This was an essential step to understanding what solutions are available to help manage distributed generation and deliver a more sustainable energy system with increased market participation from both commercial and domestic energy users. This paper sets out what was identified in relation to both network operational technology and market operational technology, and how it applies to ESB Networks' proposed Operations Systems Roadmap.

ESB Networks will need to implement major new components including a Distribution Management System (DMS), a Distributed Energy Resource Management System (DERMS) and a Market Management System (MMS) to meet distribution system customers' needs, in line with the Climate Action Plan and the Clean Energy Package. New and enhanced capabilities such as unbalanced load flow, state estimation, congestion management and optimal load flow, as well as new protocols and interfaces, driving substantial investment in operational technology, will be required.

3 EXECUTIVE SUMMARY

To achieve a fully functioning system capable of meeting the new demands, augmentation of existing functionality as well as procurement of new functionality may be required. Any system upgrade or new system implementation will follow a process of high-level design (HLD), detailed design (DD), build, test and deploy.

This will be executed through a multiyear plan involving two primary workstreams. The first workstream will focus on piloting of new activities on the ground, supported by interim upgrades or adaptations of existing technologies. This will generate lessons learned from each pilot to take forward to an enduring end state solution. The second workstream will focus on the releases of new technologies into the ESB Networks' eco-system. It is anticipated that there may be as many as five pilots running for approximately one year each commencing in 2022. The deployment of new functionality will be broken down into 3 releases running for approximately 6 years.

This document shares the outcome of the current state review, and the proposed future technology roadmap for operational system upgrades and deployments within ESB Networks relating to DERMS, DMS and MMS. The paper also details the associated operational and resourcing needs, licensing, and hardware requirements.

4

ESB Networks' As-Is Network Operations Technology

The core of the current ESB Networks' operations technology consists of both a SCADA and an OMS system. Those two core operational systems are used together from each control room workstation in the National Distribution Control Centre (NDCC). SCADA is the gateway between the control room and network devices across the country. The two systems are integrated to allow for efficient operation of the system.

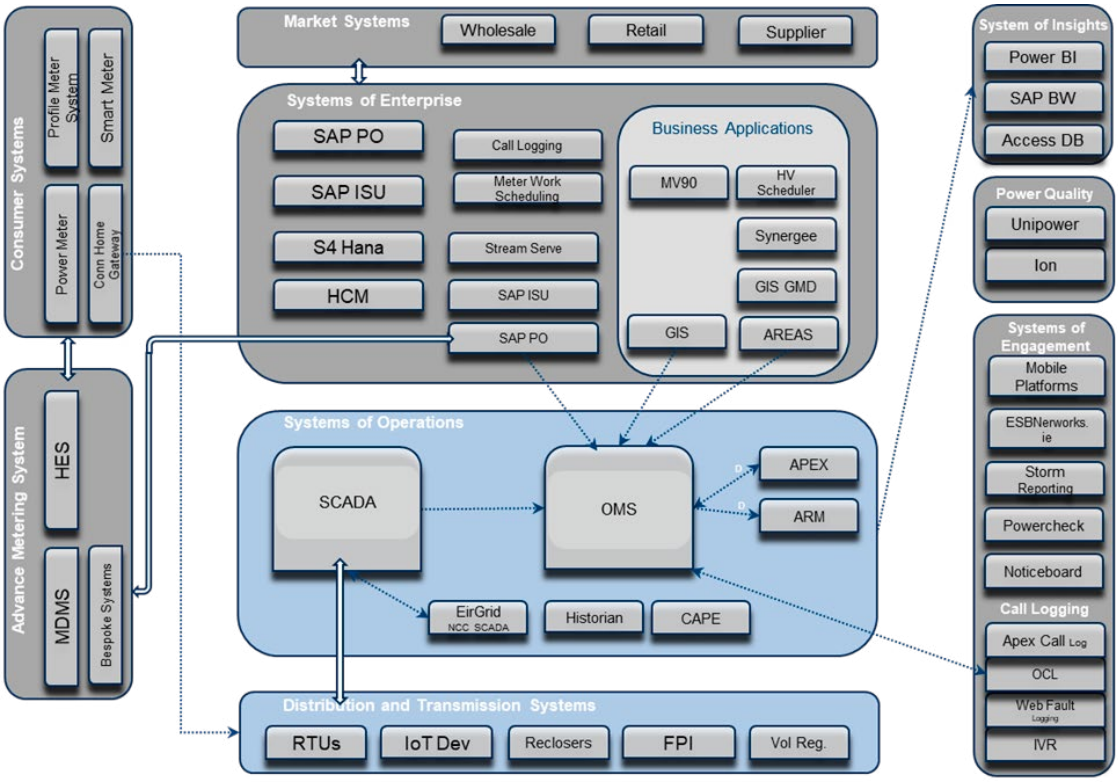
4 ESB NETWORKS' AS-IS NETWORK OPERATIONS TECHNOLOGY

The SCADA system provides a scalable system of communication front-end performing data acquisition from approximately 800 ESB Networks' substations using various protocols over serial communications and a growing number (currently 2,500+) of distribution automation devices, resulting in a total of about 500,000 points. This also includes secure links to the control system at Ireland's TSO, EirGrid. No other protocols (particularly DER-specific protocols) are implemented, talthough some of the relevant protocols are widely available. The system is also used to provide other traditional SCADA capabilities such as visualisation, alarming, controls, tagging and an internal historian.

OMS currently serves as a network management system covering the processes of fault management and switching planning and execution, for control room operators, dispatchers and 34 regional offices.

Several DMS applications have been developed and piloted in a proof-of-concept environment, as part of the National Network, Local Connections Programme but are not implemented in production. ESB Networks plans to implement capabilities such as unbalanced load flow, load forecasting and other basic optimisation capabilities.

