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Telecommunications Regulatory Authority
مملكة البحرين - Kingdom of Bahrain

Report on the New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain

Economic Regulatory Framework

15 April 2018

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Final

Purpose: To establish an economic regulatory framework giving effect to the key Government policy regarding the delivery of ubiquitous ultrafast broadband infrastructure set out in NTP4.

New Telecommunications Economic Regulatory Framework Report

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Executive Summary

Executive Summary

1. In its Fourth National Telecommunications Plan (“NTP4”), the Government of the Kingdom of Bahrain (the “Government”) has set out a clear policy for an advanced broadband infrastructure and has introduced a set of new objectives for the telecommunications market. The reforms set out in NTP4 are driven by the Government’s vision for Bahrain to become a global Information and Communications Technology (“ICT”) hub and centre for business, and for the Kingdom to continue to remain at the forefront of digital developments.
2. Key decisions made in NTP4 include the following:
 - a. The National Broadband Network (“NBN”) will be delivered over a single telecommunications infrastructure utility network (the “Single Network”).
 - b. The Single Network will be owned, operated and deployed by a newly created functionally separated entity (the “FSE”).
 - c. The FSE will be established by separating Bahrain Telecommunications Company B.S.C. (“Batelco”) into two separate entities.
 - d. The FSE will provide wholesale services only and it will be allowed to earn a fair return on its investment.
 - e. The FSE will offer its services on an Equivalence of Inputs (“Eol”) basis.
3. Following the principles and objectives set out in the Authority’s *Economic Regulatory Framework Purpose Statement Report* (the “Purpose Statement”), the present *Report on the New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain* (the “Framework”) sets out how the Authority expects to implement NTP4 policies with respect to the delivery of ubiquitous ultrafast broadband infrastructure.
4. In implementing the NTP4 policies, the Authority will follow a gradual approach to separating Batelco, characterised by a transitional phase and a long-term arrangement. During the transitional period, Batelco will work towards moving to the long-term arrangement of separation, whilst at the same time guaranteeing that the right products and services are being offered to ensure downstream operators are able to compete effectively. The transitional period will end with the issuance of a licence to the FSE, which will be issued once the FSE has met a number of criteria and milestones. There may be further milestones to be met as part of the licence conditions. As such, key areas of this Framework will consider both the transitional phase and the ‘end state’ to be achieved in the long term.

Framework Foundations

5. The Framework is underpinned by a set of key components which will guide the direction of regulation of functional and the wholesale services supplied under the new market structure. These components cover the following areas:
 - a. The FSE Product and Service Set
 - b. The Single Network
 - c. Security requirements

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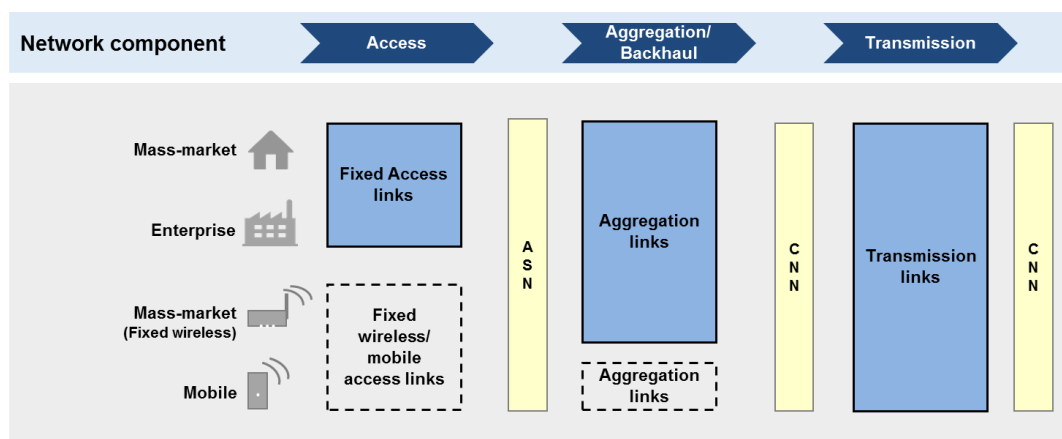
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- d. Systems and Processes
- e. Organisational incentives

FSE Product and Service Set

6. The Authority's key requirement for the FSE Product and Service Set is that it must give all downstream operators¹ the flexibility to build their own (virtual) optimised, efficient networks. Such networks should therefore meet their individual, reasonable requirements for access, backhaul, aggregation, and transmission links, which will create the foundation of a "level playing field" for Other Licensed Operators ("OLOs") competing with Batelco's retail business units post separation, referred to as Batelco's retail entity ("BRE").
7. For downstream operators to be able to utilise FSE products and services to build their own optimised, efficient networks, the FSE will need to offer wholesale products and services across the different components of the network. This should give each operator a menu of wholesale products to choose from, which can be combined according to their individual and reasonable requirements, therefore creating the basis for a "level playing field" and effective service-based competition.
8. The specific set of products and services that the FSE will offer, both on a long term and transitional basis, will be chiefly driven by downstream operator's business requirements.
9. Therefore, as a first step in this process, the Authority has engaged with key stakeholders to understand their individual requirements.
10. The Authority considers that appropriate products and services will need to be offered across all components of the telecommunications network as illustrated in Figure 1. Operators have been invited to set out their individual requirements for each type of link, based on the types of retail services they plan to offer in future.

Figure 1: Stylised network components



Source: the Authority
 Blue: Fixed line links
 Dashed: Wireless links

¹ Throughout this report, 'downstream operator' is used to refer to both the OLOs and Batelco's retail entity offering services in the retail segment.

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11. Under the new market structure, there are a number of potential permutations for the links set out above, connecting Points of Presence (“POPs”) controlled by either the FSE or the downstream operators themselves. Each of these scenarios may require a different set of co-location capabilities by the FSE and other operators. As part of its stakeholder engagement, the Authority is aiming to understand the relevance of these options and seeks to understand operator’s specific needs with regards to co-location and other requirements.
12. Once downstream operators have submitted their reasonable business requirements to the FSE, it will be required to propose specific product solutions that meet such requirements. The full list of products and services to be offered by the FSE in the long term will be established as part of the RO Order process.

FSE Single Network

13. In the Authority’s view the FSE Single Network should fulfil three core purposes:
 - a. Encompass the infrastructure required to enable fixed telecommunications networks as set out in the Purpose Statement.
 - b. Support the FSE Product and Service Set that will be used by downstream operators to build solutions that meet their requirements.
 - c. Achieve NTP4 deployment targets, which specify that the NBN should cover 95% of all residential customers and 100% of all business customers and public radio communication stations.²
14. Upon separation, control of the relevant passive infrastructure as well as certain active equipment of Batelco will be transferred to the FSE. Batelco will be required to propose the appropriate assets to be transferred to the FSE before separation and the Authority will review and approve the proposal based on a number of guiding principles, including:
 - a. Alignment with Eol;
 - b. Delivery of the FSE Product and Service Set;
 - c. Efficiency;
 - d. Independence;
 - e. Security requirements; and
 - f. Potential for cross subsidisation.
15. Batelco’s proposal for asset transfers to the FSE as well as any potential sharing or leasing arrangements for premises or equipment to be used by both parties, the FSE and the rest of Batelco, will be subject to the Authority’s review and approval.
16. The Authority is of the view that it is necessary to ensure that the FSE’s exclusive control over the Single Network continues to hold in future, in line with the Purpose Statement objective to “*Ensure that licences for operators other than the FSE do not confer rights to deploy, operate or maintain passive fibre infrastructure*”.³ The Authority will consider

² NTP4, paragraph 17.

³ Authority (2017). ‘New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain – Purpose Statement’.

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additional measures, such as changes to licences, to ensure that only the FSE may install new ducts and fibre lines.

FSE and Single Network Security

17. The FSE, as the sole party controlling the Single Network, will be required to implement security measures that meet international standards and regulations currently in place in Bahrain. The Authority has identified six areas that will need to be addressed with regard to the FSE's security obligations:
- a. **National security.** The FSE will need to ensure that in the operation of the Single Network, all national security obligations are complied with. This will include requirements as part of two key regulations, the Lawful Access regulation and the Internet Safety regulation.
 - b. **Asset security.** To address the need to ensure the physical security of the Single Network and its supporting infrastructure, the Authority requires that the FSE's physical security measures encompass both prevention of unauthorised access through the installation of physical security perimeters and entry controls, the monitoring and logging of any access, and protection against environmental threats including fire, floods and other forms of disaster that may affect the facilities.
 - c. **Organisational security.** To address the risk of insider attack, the FSE will need to ensure that appropriate measures are in place both during the hiring phase when introducing new employees, contractors and consultants to the FSE, and as part of its ongoing organisational security process to ensure that employees that originally had no malicious intent are not recruited by those wishing to do harm to the FSE and the Single Network.
 - d. **Information security.** The FSE will be required to comply with the Critical Telecommunications Infrastructure ("CTI") risk management regulation. The FSE will be responsible for safeguarding a substantial amount of information, encompassing not only data transmitted over the network but also data relating to the Single Network architecture. The Authority requires the FSE to ensure that confidentiality and integrity of all data in transit, accessed or stored across the Single Network or within the FSE systems, is maintained.
 - e. **Cyber security.** The Authority requires that the FSE implements necessary security controls to mitigate the risks of cyber-attacks, including the establishment of a secure and resilient cyber security architecture in which the FSE operates and offers its service. This cyber security architecture should reflect the current and anticipated cyber-attack environment, identifying trends in attack data to proactively detect areas of prioritisation. The FSE will further be required to establish a robust incident response process in the case where malicious attacks are detected.
 - f. **Physical network security.** The Authority considers it is critical for the FSE to ensure the physical network security of the Single Network by developing and deploying a network with sufficient speeds, resilience and redundancy, ensuring to the fullest extent possible that the network remains operational even in the event of disruptions that impact normal operation.