HIGH-LEVEL ARCHITECTURE VIEW IN CURRENT STATE (ONLY THE SYSTEMS CONSIDERED FOR ADMS IMPLEMENTATION / REPLACEMENT)



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Forecasted Operational Challenges

The electrification of heat and transport, while also increasing the level of renewable generation on the grid moving towards the target of 70% of demand, is central to meeting Ireland's national emissions reduction targets. This creates a need for ESB Networks to introduce new solutions to increase the capacity and reliability of the distribution system to meet the emerging needs that these resources create.

5 FORECASTED OPERATIONAL CHALLENGES

An example of these challenges in practice for ESB Networks is the expansion of the electric vehicle market in Ireland. It is anticipated that there will be more than 950,000 electric vehicles on Irish roads by 2030, resulting in very large increases to demand on the Irish network due to increased domestic and commercial charging. Another example is the imbalance between renewable wind and solar generation and electricity demand in Ireland. Wind generation curtailment is increasingly commonplace representing a significant loss in both economic and electrical efficiency. Curtailment is caused by congestion and excess generation during times of low demand that could potentially be offset by flexibility services in the future. This will increase with growing levels of microgeneration unless solutions are introduced to increase the balance at a local level.

ESB Networks' current operational technology does not have the functionality required to introduce these new operational solutions. As part of the National Network, Local Connections Programme, the Operational Systems Projects (OSP) workstream has been tasked with identifying the specific capabilities, such as load flow modelling, state estimation, congestion management and optimisation, required to address these challenges and develop a plan to deliver the technology requirements to enable them.

With these technologies in place, ESB Networks will be able to implement an alternative solution whereby active customers will play a role in stabilising the electricity grid. This will require the creation of new flexibility markets, allowing customers who meet certain criteria (individually, aggregated or in communities) to engage in flexibility services via the use of batteries, renewable generation such as solar panels or heat pumps, and smart technologies.

6

Required Capabilities

To achieve the desired outcome, it is essential the ESB Networks plan for the upgrade of both the network operational and market operational systems. This will involve investment in an ADMS that will allow ESB Networks to agilely extend and adapt how they deliver a reliable, electricity supply to their customer base. It will also require investment in a flexible market management system that can incorporate complex market rules meeting both regulatory and legislative compliance.

Both systems will need to be reliable, adaptable, and scalable as there will continue to be increased challenges and changes to the electricity system beyond the year 2030.

6 REQUIRED CAPABILITIES

6.1 NETWORK OPERATION CAPABILITIES

To achieve the objectives of the National Network, Local Connections Programme, ESB Networks will need to develop a series of new network operational capabilities. This will be achieved by augmenting the existing technology stack and/or by procuring and deploying new technologies.

ESB Networks will need to have the ability to operate, control and communicate with the increasing volume of renewable generators across the network. This may be achieved by using enhanced SCADA capabilities to an increased number of points, including low voltage (LV) network and distributed energy resources (DERs). ESB Networks control room operators will require a communication line with distributed generators, third party DER aggregators, TSO (EirGrid), and other systems to successfully perform the role of the Distribution System Operator (DSO).

System augmentation and deployment of new technology will also be required to allow ESB Networks forecast and manage the network loading and voltage profile at a local level, including through dynamic network configuration, voltage regulation, reactive power management, and management of demand side response, storage, and generation. The DSO will need to perform complex network analysis and forecast assessments to maintain network security and capacity limits, including online power flow studies, state estimation and unbalanced three phase power flow optimisations. There is a further requirement to actively monitor, manage, and coordinate electrical system parameters including dynamic response / protection, short circuit levels, etc.

These functions can be introduced by putting in place advanced applications available within an Advanced Distribution Management System (ADMS). Implementing an ADMS involves ESB Networks extending its current OMS and SCADA capabilities to introduce DMS and DERMS applications.

Capabilities of this nature could be developed in the control centre allowing 24/7 monitoring and management of the grid. To enable such capabilities, ESB Networks will need to invest significantly in the operational technologies, including DMS, DERMS, as previously indicated.

6 REQUIRED CAPABILITIES

6.2 MARKET OPERATION CAPABILITIES

The Clean Energy Package requires the DSO to enable distributed generation, storage, demand side flexibility and allow active customers and communities participate in all organised markets. These include local flexibility markets, and participation in wholesale and ancillary services markets, without causing unsafe or insecure local conditions. ESB Networks needs to introduce a new set of capabilities to enable this. These capabilities include DER registration, ability to publish procurement events, and the ability to submit bids and select lowest cost providers. Such technology capabilities can be met with the introduction of a market management system (MMS).

An MMS is a fully integrated software platform that will assist with the development of a flexible energy market. An MMS platform can connect renewable generators, subject to curtailment, to flexible, local energy assets with the capability to absorb excess power to avoid curtailment. This enables more wind or solar generation to be exported and consumed. An MMS can determine the cost of flexibility and provides functions such as ancillary services, dispatch, and market information to enable participants to trade energy using a single platform.

MMS software can conduct registration, procurement and tendering of flexibility services and manage bidding and auctioning processes, all of which will become part of the new integrated energy market. Once the bidding process is complete the MMS selects or nominates the relevant DERs for flexibility. The MMS will then verify and provide settlement for the services delivered by the DER provider. The MMS will also play a central role in facilitating the participation of distributed resources in markets managed by the SEMO and the TSO, in a manner that avoids unsafe or insecure conditions. Once deployed the MMS system will need to be fully integrated with ADMS for optimal network performance.

7

Technology Solutions

ESB Networks have performed an analysis of the functional fitness of the existing operational systems and the potential introduction of a future ADMS. The outcome of this analysis indicated that further enhancement of ESB Networks' operational technology may be implemented as part of the National Network, Local Connections Programme.

7 TECHNOLOGY SOLUTIONS

As part of this exercise, ESB Networks has compiled documentation containing 2,000+ functional and technical requirements to deliver a clear and specific technology roadmap which will secure the operational and market capabilities needed to enable the required eco system. These requirements were organised into three categories - functional design, solution architecture and market operations - with four levels of detail.

TABLE 1 **FUNCTIONAL DESIGN REQUIREMENTS**

COUNT	LEVEL 1	LEVEL 2	LEVEL 3 AND 4
OMS & Dispatch	8	37	216
SCADA & Control Centre	11	61	207
Reporting	18	50	200
DMS	1	11	210
DERMS	6	20	118
	44	**179**	**951**

TABLE 2 **SOLUTION ARCHITECTURE REQUIREMENTS**

COUNT	LEVEL 1	LEVEL 2	LEVEL 3 AND 4
Platform requirements	1	8	690
Interface requirements	1	13	247
	2	**21**	**937**

TABLE 3 **MARKET OPERATIONS REQUIREMENTS**

COUNT	LEVEL 1	LEVEL 2	LEVEL 3 AND 4
Engage Market - Functional Requirements	1	3	16
Procure, Dispatch, and Settle - Functional Requirements	6	12	118
Market Operations - Non-Functional Requirements	7	9	37
	14	**24**	**171**

The output of our analysis showed that ESB Networks needs to address current requirement capability gaps in four areas: DMS, DERMS, other operational systems and market management systems.

7 TECHNOLOGY SOLUTIONS

7.1 DMS ADDITIONAL REQUIREMENTS:

A Distribution Management System (DMS) can be described as an enhancement of the visibility and control capabilities typically provided by SCADA.

Throughout the previous phase of the project, the ADMS functional specification identified 11 advanced DMS application requirements for the fully functioning future state system. Most of these applications are supported within the current ESB Networks Ecosystem. The applications that are not currently supported include Short Circuit and Fault Location Analysis, and Adaptive Protection Settings, and will be required in the enduring solution.

A planned implementation effort of providing the new data, and configuring and testing these applications is to be carried out. Further detailed analysis may uncover additional capability gaps in the other licensed DMS advanced applications.

7.2 DERMS ADDITIONAL REQUIREMENTS:

DERMS is an automatic control system which facilitates system management at a local level via real time dispatch of distributed energy resources and other controllable grid assets. DERMS adds to the visibility and control functions provided by SCADA. DERMS can provide granularity down to specific customer owned assets such as smart batteries. Such capability is a requirement for the National Network, Local Connections Programme.

The ADMS functional specification identified 20 required DERMS applications. Of the 20 required applications, only 12 are fully supported by the current ESB Networks system. The following functionalities are not supported by ESB Networks system: Grid Edge Control, Control Instruction and Fail-Safe condition. While the current system only partially supports Constraint Management, Merit Order Queueing and Black Start.

7.3 OTHER OPERATIONAL ADDITIONAL REQUIREMENTS:

The majority of required SCADA functionality exists in the currently implemented system however the currently implemented system does not support the suite of industrial protocols under consideration for DER management. From 59 functionalities captured in the SCADA section, only three functionalities will not be supported. They are Accuracy Monitoring, Inheritance tags and Email Notification

Likewise, most of the required OMS functionality exists in the ESB Networks system. From 38 functionalities captured in the OMS section, only one functionality, Field Updates of Faults is not in use. The remaining L2 functionalities are supported.

7 TECHNOLOGY SOLUTIONS

7.4 MARKET MANAGEMENT TECHNOLOGY REQUIREMENTS:

As the level of renewable penetration increases, the DSO network will have to be prepared to handle increased load from the demand side. DSOs can opt for a technical solution using network assets at their disposal; however, they must combine their solutions with the creation of a flexibility market to handle congestion problems in an efficient manner.

Once a constraint is identified, the DSO needs intelligence, such as visibility, availability, and price, of what DERs are available within the connectivity of the congested network. An MMS provides this visibility and supports the auction and selection process. An MMS also supports a market for flexibility services to meet user needs on the distribution system including DER participation in TSO/wholesale markets.

Once implemented, the MMS software platform will conduct the procurement, bidding, tendering and DER selection of services required by the DSO. This platform will also conduct verification and settlement of services provided by DERs.

Proposed functionalities of an MMS system will include:

1. **Tender creation.**
2. **DER registration.**
3. **DER offers against tenders.**
4. **ESB acceptance of offers.**
5. **DER notification of acceptance or rejection.**
6. **Settlement and verification**

The MMS will be integrated with the DSO Portal, MMS and an ADMS/DERMS integrated platform.

8

Implementation Workstreams

There are two planned implementation workstreams. The first workstream will develop pilot capabilities to meet 2022, 2023, and 2024 criteria that satisfies each pilot implementation milestone. Each pilot will act as an evolution towards the enduring end state system.

The piloting workstream is looking at how to transition ESB Networks' systems and organisation between 2022-2025, it will define the eco-systems and technologies that will meet and deliver the DSO requirements. By defining the technology, systems, and interface requirements between now and 2025, a clear delivery plan can be put in place for a practical enduring solution.