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18. In providing an end-to-end security solution, the Authority expects the FSE to consider the above security areas across all layers as relevant, including the infrastructure layer, service layer and applications layer.

FSE Systems and Processes

19. It is the Authority's view that the FSE's support systems will, in the long run, need to meet EoI requirements, be fit for purpose, and efficient in both their design and delivery. In addition, the systems and processes employed by the FSE are driven by its products and services and the management, operation, design and deployment of the Single Network, as well as the security obligations specified above.
20. Whilst the Authority does not prescribe the precise nature of systems and associated architecture to be employed within the FSE, it anticipates that it will be required to establish a number of Information Technology ("IT") systems, including Business support systems ("BSS"), Operational support systems ("OSS") and Management information systems ("MIS"). Batelco will be required to demonstrate that the proposed technical solutions for the IT systems meet the requirements derived from EoI, downstream operators' business requirements for products and services, the Single Network as well as security requirements.
21. The Authority anticipates that each of the OSS, BSS and MIS will be developed in such a way that ensures they are able to both meet the demands of the current telecommunications sector and lend themselves to future development in preparation of anticipated trends. These could include the expansion of the NBN and associated increase in bandwidth demand among others.
22. With regards to ensuring EoI, it is the Authority's view that the FSE's systems should be physically separate from the rest of Batelco in the long run. This requires the use of separate hardware, operating systems and physical support such as maintenance contracts.
23. However, the Authority acknowledges that the separation of integrated IT systems and processes may be associated with additional costs to Batelco. There will therefore be a different set of requirements for systems separation during the transitional phase and in the long term. Decisions will be made on the basis of the scope for discrimination in the event of data leakage, incremental cost and efficiency and requirements of information security among others. This will ensure that the new entity fully meets the EoI and security obligations whilst giving appropriate consideration to Batelco's commercial position.

FSE Organisational Structure and Human Resources

24. In order to deliver its scope of business in accordance with the principles set out in the Purpose Statement, the Authority envisages that the FSE will have a need for the right people, processes and incentives. These three elements make up the FSE's management structure and HR and ensure that the FSE is sufficiently and efficiently resourced and incentivises decisions that are in the FSE's own commercial interest, independent of downstream operators.
25. As such, in establishing the organisational and management structure for the FSE, the following steps will have to be mandatorily implemented by Batelco:
 - a. **Independent and efficient resourcing.** The FSE will establish a selection and hiring process that leads to an efficient and effective workforce.

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- b. **Independence of management incentives.** The governance arrangements are to ensure the independence of the staff employed by FSE.
- c. **Independence of strategy development.** The development of the FSE's strategy should be independent of all individuals or entities outside of the FSE in the interests of maintaining EoI and independence, whilst ensuring the strategy is developed in the best interest of the FSE and all downstream operators. The FSE will be required to formally consult with downstream operators and other relevant stakeholders in relation to proposals for major investment, introduction of new products, and material changes to the terms of existing products.
- d. **EoI compliance.** The FSE will need to adapt its remaining business processes to comply with EoI requirements, will need to monitor compliance to assess whether these EoI requirements are being met, and identify any instances where this may not be the case.

New Economic Regulatory Framework

- 26. In line with the Authority's Purpose Statement, the Framework will promote service-based competition in a market that is fair, effective and sustainable by ensuring a level playing field for all downstream operators. Moreover, the Framework will ensure an efficient supply of telecommunications products and services. Finally, it will ensure that there are incentives for FSE to be efficiently resourced, able to recover its efficiently incurred costs and is allowed to earn a fair return on its investment.
- 27. In particular, the Framework is structured around three areas of regulation:
 - a. Equivalence of inputs.
 - b. Separation of Batelco.
 - c. Regulatory pricing framework.

28. Each of the areas noted above will be described in turn below.

Equivalence of Inputs

- 29. The Authority will follow the Government's position on EoI.

Figure 2: The Government's position on EoI

"[...] These shall include, at a minimum, effective measures to ensure that the new entity delivers NBN-based wholesale products and services to the Incumbent Operator's retail business unit(s) and its competitors on an "equivalence of inputs" basis. [...]"

Source: NTP4, paragraph 24f.

- 30. The Authority shares the Government's view that EoI is suited to achieving non-discrimination and equivalence of access to the FSE's services, which will be important for the regulatory objective of promoting service-based competition. In order to be effective, EoI should cover the full range of price and non-price factors that may affect competition at the retail level.
- 31. During the transitional phase, however, an alternative approach to address non-discrimination that may be less costly and quicker to implement for the FSE, is known as

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Equivalence of Outputs (“EoO”). Furthermore, it might be applied to any non-NBN based wholesale products and services that the FSE may offer following separation.

32. The Authority is of the view that the NBN-based wholesale products and services offered by the FSE should, be subject to EoI. Other products could potentially also be subject to EoI in the long term. EoI obligations will be applied in relation to timescales, prices, service levels, information disclosure, and systems and processes. These obligations will be complemented by other aspects of regulation, including quality of service requirements and an EoI compliance monitoring regime.

Separation of Batelco

33. The Authority’s Purpose Statement highlights that the FSE is to be established by. “[...] *separating the appropriate components of Batelco’s wholesale and infrastructure business units into the [FSE] and the rest of Batelco*”.⁴
34. In the process of considering the level of separation, the Authority acknowledges that stronger forms of separation entail substantially increasing costs (through loss of vertical efficiencies) and potential disruption to the business and the industry as a whole. However, functional separation will enable the FSE to invest in the Single Network, and it will enable the benefits of the resulting economies of scale of the Single Network to be passed through to end users by promoting service-based competition.
35. NTP4 states that “*during the transitional period leading up to the establishment of the new entity, the Authority, in coordination with Government, shall take the measures necessary to adopt, implement and enforce effective functional separation on a gradual basis together with associated equivalency safeguards*”.⁵
36. The Authority will, therefore, base any decisions on an assessment of the proportionality of different forms of separation and will take into consideration any steps undertaken by the incumbent operator to transfer network assets to a separate entity.
37. During the transitional period, the Authority will establish a robust mechanism for monitoring compliance of Batelco and the FSE, particularly with regard to the delivery of EoI and achieving the NBN deployment and performance targets.

Regulatory Pricing Framework

38. The Authority has considered alternative high-level approaches to be used to regulate the prices of the FSE in line with its Purpose Statement objectives⁶. It has concluded that a Building Block Model (“BBM”) with a Regulatory Asset Base (“RAB”) that promotes efficiency and is best suited to achieving the regulatory objectives in the long term as the FSE moves towards a stronger form of separation as standalone utility style operator. This framework provides adequate incentives for investment in a fibre-based NBN whilst supporting efficiency and competition objectives.
39. The BBM framework will be complemented with appropriate regulatory instruments in line with the characteristics of the specific products and services that will be offered by the FSE, as well as efficiency and market conditions.

⁴ Authority (2017). ‘Purpose Statement’.

⁵ The Fourth National Telecommunications Plan, paragraph 24(g).

⁶ Authority (2017). ‘New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain – Purpose Statement’.

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40. In the interim period prior to the separation of Batelco, the Authority will take into account, the transitional needs of all operators and evaluate incentives required to ensure a smooth transition to the long term FSE Product and Service Set.

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List of Acronyms and Definitions

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ASN	Access Service Node
Authority	Telecommunications Regulatory Authority
Batelco	Bahrain Telecommunications Company B.S.C.
BBM	Building Block Model
BEREC	Body of European Regulators for Electronic Communications
BRE	Batelco Retail Entity which is the separated retail business unit of Batelco
BSS	Business Support System
Capex	Capital Expenditure
CAPM	Capital Asset Pricing Model
CCA	Current Cost Accounting
CNN	Core Network Node
CPE	Customer Premise Equipment
CTI	Critical Telecommunications Infrastructure
DDoS	Distributed Denial of Service
DoS	Denial of Service
DSLAM	Digital Subscriber Line Access Multiplexer
ECPR	Efficient Component Pricing Rule
ENISA	European Network and Information Security Agency
EoI	Equivalence of Inputs
EoO	Equivalence of Outputs
EWA	Electricity and Water Authority
FALCON	FLAG Alcatel-Lucent Optical Network
FCM	Financial Capital Maintenance
Framework	Report on the New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain
FLAG	Fibre-Optic Link Around the Globe
FRO	Forum on Batelco's Reference Offer
FSE	Newly created <u>functionally separated entity</u> , formed by separating Batelco
FSE Product and Service Set	Products and services to be offered by the FSE on a long term basis
FWA	Fixed-Wireless Access
Government	The Government of the Kingdom of Bahrain
GBI	Gulf Bridge International
Gbit/s	Gigabit per second
GCC	Gulf Cooperation Council
GPON	Gigabit-capable Passive Optical Networks
HCA	Historical Cost Accounting
HR	Human Resources

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List of Acronyms and Definitions

ICRA	Initial Cost Recovery Account
ICT	Information and Communications Technology
IFC	International FALCON Connectivity
IEC	International Electrotechnical Commission
IP	Internet Protocol
ISMS	Information Security Management System
ISO	International Standards Organisation
IT	Information Technology
ITU	International Telecommunications Union
KPI	Key Performance Indicators
LRIC	Long-run Incremental Cost
LTE	Long-Term Evolution
Mbit/s	Megabit per second
MIS	Management Information System
MSAN	Multi-Service Access Nodes
NBN	National Broadband Network
NTP4	Fourth National Telecommunications Plan
OLO	Other Licensed Operator
OLT	Optical Line Terminal
Opex	Operating expenditure
OSI	Open Systems Interconnections
OSS	Operational Support System
POP	Point of Presence
P2MP	Point-to-Multipoint network architecture
P2P	Point-to-Point network architecture
Purpose Statement	Economic Regulatory Framework Purpose Statement Report
QoS	Quality of Service
RAB	Regulatory Asset Base
RO	Reference Offer
RPI	Retail Price Index
SAC	Standalone Cost
SFO	Saudi Fibre Optic
Single Network	The single telecommunications infrastructure utility network in Bahrain
SLA	Service Level Agreement
SLG	Service Level Guarantees
SMP	Significant Market Power
Vision 2030	Economic Vision 2030 for Bahrain
VSAT	Very Small Aperture Terminal
WACC	Weighted Average Cost of Capital
WAPC	Weighted Average Price Cap
WiMAX	Worldwide Interoperability for Microwave Access

1 Introduction

41. In its Fourth National Telecommunications Plan (“NTP4”), the Government of the Kingdom of Bahrain (the “Government”) has set out a clear policy for an advanced broadband infrastructure and has introduced a set of new objectives for the telecommunications market. The reforms set out in NTP4 are driven by the Government’s vision for Bahrain to become a global Information and Communications Technology (“ICT”) hub and centre for business and for the Kingdom to continue to remain at the forefront of digital developments.
42. The NTP4 notably calls for the development of a single telecommunications infrastructure utility network (the “Single Network”), encompassing the infrastructure required to enable fixed telecommunications networks in Bahrain.⁷ This Single Network is to be the backbone of the wider ICT eco-system, stimulating economic growth consistent with the Government’s broader social and economic objectives.⁸
43. To give effect to the new Government policy, and in accordance with its duties under Article 3(e) of the Telecommunications Law, the Telecommunications Regulatory Authority (the “Authority”) is developing a new regulatory framework.

1.1 Key Government Policies Stated in NTP4

44. This Framework has been developed specifically in relation to the NTP4 policy regarding the “*Delivery of Ubiquitous Ultrafast Broadband Infrastructure*”,⁹ which establishes the Government’s position on the development of a single, fibre-based National Broadband Network (“NBN”), capable of delivering ultra-fast broadband products to consumers and businesses across the Kingdom. This policy is associated with a number of key decisions, namely:
- a. **The NBN will be delivered over the Single Network.** The Single Network will support the development of the NBN and will be owned, operated and deployed by a newly created functionally separate entity (the “FSE”).¹⁰
 - b. **The FSE will provide wholesale services only.** The FSE will be the only entity able to deploy and operate NBN-related fibre infrastructure in Bahrain and will exclusively provide wholesale products and services based on the NBN.¹¹
 - c. **The FSE will be established as an independent entity.** The FSE will eventually be formed by separating the incumbent telecommunications operator, Bahrain Telecommunications Company B.S.C. (“Batelco”), into two distinct entities. The FSE will comprise the appropriate components of Batelco’s wholesale and infrastructure business units with the other entity absorbing the remaining parts of

⁷ As per paragraph 13 of the NTP4. This would also include the supporting infrastructure required to enable fixed telecommunication networks.

⁸ These are set out in greater detail in the Government’s Economic Vision 2030 for Bahrain.

⁹ NTP4, Section (I).

¹⁰ NTP4, paragraph 20.

¹¹ NTP4, paragraph 24b.

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Batelco's business, including its retail unit. This is referred to as Batelco's retail entity ("BRE"). The terms Batelco and BRE are further defined in paragraph 47.

- d. **The FSE will be allowed to earn a fair return on investment.** Its return on its investment is to reflect the risk profile of its assets, and it is to be able to recover efficiently incurred costs to meet deployment and performance targets set out in the NTP4.
 - e. **The FSE will offer its wholesale products and services on a non-discriminatory basis.** This means that the FSE will offer its products and services to all licensed operators in the Kingdom, including BRE, in accordance with the same timescales and pursuant to the same terms and conditions, including everything related to price, service levels, and information about product development and launch.¹²
45. The Authority will implement the NTP4 policy on a gradual basis in order to ensure that decisions can be taken after relevant data and information is available and to minimise the disruption to the industry. As such, the implementation of the Framework is divided into a 'transitional phase' and 'long term' or 'final' outcomes. During the transitional phase Batelco will be required to take steps to implement functional separation and to offer a transitional set of products and services. It will further be required to meet a number of criteria and milestones which will be specified at a later stage. Once the Authority is satisfied that Batelco has met the set criteria and milestones it will issue a licence to the FSE upon which time the transitional period ends. There may be further criteria and ongoing responsibilities to be met by the FSE following the issuance of its licence.
46. The establishment of the FSE as the sole operator of the Single Network will involve a move from a dominant infrastructure provider, Batelco, to the creation of a separated licensed monopoly in some wholesale markets. The new market structure will be characterised by the separation of Batelco's wholesale and infrastructure business units, which will form part of the FSE, from the rest of Batelco.
47. Batelco Group has a number of subsidiaries and affiliates in several countries, as well as its operations in Bahrain.¹³ For the purposes of this report, whenever reference is made to Batelco, this refers to Batelco's Bahrain operations which encompasses the FSE and BRE. The term "rest of Batelco" refers to the separate business units of Batelco which are outside the FSE. Furthermore, for the purpose of this report, the term "BRE", refers to Batelco's retail business unit, which will be functionally separate from the FSE. This is illustrated in Figure 3.
48. Historically, the Authority's regulatory framework has focused on promoting infrastructure-based competition. However, in fixed network markets, entry and subsequent infrastructure-based competition have to date materialised only on a limited scale. In contrast, under the new Framework, there will be a focus on promoting stronger service-based competition whilst moving away from a framework which sought to promote infrastructure-based competition. As per the NTP4 mandate other licensed operators ("OLOs") in the retail market will continue to compete with BRE, which will be separated

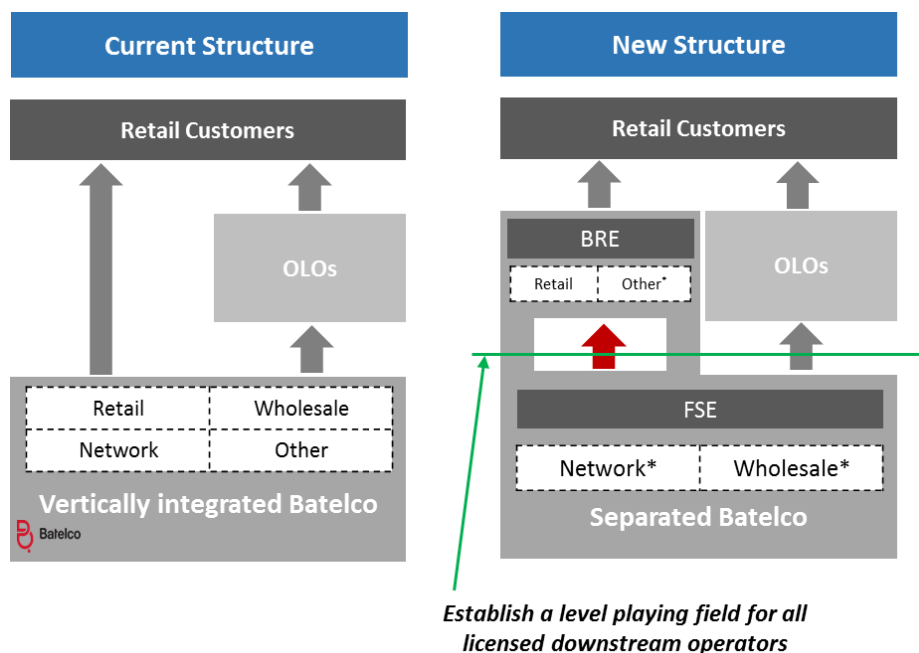
¹² NTP4, paragraph 24f.