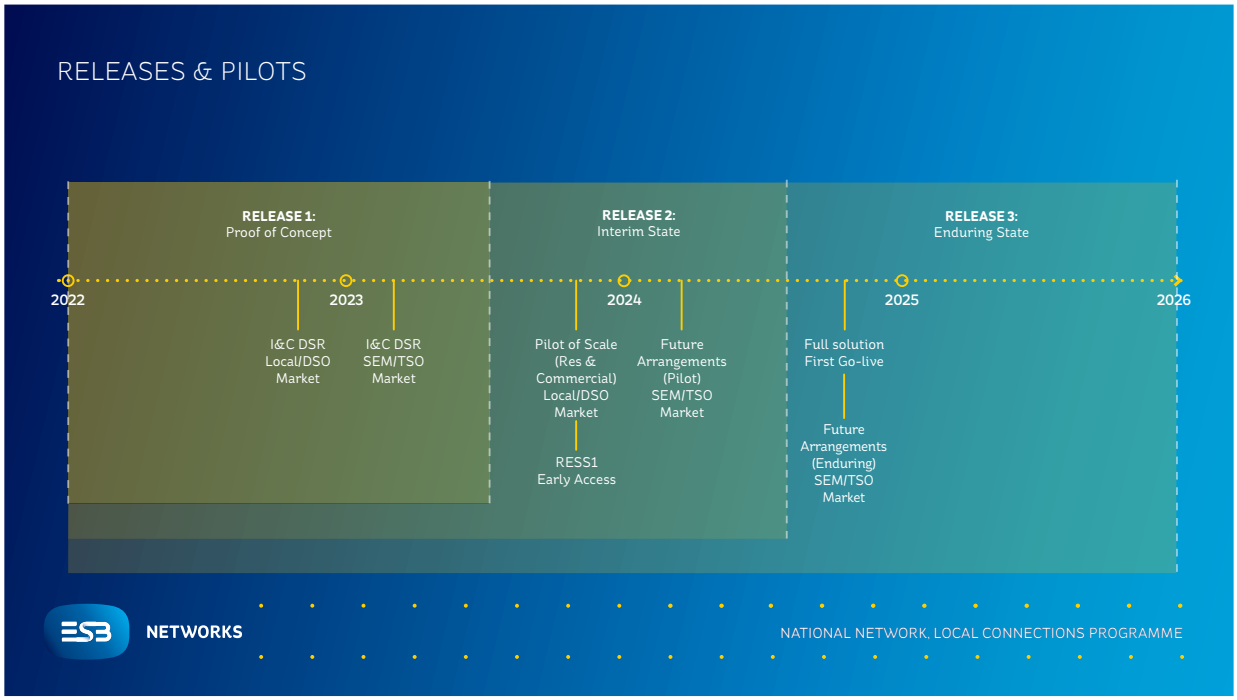
The second workstream is focussed on building an end state capability by 2025 with full ADMS implementation being the end goal. It is envisaged that ESB Networks will either augment the current OMS and SCADA functionality using the existing vendor or alternatively procure a new fully functioning ADMS system as one single infrastructure and platform.

8 IMPLEMENTATION WORKSTREAMS

8.1 OPERATIONAL TECHNOLOGY PILOT

The operational technology pilot workstream will be broken down into 5 separate pilots each running for approximately 1 year. The pilot approach will follow an evolution towards the end state capability model for each pilot/year. In practice, that means that several versions of the same process may exist between 2022-2025 building upon lessons learned in previous pilots.

Prior to the commencement of each pilot, the relevant capabilities will be defined using a capability model and engagement with ESB Networks stakeholders via workshops. The below graph indicates the timeline for the full end to end piloting process. Each pilot will include high level design, detailed design, build, test and deployment stages throughout. There will be significant overlap between the start and end dates of each pilot.

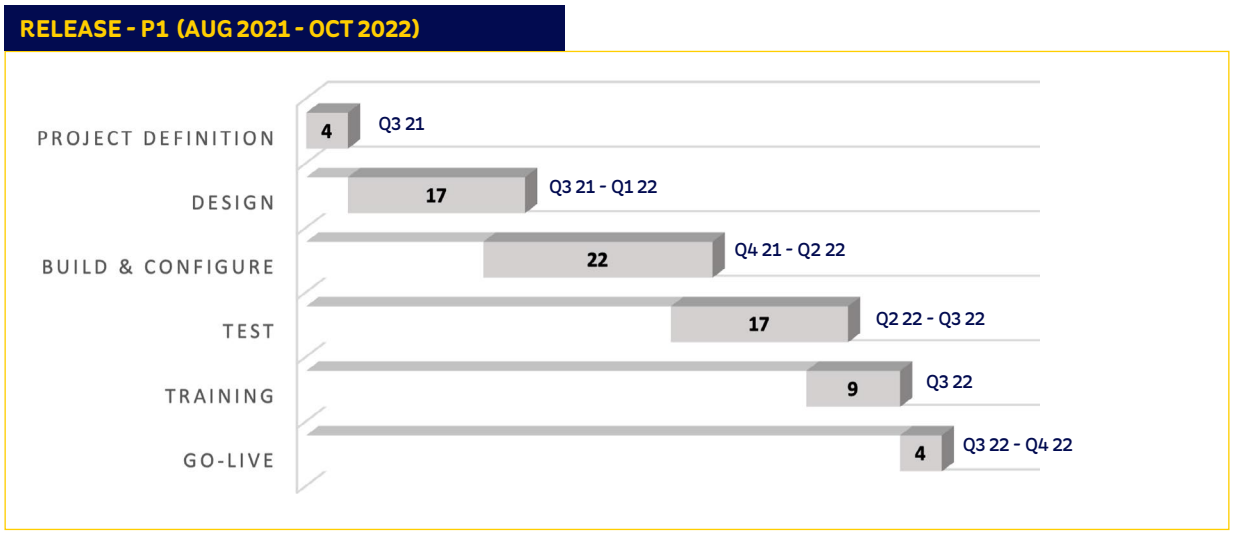


8 IMPLEMENTATION WORKSTREAMS

8.1.1 INDUSTRIAL & COMMERCIAL DEMAND SIDE RESPONSE DSO MARKET

The initial pilot will commence in Q4 2021 and run until the end of October 2022 spanning for a total of 57 weeks. This corresponds to the Industrial and Commercial Demand Side Response DSO Market (I&C DSR DSO) pilot which encompasses ESB Networks procurement of Secure and Dynamic services to address constraints driven by demand (MWs). This pilot will use existing tools and systems currently available at ESB Networks to deliver the following milestones:

- Identification of network needs.
- Procurement and bidding.
- Selection of DERs.
- Determining DER profile.
- DER dispatch.



The I&C DSR DSO pilot will be broken into various phases. The pilot definition phases will include high level overall project planning and resource availability. During the design phase, analysis will be used to determine the pilot area settings including seasonal thermal limits, seasonal voltage limits, limit margins and sensitivity factor.

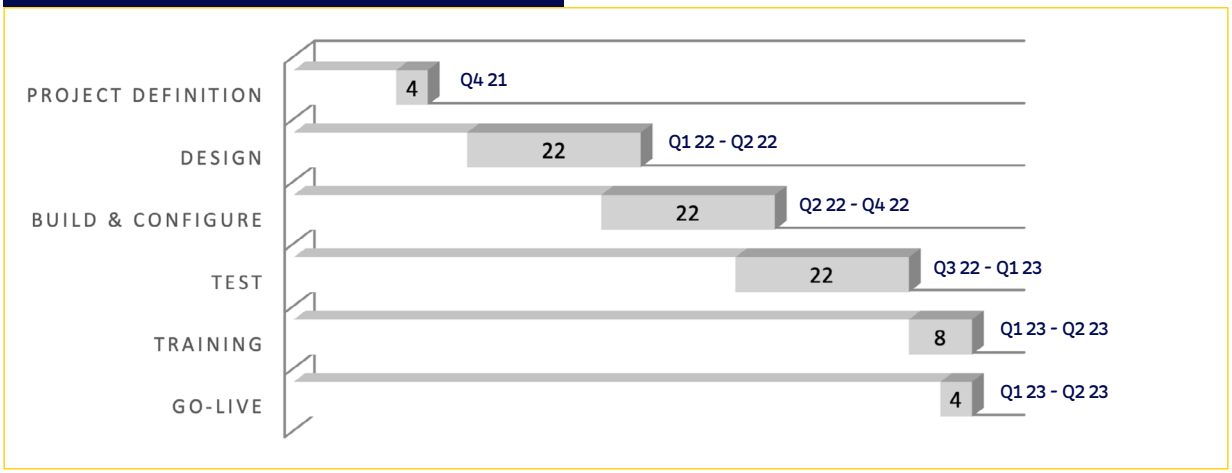
The pilot will require the configuration of Network Capacity Application (NCA), Feeder Load Management (FLM) and Optimisation) settings for specific pilot zone, development of offline tools to support processes including power systems analysis, DER selection & enrolment, DER profile determination, and M&V settlement. The DER dispatch will be done by email on day ahead and by phone on intraday for delivery of services. Various test cycles will be conducted including UAT, FAT and SIT prior to “go live”. Once pilot “go live” is reached, it will enter a monitoring phase.

8 IMPLEMENTATION WORKSTREAMS

8.1.2 INDUSTRIAL & COMMERCIAL DEMAND SIDE RESPONSE TSO MARKET

The second pilot preparation and design phase will commence in Q4 2021 with “go live” date defined as April 2023. Pilot 2 differs from pilot one as it will include elements of both operational technology and market management systems. The pilot will follow the same phase structure as pilot one with 2 additional stages of procurement and design in relation to MMS.

RELEASE P2: NOV 2021 – APRIL 2023



This pilot will address ESB Networks’ thermal and voltage constraints by procuring resources for Secure, Sustain, Dynamic, Restore, Dynamic Access Rights (Instructions Set and RESS) as well as Steady State Reactive Power Services.

The pilot will use existing tools and systems currently available at ESB Networks, including network capcity allocation, feeder load management and optimisation applications and its SCADA system for intraday DER dispatch

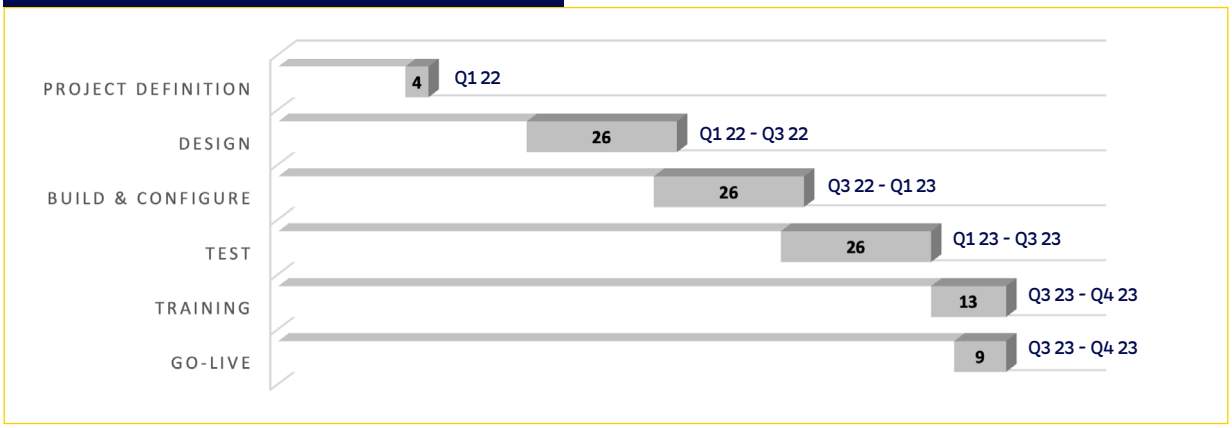
8 IMPLEMENTATION WORKSTREAMS

8.1.3 PILOT OF SCALE & RESS 1 2024

The pilot of scale and RESS-1 pilots will be run in conjunction with both commencing in Q1 2022 and with go live planned for Q3 2024. These pilots will offer all services procured in the 2023 pilot as well as Transient Reactive Power. The pilot of scale will utilise key DERMS functionalities such as loadflow, contingency analysis, optimisation and operational forecasting using the enduring DERMS/ ADMS platforms.

The pilot of scale and RESS-1 pilots will follow a similar phase structure as the two previous pilots. There will be an additional hypercare phase focussed on the on-site support of the new operational capabilities. Hypercare will be prior to the handover to ESB Networks for a live and operational system.