¹³ See: Bahrain Telecommunications Company BSC Consolidated Financial Statements, 31 December 2016. Retrieved from: <http://www.batelcogroup.com/media/153043/fs-eng-december-2016.pdf>.

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from the FSE. All downstream operators¹⁴ will rely on the FSE's regulated wholesale services to create their own retail products and services. Figure 3 summarises the change in market structure. **Figure 3: The reform of the telecommunications sector**



Source: the Authority

* Refers to the 'appropriate' components of the wholesale and network business units of Batelco.

49. This change in market structure provides the basis for the Framework as well as the wider range of activities undertaken by the Authority to give effect to these reforms (see Section 1.2. below).

1.2 Supporting the Delivery of NTP4

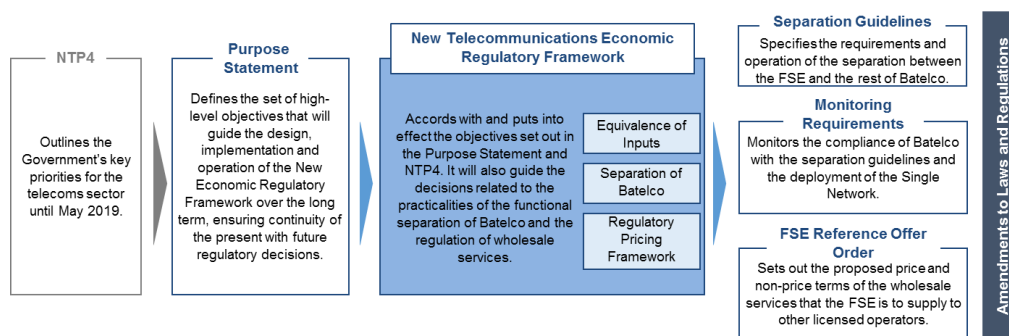
50. In response to the NTP4 policy regarding the development of the NBN, the Authority is developing a series of reports that will guide the separation of Batelco and the formation of the FSE, ensure efficient monitoring arrangements, and specify the regulation of NBN-based wholesale products and services. These are summarised in Figure 4.

¹⁴ Throughout this report, 'downstream operator' is used to refer to both the OLOs and BRE offering services in the retail markets.

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Figure 4: Programme of work to support NTP4 delivery



Source: the Authority

51. As a first step to implementing the Government's key reforms for the telecommunications sector, the Authority briefed a number of operators on its *Economic Regulatory Framework Purpose Statement Report* in May 2017 (the "Purpose Statement"). The Purpose Statement sets out the Authority's key objectives for the Framework.¹⁵
52. A number of further briefing sessions with industry stakeholders have been held in the meantime to gather further information on the requirements for the Framework.
53. The Framework comprises the second of this series of documents, which puts into effect the NTP4 and Purpose Statement and guides the remainder of the Authority's activities and regulatory decisions going forward.
54. There are a number of future regulatory documents to be produced by the Authority as part of this programme of work. These will be based on the key positions set out in this report.

Purpose Statement

55. An important feature of the key activities undertaken by the Authority, including the development of the Framework is the clear articulation of the desired outcome the Authority wishes to achieve. This guarantees the continuity of present objectives with future regulatory decisions and improves transparency around the key decisions and measures taken by the Authority. The Purpose Statement was presented to a number of operators in May 2017. The Authority's Purpose Statement has been updated to reflect feedback received during those sessions. This is summarised in Figure 5 and sets out the key regulatory objectives of the Framework.

Figure 5: The Authority's Purpose Statement of the Framework

The new economic regulatory framework will enable a telecommunications sector that works in the best long-term interests of the Kingdom of Bahrain, by focusing on five key areas of regulation:

¹⁵ Authority (2017). 'New Telecommunications Economic Regulatory Framework for the Kingdom of Bahrain – Purpose Statement'.

New Telecommunications Economic Regulatory Framework Report

Introduction

Telecommunications infrastructure

1. *Deliver a single telecommunications infrastructure utility network (the “Single Network”) which encompasses the infrastructure required to enable fixed telecommunication networks.*
2. *Through this Single Network, support the development of a fibre-based National Broadband Network (“NBN”), that enables the delivery of ultra-fast broadband products and services that meet the needs of businesses and consumers in Bahrain.*
3. *Establish an NBN that is “future proof” by ensuring it can be upgraded at minimal cost to deliver state-of-the-art performance in line with industry best practice.*

New industry structure

4. *Establish a telecommunications utility operator (“the TUO”) that is licensed to deploy, maintain and operate the Single Network and an NBN.*
5. *Establish the TUO by separating the appropriate components of Batelco’s wholesale and infrastructure business units into the TUO and the rest of Batelco.*
6. *Ensure that the TUO is licensed to only provide wholesale products and services to other licensed operators in Bahrain on an equivalence of inputs basis.*
7. *Ensure that the TUO develops and offers products and services that reflect the reasonable requirements of its wholesale customers.*
8. *Ensure that the TUO is efficiently resourced, able to recover its efficiently incurred costs and is allowed to earn a fair return on its investment.*
9. *Ensure that the TUO is able to make decisions in its own commercial interest and independently of other licensed operators.*

Economics

10. *Promote efficiency in the supply of telecommunications products and services in the telecommunications market of Bahrain.*
11. *Promote service-based competition in the telecommunications market that is fair, effective and sustainable.*

Security

12. *Ensure that the Single Network is secure and protected against physical and cyber security threats.*
13. *Ensure that the design of the Single Network meets National Security requirements.*

Legal Framework

14. *Ensure that licences for operators other than the TUO do not confer rights to deploy, operate or maintain passive fibre infrastructure.*
15. *Ensure regulatory certainty to all market participants, subscribers and users through the development of relevant legal and regulatory instruments.*
16. *Ensure transparency, consistency and accountability.*

Source: the Authority

56. The abbreviation TUO has been replaced by the abbreviation FSE in the present report. Furthermore, the abbreviation TUO has been replaced with FSE where the Purpose Statement is quoted or referenced in the present report.

New Telecommunications Economic Regulatory Framework Report

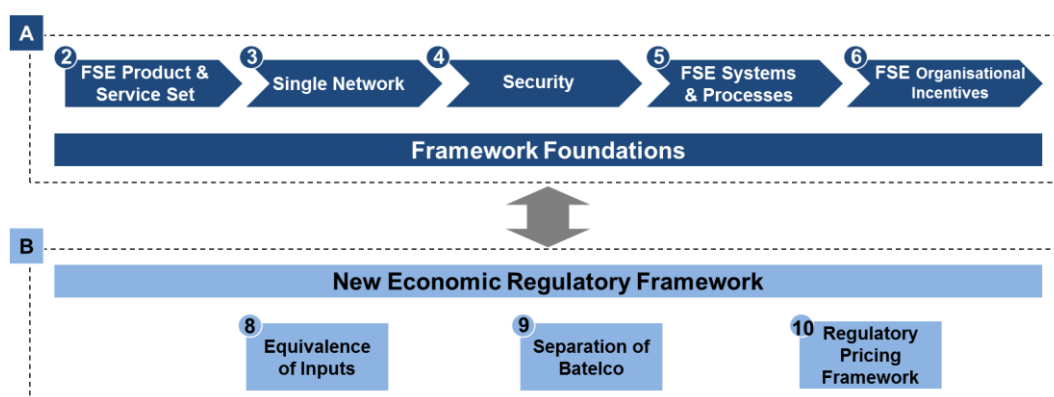
Introduction

57. To ensure the Authority follows a consistent approach, favouring the long-term interest of the people of Bahrain, the Purpose Statement and the Framework are based on a set of guiding principles.¹⁶ This means that whilst the Framework may evolve over time, the principles upon which it is based are stable.

This report

58. The NTP4 mandates a significant change in the structure of the Bahrain broadband market by promoting service-based competition and moving away from a framework seeking to promote infrastructure-based competition in the fixed broadband market. The current regulatory framework may not fully address the economic issues around the proposed changes, including the separation of Batelco and the associated strengthening of existing non-discrimination safeguards through Equivalence of Inputs (“EoI”) as well as the establishment of the FSE.
59. As such, a new framework is required to give effect to these key reforms as decreed by NTP4. With this in mind, this Framework will guide a number of decisions related to the practicalities of the separation of Batelco, the deployment of the Single Network and NBN and the form of regulation to be applied in the telecommunications market going forward. The direction provided in this Framework is to achieve the key objectives set forth in the Authority’s Purpose Statement.
60. This Framework is structured into two parts.
- Part A – The Foundations of the Framework.** This sets out the Authority’s key requirements underpinning the Framework.
 - Part B – The New Economic Regulatory Framework.** This establishes the Framework by taking the key positions derived in the Framework foundations in Part A.
61. Figure 6 summarises the structure and key components of this Framework.