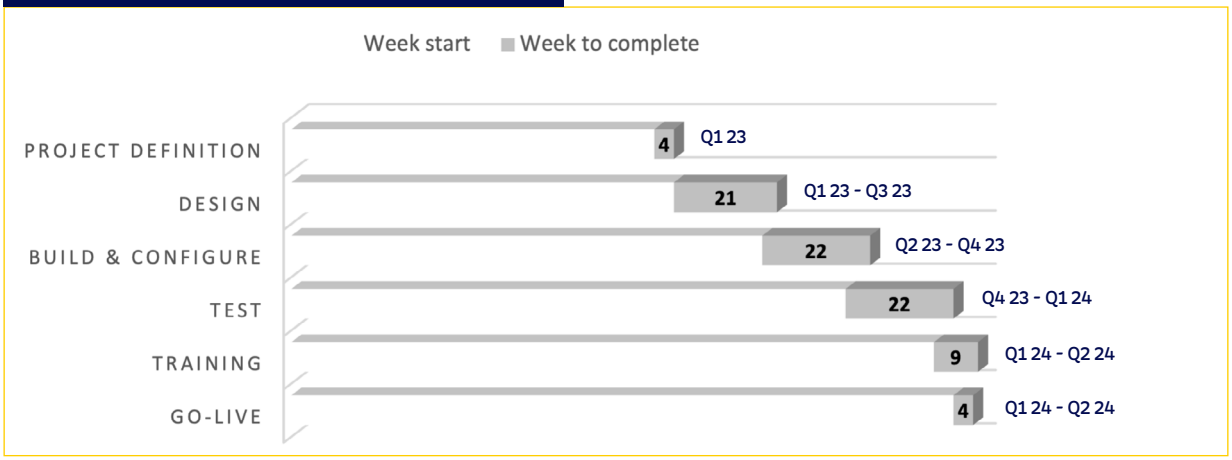
RELEASE - P3: (JAN 2022 - OCT 2023)



8.1.4 FUTURE ARRANGEMENTS PILOT 2024

The future arrangements pilot will commence in Q1 2024 with detailed design and implementation. This pilot will follow a similar path to previous pilots and feed into the finalised enduring future arrangements due to commence in Q4 2024. Like previous pilots it too will follow a period of detailed design lasting four months followed by build, test and deployment.

RELEASE P4: JAN 2023 – APRIL 2024



8 IMPLEMENTATION WORKSTREAMS

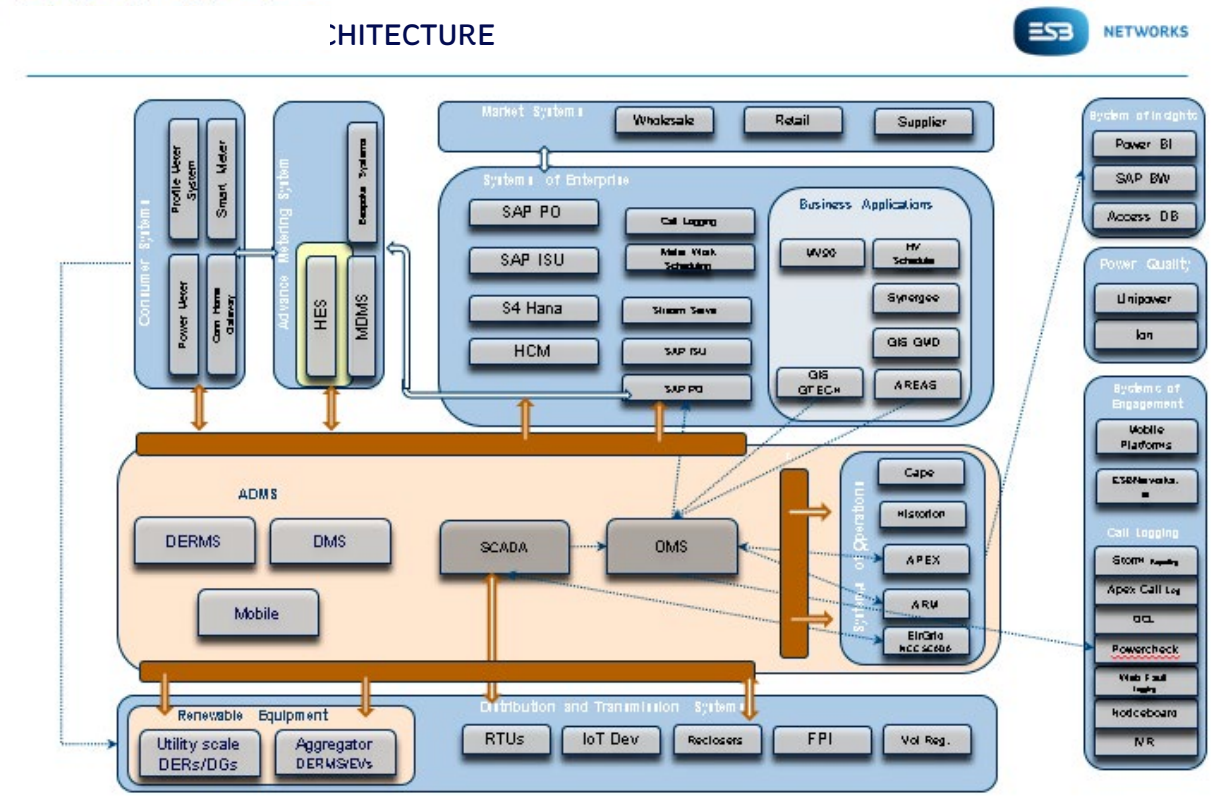
8.2 OPERATIONAL TECHNOLOGY DEPLOYMENT SCHEDULE

To roll out flexibility (including flexibility services for reliability and capacity reasons, and flexible connections for new generation and demand), the programme would need to integrate the new technologies identified throughout each of the pilot phases with the existing ESB Networks eco-system. We have outlined the activities which would be required to implement and integrate these technologies, as well as indicated timelines and resources required. Implementation of new technologies of this nature are typically comprised of different deployment cycles. Generally, deployment cycles are made up of phases including Predesign, Design, Build and Configuration, Data Import, Testing, Training, Go live & Deployment. Within each deployment, several new functionalities can be introduced. ADMS implementation is planned to commence in late 2022 and will take approximately 5 years to complete.