Figure 6: The structure of this Framework



¹⁶ These core principles are *Efficiency, Equality and Fairness, Consistency, Accountability and Transparency and Adaptability*. The Purpose Statement Report discusses these in greater detail.

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Introduction

Source: the Authority

62. Part A, the foundations of the framework, specifically establishes the Authority's approach to the determination of each of the following key technical and organisational components of the FSE and Batelco more generally that will be impacted by the Framework:
- a. **The FSE Product and Service Set.** The criteria and process by which FSE wholesale products and services are to be designed and developed (Section 2), which in turn is to guide the resources required by the FSE (as specified below).
 - b. **The Single Network.** The perimeter of the Single Network in terms of the network assets to be controlled by the FSE, based on the products and services the FSE will be required to supply and NTP4 policies (Section 3).
 - c. **Security requirements.** The key security considerations in line with national security requirements based on the FSE Product and Service Set and Single Network (Section 4).
 - d. **Systems and Processes.** The systems and processes required by the FSE as part of its separation from Batelco, based on the decisions with regards to the FSE products and services, the Single Network assets, security principles and Eol requirements (Section 5).
 - e. **Organisational structure.** The requirements in relation to the FSE's management incentives and Human Resources ("HR") based on Eol and independence requirements (Section 6).
63. Part B, the Framework, is structured around the following three elements of regulation:
- a. **Equivalence of Inputs.** The Authority's definition of Eol (Section 8).
 - b. **Separation of Batelco.** The Authority's understanding of the meaning of separation set out in NTP4 (Section 9).
 - c. **Regulatory Pricing Framework.** The regulatory pricing framework to be used to regulate the new entity's wholesale products and services. This includes the Authority's definition of and approaches to measuring the FSE's efficiency (Section 10).

Future work

64. In line with its overall strategy for the telecommunications sector in Bahrain, the Framework develops the Authority's key positions in supporting the Government's overall policy. The Framework presents the Authority's rationale for the future regulatory course of action.
65. The three key elements of the Framework which include *Equivalence of Inputs*, *Separation of Batelco*, and the *Regulatory Pricing Framework*, will guide more specific decisions and considerations of the Authority. A key objective in developing these elements is the promotion of efficiency of the FSE and the market as discussed in the Economic Regulatory Framework Purpose Statement Report. These will be established as part of future work highlighted in Figure 4 and will provide greater detail on a number of issues covered in the Framework. These activities will involve:

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- a. Developing the separation guidelines for the formation of the FSE through the separation of Batelco.
- b. Designing a regime for monitoring compliance with the separation guidelines, NBN deployment and performance targets, and Eol obligations of the FSE.
- c. Issuing a Reference Offer ("RO") Order which sets out the price and non-price terms of the regulated wholesale products and services to be offered by the newly created FSE.
- d. Identifying any amendments to existing laws, regulation and licences necessary to give effect to the Framework.

PART A – Foundations of the Framework

2 FSE Product and Service Set

66. Identifying the FSE's wholesale product and service set is an important step underpinning the development of the Framework. FSE's wholesale products and services are to meet the reasonable requirements of downstream OLOs, thereby promoting service-based competition and demand for NBN based services. This demand is, in turn, to generate sufficient revenue for the FSE to allow it to recover the costs, including a reasonable return on its investment, that it efficiently incurs to produce the wholesale products and services. In other words, the FSE's Product and Service Set is to promote service-based competition and enable the sustainability of the FSE business case over the long term.
67. Decisions regarding the FSE's Product and Service Set, therefore, can only be made once the reasonable requirements of operators have been gathered, the FSE proposes solutions to meet these reasonable requirements as well as the costs and proposed prices for these solutions, and operators have an opportunity to make submissions on these proposals.
68. This Framework gives structure to how this information is to be gathered. As such, the purpose of this section is to establish the Authority's framework for capturing the business requirements of downstream operators with regards to products and services that the FSE should offer, taking into account the objectives set out in NTP4 and the Authority's Purpose Statement as well as feedback received from stakeholders. These products and services are referred to as the *FSE Product and Service Set* in the remainder of this report.

2.1 Introduction

69. Whilst the NTP4 does not specify the types of wholesale products and services that the new entity would be required to offer to other operators, it states that: *"The range of wholesale products and services to be delivered [...] must reflect the reasonable requirements of all of the new entity's wholesale customers."*¹⁷ Additionally, this requirement is specifically identified in the Authority's Purpose Statement for the Framework.¹⁸
70. The FSE is therefore required to provide a comprehensive and "future proof"¹⁹ set of wholesale products and services that will allow downstream operators to create a range of independent services. In the Authority's interpretation of NTP4, the FSE wholesale product and service set must give both OLOs and BRE the flexibility to build their own optimised, efficient networks that meet their individual, reasonable requirements for access, backhaul, aggregation, and transmission links. Such a wholesale product and service set,

¹⁷ NTP4, paragraph 24h.

¹⁸ Specifically, objective number 4 states that the Framework will *"Ensure that the [FSE] develops and offers products and services that reflect the reasonable requirements of its wholesale customers"*.

¹⁹ This is to mean that the FSE should ensure its products and infrastructure can be upgraded at minimal cost to deliver state-of-the-art performance in line with industry best practice, as set out in the Purpose Statement.

New Telecommunications Economic Regulatory Framework Report

FSE Products and Service Set

together with the EoI regime set out in Section 8, will create the foundation for a level playing field for OLOs and BRE in the retail market for telecommunications services.

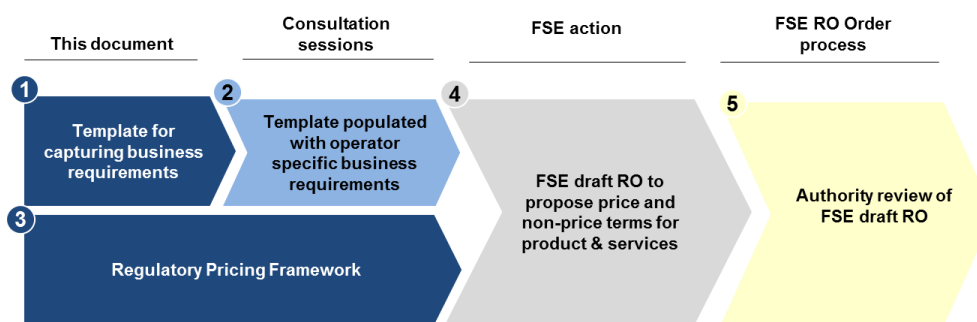
71. In assessing the range of potential wholesale services to be offered by the FSE, the Authority has been guided by the following steps as illustrated in Figure 7:
- a. **Step 1.** Template for capturing the business requirements of downstream operators across the different elements of the telecommunications network is based on the Authority's Purpose Statement. The template for capturing the business requirements is described in the next sub-section.
 - b. **Step 2.** OLOs and the BRE are to populate the templates with their business requirements. This is to identify specific business requirements for downstream operators based on feedback received as part of consultations held with both OLOs and BRE.²⁰ The Authority will forward all of these specific requirements to Batelco.
 - c. **Step 3.** Regulatory Pricing Framework that will promote efficiency, service-based competition and FSE's investment in the Single Network. The design of the Regulatory Pricing Framework is developed in Section 10 and Annex A of the present report.
 - d. **Step 4.** Based on the specific business requirements for downstream operators, and the Regulatory Pricing Framework, Batelco is to propose price and non-price terms for the FSE's products and services. This will include a process for meeting immediate requirements by establishing a transitional product set, as well as the development of solutions that meet downstream operator's long term needs. The transitional products and services would be offered up to the point where the FSE is given its licence, and the long-term products and services will be specified in the FSE's RO Order.
 - e. **Step 5.** The Authority will review Batelco's proposed price and non-price terms of the FSE's products and services as part of the RO process and issue the FSE's RO Order prior to the FSE begins trading. This review will address, amongst other things, whether the draft RO promotes service-based competition, enables the sustainability of the FSE business case and is efficient. The Authority will review operators' business requirements if FSE raises a dispute. Such a dispute will not stay automatically the product or service provision by the FSE. As part of this process, necessary amendments to Batelco's existing RO may also be implemented.

²⁰ The Authority has held a number of such sessions in its offices in October and November 2017 and continues to engage with operators and stakeholders on a regular basis.