The implementation of the system can be broken into a deployment plan as follows:

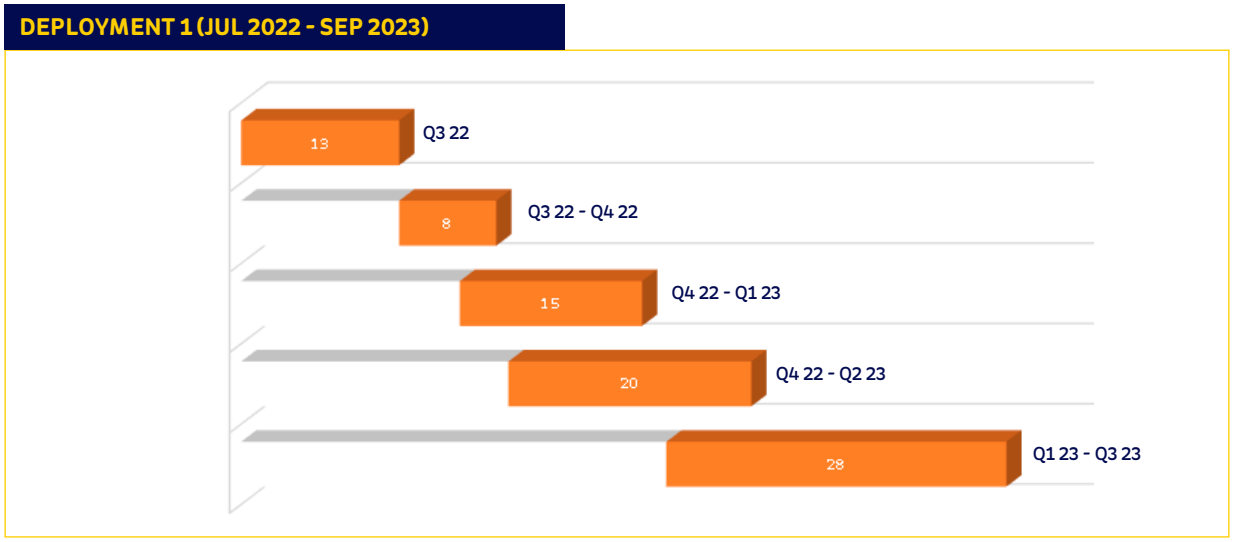
1. **Deployment 1 - ADMS set up**
2. **Deployment 2 - DERMS & SCADA**
3. **Deployment 3 – OMS**

The below graphic presents the indicative to-be architecture. The final architecture will depend on a number of key factors including the outcome of market testing and further design activities within the programme.



8 IMPLEMENTATION WORKSTREAMS

8.2.1 DEPLOYMENT 1 ADMS SET UP:



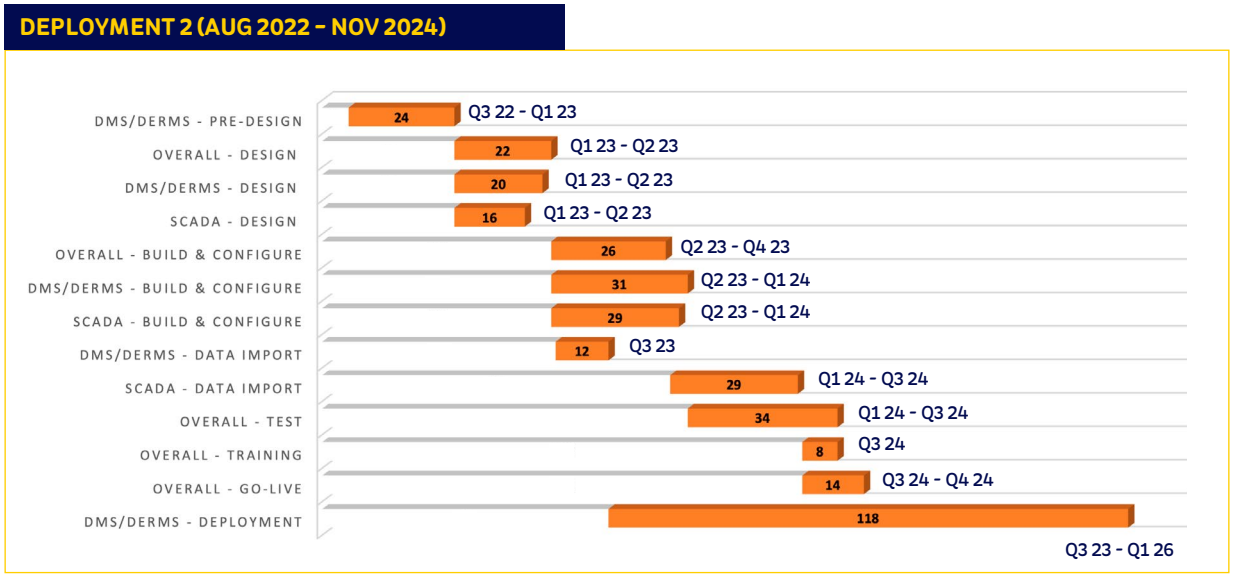
Deployment 1 relates to ADMS setup and will run for approximately 14 months. Throughout Deployment 1, ESB Networks would need to clarify all requirement gaps between the “as-is” and “to-be” system processes. There would be an initial requirement for high level project planning including resourcing availability and associated costings.

The next phase of the deployment would see the detailed design of ADMS architecture and infrastructure, interfaces, and configuration. This would be achieved by the scheduling of extensive workshops resulting in detailed design documentation. Once all documentation is signed off, the project would enter the test phase of the release. Testing phase completion would allow deployment of software updates.

Importing of data to the new ADMS would take approximately 5 months and will require ESB Networks to review and modify data where required. Prior to completion, ESB Networks would review all data deliverables for quality, completeness, and correctness.