New Telecommunications Economic Regulatory Framework Report

FSE Products and Service Set

Figure 7: Key steps in defining the FSE Product and Service Set



Source: the Authority

72. The remainder of this section discusses the dimensions of the specific business requirements that the Authority considers are appropriate to capture from downstream operators.

2.2 Framework for Capturing Business Requirements

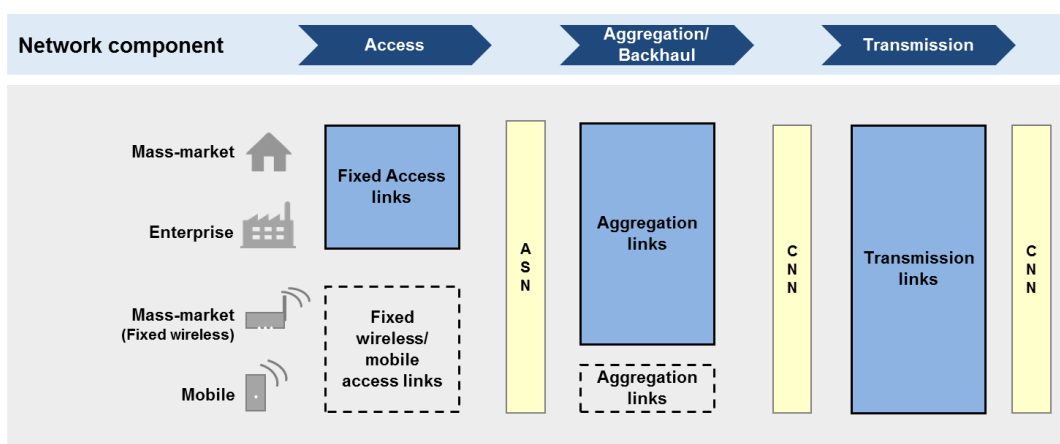
2.2.1 Network representation approach

73. FSE Product and Service Set must give all downstream operators, including OLOs and BRE, the flexibility to build their own optimised, efficient networks that meets their individual, reasonable requirements for access, backhaul, aggregation, and transmission links.
74. For downstream operators to build their own optimised, efficient networks, the FSE will need to offer wholesale products and services across the different components of the network. This should give each operator a menu of wholesale products to choose from, which can be combined according to their individual and reasonable requirements, therefore creating the basis for a “level playing field” and effective service-based competition.
75. The Authority therefore has framed the operators’ business requirements for the FSE products and services in accordance with the network elements identified in Figure 8. For the purposes of framing operators’ business requirements, the network is defined across *access*, *aggregation/backhaul* and *transmission* components as illustrated in Figure 8. For the avoidance of doubt, this network representation approach is used solely for the purposes of framing the operator business requirements. The final products and services offered by the FSE may or may not follow this framework.

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FSE Products and Service Set

Figure 8: Schematic of network components for framing operators' business requirements



Source: the Authority

Blue: Fixed line links

Dashed: Wireless links

76. Across each of these network components a broad range of connectivity links could be provided, either taking the form of *fixed line* connections or *wireless* connections. In the remainder of this report, unless where otherwise stated, the Authority will focus on fixed line connections. Across each of these network components the following groups of fixed wholesale connectivity links could be provided:

- a. **Fixed Access Links.** Wholesale broadband access products and services are defined as those services that connect the network termination point at the end user's premises (typically a Customer Premises Equipment ("CPE") with an operator's Point of Presence ("POP") in the access network, referred to as an Access Service Node ("ASN").²¹ The Authority separates the products to be provided in the access network into three general segments, depending on the types of end users served by retail providers²². It notes however that downstream operators may use a different customer classification and therefore does not ignore any other types of end-users that operators consider relevant. The following end-user types are considered in this report:
 - i. *Mass-market.* These are typically targeted at residential users, smaller businesses or small office/home offices who do not require the same quality of service as larger businesses and for whom the quality of service offered on mass-market retail packages is sufficient.
 - ii. *Small and medium enterprises ("SMEs").* These connections could target SMEs, which may require customised packages with specific requirements for latency, contention or customer support.

²¹ Access Service Nodes typically contain the active equipment used to provide a range of telecommunications services. In their most general form, the Authority understands Access Service Nodes to incorporate telephone exchanges, mobile network base stations or fixed wireless network stations.

²² See Authority (2014). 'Determination of Significant Market Power and Determination of Dominant Position in the Markets for Provision of Broadband Internet Access Services from a Fixed Location', 27 March 2014, MCD/03/14/018.

New Telecommunications Economic Regulatory Framework Report

FSE Products and Service Set

- iii. *Enterprise.* These are typically targeted at larger businesses that require higher quality and more customised broadband services with additional customer support.
- b. **Aggregation/Backhaul Links.** Aggregation products are defined as wholesale products which offer aggregation capacity between an operator's ASN and operator's POP in the core network, referred to as a Core Network Node ("CNN").²³ These products and services include backhaul capacity for mobile base stations as well as other ASNs used to deliver fixed-wireless access. The Authority notes that some operators may consider mobile backhaul to fall in the access part of the network. However, for the purposes of establishing business requirements the classification of mobile backhaul as an access or backhaul level link is irrelevant.
- c. **Transmission Links.** Transmission links are defined as wholesale products and services which offer transmission capacity between an operator's CNN, data centres, service platforms or international landing stations.
- d. **Co-location.** Physical co-location would enable downstream operators to install their own electronics within the FSE's ASNs or CNNs. Based on the FSE's position as the sole operator of the Single Network, there may be a need for such a service in the FSE Product and Service Set. The degree to which co-location may be required will depend whether a specific link terminates at a FSE controlled POP or a POP controlled by a downstream operator.

2.2.2 Options for connectivity links

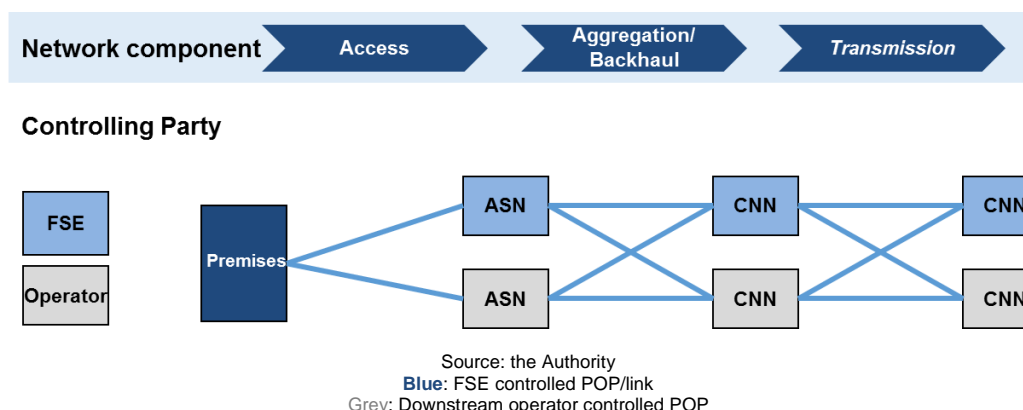
77. The Authority notes that there a number of potential permutation for the links set out above, connecting POPs controlled by either the FSE or downstream operators. These are illustrated in Figure 9.

²³ The Authority defines such nodes as those whose primary function is not to deliver access services to end users but rather to support the transfer of traffic between other network nodes.

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FSE Products and Service Set

Figure 9: Illustration of links originating and terminating from OLO and FSE controlled POPs

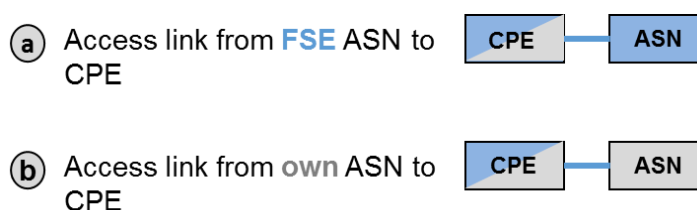


78. A number of options of each connectivity link across the network components could therefore be identified. The Authority considers a set of such options which could be relevant to downstream operators. These are discussed below.

Fixed access links

79. Access links could theoretically be provided across the following configurations:
- The link could connect a FSE controlled ASN with the CPE at the end user premises. In this scenario operators may need to co-locate in the FSE's POP. CPE's could be controlled by either the FSE or the operators themselves or could have components controlled by either party.
 - The link could connect an operator's own ASN with the CPE at the end-user premises. Under this scenario the FSE may require access to the operator's ASN.

Figure 10: Options for access links configurations



Source: the Authority

Aggregation/backhaul links

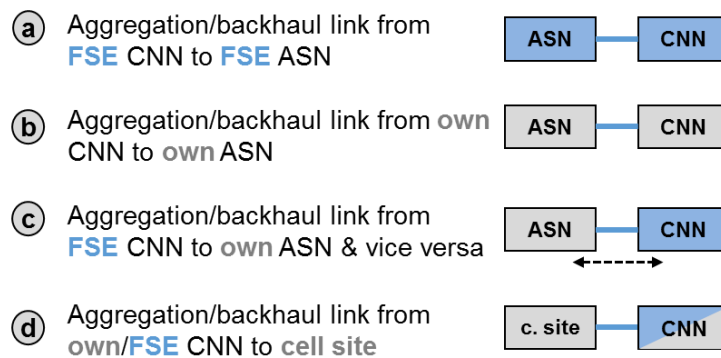
80. Backhaul/aggregation links provide for a potentially larger set of options and could be provided across the following configurations:
- An aggregation/backhaul link could connect a FSE controlled CNN with a FSE controlled ASN, providing a virtual-type link across the aggregation network. Operators may require co-locations space and access to the FSE's nodes under this scenario.

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FSE Products and Service Set

- b. A link could connect an operator's own CNN with its own ASN. Under this scenario, the FSE would provide links between the operator's POP but may require access to such POPs for connection purposes.
- c. A link could connect the FSE's own CNN with an ASN controlled by the downstream operator. Vice versa, a connection could originate from an operator's own CNN and terminate at an ASN controlled by the FSE.
- d. The Authority specifically highlights links connecting operator's cell sites. These could again originate from an operator's own CNN or from CNNs controlled by the FSE.

Figure 11: Options for aggregation/backhaul links configurations



Source: the Authority

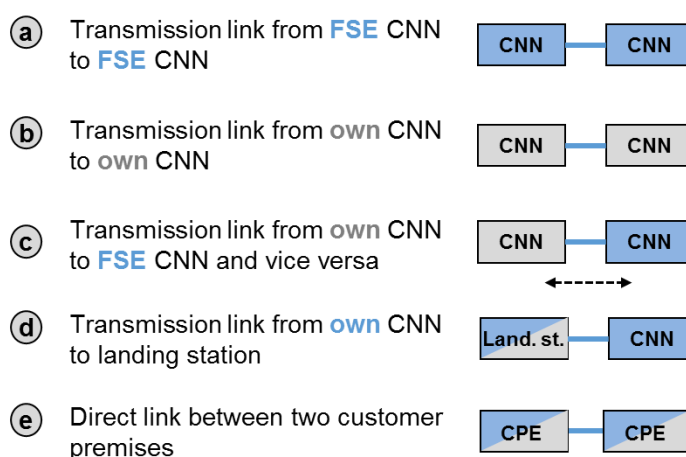
Transmission links

81. Transmission links can be considered across the following configurations:
- a. A transmission link could connect two FSE controlled CNNs, again providing a virtual network connection to downstream operators.
 - b. A link could connect two CNNs controlled by the downstream operators.
 - c. A link could connect the FSE's own CNN with a CNN controlled by the downstream operator. Vice versa, a connection could originate from an operator's own CNN and terminate at a CNN controlled by the FSE.
 - d. The Authority specifically highlights connections between international landing stations and CNNs. Landing stations could be controlled by the FSE, the operator or any other entity.
 - e. An additional type of link considered in this context is a direct connection between an end-user's two premises, without passing any POP's of either the FSE or the operator. This link would likely be relevant for retail services targeted at large enterprises or other entities.

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FSE Products and Service Set

Figure 12: Options for transmission links configurations



Source: the Authority

2.2.3 Outline business requirements

82. In the Authority's view, the FSE wholesale products and services should meet the business requirements of downstream operators for each of these different network components – i.e. access, aggregation/backhaul and transmission. The FSE Product and Service Set should provide downstream operators the flexibility to offer retail products that are innovative, efficient and that meet their customers' needs.
83. Whilst the business requirements will be confirmed with downstream operators, the Authority is currently of the view that business requirements with regards to the FSE Product and Service Set could span across the following dimensions:
 - a. Quality of Service ("QoS") and performance requirements.
 - b. SLA requirements.
 - c. Bandwidth profile requirements.
 - d. Security-related requirements.
84. The Authority will review the reasonableness of operator's requirements against their potential benefits and costs, both to the industry as a whole and the operators concerned.

2.2.4 Stakeholder input

85. In line with the Authority's purpose statement, this framework for eliciting operator's business requirements has been presented to a number of operators as part of information sessions held at the Authority's offices in October and November 2017. In addition, operators have been presented with a template document to specify their individual requirements.
86. The Authority will forward the templates populated with operators' business requirements to Batelco. Batelco will then be required to reflect reasonable requirements in proposed FSE products and services to be presented in its RO. The Authority will review and assess Batelco's proposals against the reasonable requirements collected from a number of operators.

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FSE Products and Service Set

The Authority's position:

87. The FSE's products and services are to give all downstream OLOs and BRE the flexibility to build their own (virtual) optimised, efficient networks that meets their individual, reasonable requirements for access, backhaul, aggregation, and transmission links.
88. The process for developing the FSE's products and services starts with collecting operators' business requirements. Batelco is to propose in the FSE draft RO the price and non-price terms for the FSE products and services that meet operators' business requirements. The Authority will review the FSE draft RO as it prepares the RO Order, addressing, amongst other things, whether the draft RO promotes service-based competition, enables the sustainability of the FSE business case, and is efficient. The Authority will review operators' business requirements if FSE raises a dispute. Such a dispute will not stay automatically the product or service provision by the FSE.

3 FSE Single Network

3.1 Introduction

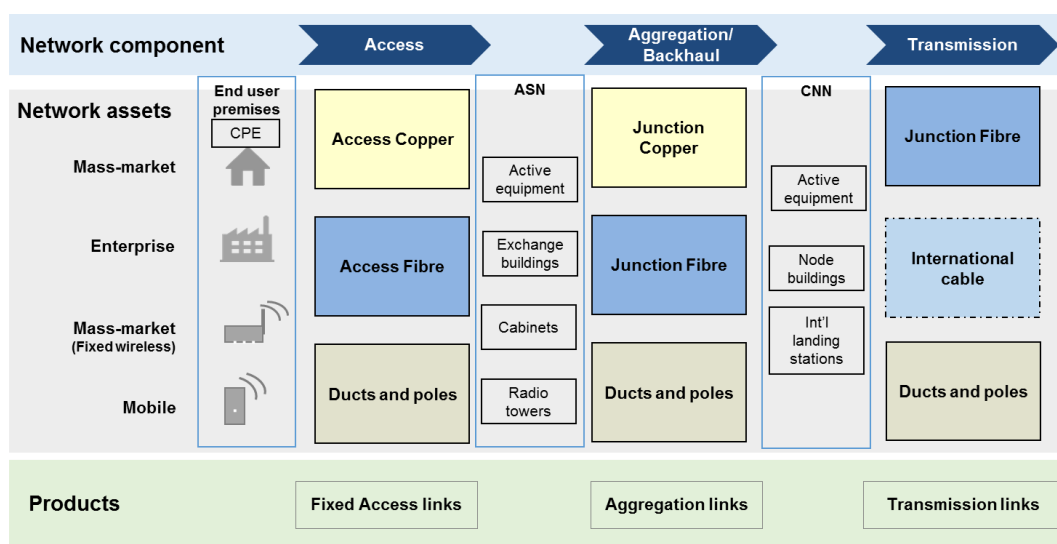
89. The Single Network constitutes one of the key policies put forward in the Government's NTP4 and the Authority's Purpose Statement outlining the requirement for a single, exclusive telecommunications infrastructure utility network in Bahrain. The Single Network is to support the development of a fibre-based NBN, enabling the delivery of ultra-fast broadband products and services that meet the needs of businesses and consumers in Bahrain.
90. The principles that will be used to establish the FSE Product and Service Set, as described in the previous section, have been guided by this policy, and will ensure the FSE offers wholesale products and services that meet the reasonable, individual requirements of downstream operators, in line with promoting a fit for purpose, "future proof" NBN. These products and services help to define the boundaries of the Single Network through operational requirements. Finally, the Single Network is guided by a set of deployment targets for the NBN established as part of NTP4.
91. In the Authority's view, the FSE Single Network should therefore fulfil three core purposes:
- a. It is to encompass the infrastructure required to enable fixed telecommunications networks as set out in the Purpose Statement.
 - b. It is to support the FSE Product and Service Set that will be used by downstream operators to build solutions that meet their requirements.
 - c. It is to meet NTP4 deployment targets, which specify that the NBN should cover 95% of all residential customers and 100% of all business customers and public radio communication stations.²⁴
92. Using the network representation approach employed in the previous section, the Authority has identified the high-level network elements and assets that are used to deliver telecommunications services. In the following section, each of these assets is discussed in the context of the Single Network.

²⁴ NTP4, paragraph 17.