8 IMPLEMENTATION WORKSTREAMS

8.2.2 DEPLOYMENT 2 DERMS/SCADA



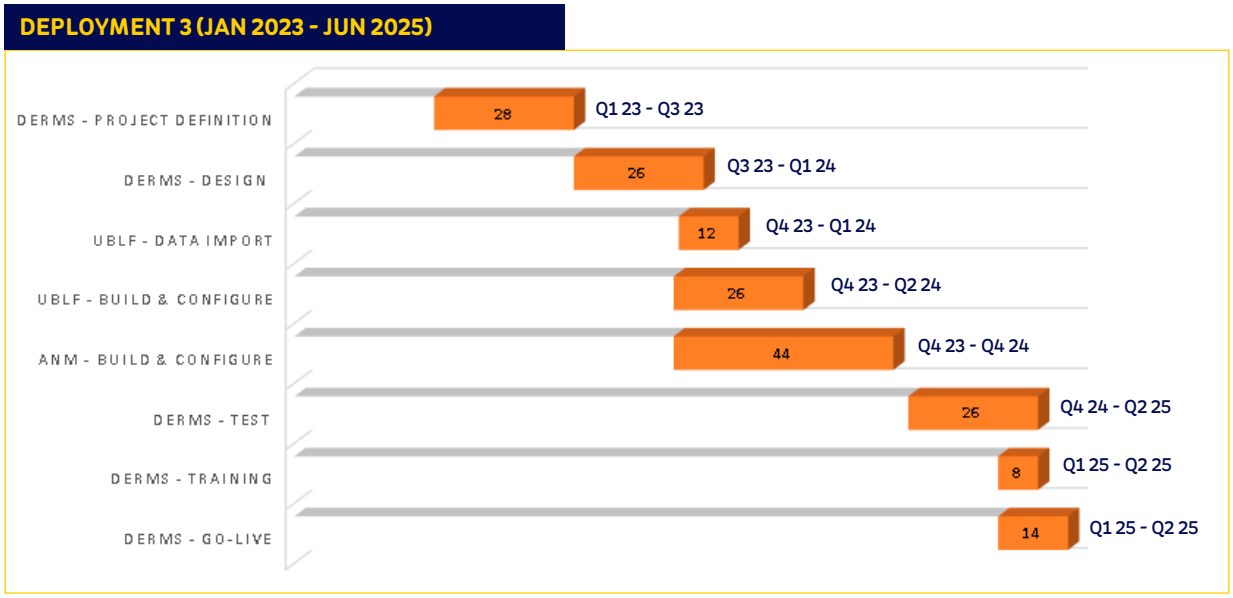
Deployment 2 relates to DERMS/SCADA setup and will run for approximately 3 years. There will be an initial predesign phase where the overall National Network, Local Connections programme business, operational and market processes would be defined. The next stage of deployment 2 is the detailed design phase which would include detailed design of product configuration, DMS/DERMs interfaces design workshops and SCADA configuration workshops.

Once workshops are complete and detailed design agreed upon, the project will enter the build and configure phase. This would include the development for a minimal viable product for the 2024 pilot (listed above), the development and deployment of software, and loading of data to be used for the pilot.

The pilot would simulate different scenarios to test Unbalanced Load flow (UBLF) and DERMS by importing further data in relation to weather and historical load generation profiles. An automated process for data import would be developed throughout deployment 2. Prior to exiting deployment 2, a full end to end system integration testing, user acceptance testing, and functional acceptance test would be completed. This would be followed by penetration testing to identify any security breaches within the software. It is envisaged that the system go live will be followed by a period of hyper care period prior to full rollout.

8 IMPLEMENTATION WORKSTREAMS

8.2.3 DEPLOYMENT 3: JAN 2023 -JUN 2025



Deployment 3 is will run over a period of approximately 2.5 years. The focus of deployment 3 is the deployment of an OMS. Deployment 3 is not dependant on the completion of deployment 2 however due to resources focused on DERMS targets, it will commence after 2024 pilots have successfully finished and the R1 system is accepted in production. During the project definition phase, a detailed plan including resource availability will be outlined. This will be followed by extensive design workshops that will feed into the extensive detailed design documentation of the OMS system.

Detailed design phase will include OMS interface design with systems including SAP-ISU, CRM systems, SAP-ARM/APMS, MWFM, AMI, reporting/ DW, business process design and overall system architecture design.

Upon completion of design, deployment 3 will enter the build and configure phase. This will include the development of designed interfaces, testing and refinement. A period of one month would be set aside for customer data import followed by a further 6 months of FAT, UAT, SIT and penetration testing. Once testing is completed, ESB Networks employees would be trained on the functionality of the OMS system prior to “go live”.

9

Conclusion

The National Network, Local Connections Programme team has clarity on the capabilities required to implement the objectives of the National Network, Local Connections Programme, an understanding of the technologies required to enable them, and the set of activities required to implement them. The team is further confident there is a clear, proposed roadmap to implement these technologies, allowing ESB Networks to both a.) achieve the intermediary piloting milestones as defined by the CRU and b.) lay the foundation for an efficient enduring solution.

9 CONCLUSION

The estimations and assumptions used in this assessment have been based on consultation with industry subject matter experts, evaluation of global best practices, perspectives from leading vendors and lessons learned from other prominent utilities.

Pending the customers' and stakeholders' appetite to progress a programme of work in line with what is set out in this document and the CRU's approval to go forward, the National Network, Local Connections Programme will proceed to take action against this proposed roadmap.

Near-term next steps include:

1. **Continued consultation**
   National Network, Local Connections Programme will continue to engage other energy stakeholders critical to the success of this programme, including the regulator, EirGrid, consumer advocacy groups and representative DER providers. The intent is for these stakeholders to provide feedback on the proposed milestones and timelines and to consider changes based on their own requirements.
2. **Resourcing**
   Progress has already been made on defining a resource profile based on the activities and estimated time to execute them. This includes an evaluation of the resources required, the skills these resources need and the best way to secure these resources. This estimate will continue to be refined and assigned a cost value to better understand the overall cost to implement.
3. **Procurement approach**
   There are multiple options as to which vendor has the best solution to implement these capabilities based on the product maturity and cost to implement and operate. These options include engaging directly with ESB Networks current vendor set and potentially going out to market for a third party provider. The National Network, Local Connections Programme is currently evaluating these options from a cost and performance standpoint.