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FSE Single Network

Figure 13: High-level network assets used to deliver broadband services



Source: the Authority

93. Each of the network components, access, aggregation/backhaul and transmission presented in Figure 13 are underpinned by a core set of physical infrastructure and assets, namely, the ducts, trenches and poles as well as the cable used to transmit digital signals. There are generally two types of cables used in telecommunications infrastructure; fibre and copper lines. In addition to such physical or 'passive' infrastructure, a range of active equipment will be required in order to enable fixed telecommunications services. This equipment can be housed in ASNs, CNNs, customer premises (referred to as CPEs) or in other buildings or facilities, such as street cabinets.
94. The Single Network will be established primarily by separating Batelco's existing network assets. As such, each of these network components is discussed in relation to the separation arrangements between the FSE and the rest of Batelco in the section below.

3.2 Separation of Batelco's Network Assets for the FSE Single Network

3.2.1 Introduction

95. The FSE will be required to control, manage and operate a number of assets currently under the responsibility of Batelco in order to meet its obligations to supply the Product and Service Set. This section defines the process by which the asset demarcation points implied by these product choices, the wider Single Network objective and NTP4 deployment targets, will be determined.
96. For the purposes of this discussion, assets are separated into the following asset classes, in line with the stylised network model set out in Figure 13:
- Fibre cable.** Fibre optic cables used to provide fibre-based broadband access and fibre backhaul within Bahrain.
 - Copper wire.** Legacy copper cable used to provide copper-based data and voice services.
 - Duct and poles.** Underground tunnels and telegraph poles that carry both fibre and copper telecommunications cables.

New Telecommunications Economic Regulatory Framework Report

FSE Single Network

- d. **Active equipment.** Active elements required for the transmission, reception and translation of data. This includes Optical Line Terminals (“OLTs”), Multi-Service Access Nodes (“MSANs”), switches and routers.
 - e. **Exchange buildings and cabinets.** Buildings containing a local ASN used for the housing of active equipment required to provide data and voice services.
 - f. **International landing stations and international cable.** Cable landing points for international underwater and terrestrial telecommunications cables to make landfall in Bahrain, and international cables owned by Batelco.
 - g. **Office accommodation.** Office space for the use of Batelco staff.
 - h. **Other assets.** These comprise a range of other assets currently held by Batelco but are outside the immediate scope of this report.²⁵
97. Batelco will be required to propose whether and if so, how it will transfer control of deployment, operation and maintenance of these assets to the FSE as part of its asset allocation plan. Batelco will be required to provide evidence to support its proposals with respect to the criteria set out in the following section 3.2.2. The Authority will review and approve Batelco’s proposals in accordance with these criteria.
98. Finally, where the separation of control for an asset is complex, the Authority may work with Batelco and the FSE to agree the final arrangement for the control, which may include the introduction of supply or sharing arrangements.

3.2.2 Network asset demarcation criteria

99. The Authority’s Purpose Statement establishes that the Single Network is to encompass the infrastructure required to enable fixed telecommunications networks. As part of its Undertakings²⁶ to the Authority, Batelco will be required to establish an asset allocation plan for the Authority to review, which will set out which types of assets are to be under the control of the FSE.²⁷ In determining the demarcation of assets to be controlled by the FSE and the rest of Batelco, a number of principles will need to be considered by Batelco, such as:
- a. **Delivery of the FSE Product and Service Set.** The assets to be controlled by the FSE should be driven by the FSE Product and Service Set, which the FSE will be required to deliver to all downstream operators. The following criteria are pursuant to the requirements, as noted in Section 2.
 - b. **Alignment with Eol.** Any demarcation is to ensure that all aspects of Eol are maintained and that all downstream operators are able to compete on a “level playing field”, thereby promoting service-based competition. In particular, any arrangement should not discriminate against either OLOs or BRE when considering potential access and sharing arrangements.

²⁵ This includes, for example, mobile assets or services platforms.

²⁶ More detailed requirements on the scope of Batelco’s Undertakings will be set out as part of the Authority’s Separation Guidelines.

²⁷ The future activities and regulatory plans discussed in this report are summarised in Annex B.

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FSE Single Network

- c. **Efficiency.** The transfer of assets will need to ensure that the FSE is resourced efficiently and able to recover its efficiently incurred costs, including a fair return on investment. This means that any potential transfer charges that may result from a transfer of control of certain assets from Batelco to the FSE should be based on efficient costs. The scope of assets transferred should be sufficient for the FSE to fulfil its functions but should not involve any assets which the FSE does not feasibly require control over as part of the Single Network to avoid any inefficient capex.
 - d. **Independence.** More generally, and in line with EoI, any asset transfer is to ensure the FSE is able to make decisions in its own commercial interest, independent of other licensed operators, in particular BRE.
 - e. **Security requirements.** Any potential access and sharing arrangements between the FSE and the rest of Batelco or OLOs should be consistent with the security requirements set out in Section 4.
 - f. **Potential for cross subsidisation.** The asset demarcation should limit the potential of Batelco to cross subsidise between returns earned on assets used in regulated markets with those deployed as part of competitive environments.
100. It is the Authority's view that the identification of appropriate assets to comprise the Single Network should be determined primarily by the FSE's operational need for these assets to deliver the products and services which are based on operators' business requirements highlighted in Section 2. Where assets are used exclusively for the provision of products and services within the FSE Product and Service Set, it follows that these assets should be under the control of the FSE to enable it to be operational. Similarly, where assets are not required to deliver any items within the FSE Product and Service Set, these assets could remain under the control of rest of Batelco as long as they are not critical to achieving the Authority's Purpose Statement objectives.
101. Given that the FSE will be established by incorporating the appropriate components of Batelco's assets, there may be a limited number of cases where assets may be required by both the FSE and the rest of Batelco. When this occurs, Batelco will be required to identify the primary user of the asset, in addition to taking into consideration any additional implications of transfer of control of certain assets on the coverage and performance target set out in the Purpose Statement and the NTP4. That is where an asset control transfer may risk the achievement of the NTP4 performance and deployment targets this may outweigh concerns with regards to the primary user of a certain asset. The Authority notes that an asset control transfer could in principle be completed in a number of ways, ranging from transferring legal ownership to granting rights of control to the FSE.
102. Given that the transfer of control of Batelco's assets to the FSE will be determined, amongst other things, by whether they are inputs to the FSE Product and Service Set, there are a number of assets whose final allocation will be dependent on the products to be supplied by the FSE. This approach to asset demarcation avoids the unnecessary transfer of legacy assets whose use is outside the scope of the FSE Product and Service Set and any associated transfer costs, in addition to ensuring that the OLOs, the rest of Batelco and the FSE are able to deliver their full product set following separation.

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3.2.3 Asset demarcation evaluation

103. The criteria established above should be applied by Batelco in establishing its asset control allocation proposition. The Authority will review each of Batelco's proposals against such criteria.

Fibre cable

104. Fibre cables form a key part of any telecommunications network in both core transmission, backhaul and broadband access, allowing for the provision of ultra-fast broadband connections, mobile base station backhaul or links to international landing stations amongst others. The Authority's Purpose Statement establishes that the FSE will be responsible for the deployment and operation of the NBN which is to be based on fibre infrastructure, and this is reflected in the FSE Product and Service Set.
105. Given that the FSE's proposed product set includes the provision of transmission as well as aggregation/backhaul wholesale products, it will likely offer solutions where the point of handover lies beyond the local exchange. Therefore, it is the Authority's view that control over all elements of the fibre network will be transferred to the FSE following separation under the criteria of operational need.²⁸ In line with the Single Network objective established in the Purpose Statement, this includes all fibre optical cables laid out as part of Batelco's Point to Multipoint ("P2MP") and Point to Point ("P2P") fibre access network topology, fibre cables used for backhaul or transmission purposes as well as fibre in the core.

Copper wire

106. Legacy copper cables are typically used to provide traditional broadband products such as DSL as well as traditional voice services. Given that the FSE may also provide legacy copper-based wholesale data products during a transitional period, it may be required to also obtain control of Batelco's legacy copper infrastructure. The bulk of this network lies in the access component, commonly referred to as the 'local loop', which provides the physical connection from the ASN (i.e. a local exchange) to end user premises over which copper voice and data services are delivered.
107. The Authority notes that transfer of the copper access network may not prevent BRE from delivering its retail voice services as the FSE could offer appropriate wholesale products and services, which could be used as an input for voice-only offerings.
108. Furthermore, as it may be difficult to separate access and non-access copper networks, the FSE may also provide products that use the copper non-access network for a limited transitional period. It is the Authority's view that the FSE may therefore require use of the full copper network, including access and non-access, and therefore this could be transferred to the FSE.
109. The Authority notes that in addition to ensuring that the FSE is fully operational under this option, transfer of control over the copper network offers additional benefits with regard to

²⁸ In particular, as stated in Section 3.2, no distinction is made between the 'trunk' and 'terminating' segments of domestic transmission services.

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supporting the transition from copper to fibre-based services. Consolidation of both fibre and copper networks under the control of a single entity will allow for a coordinated approach for the rollout of the NBN which may otherwise be misaligned if the copper network were to remain under the control of the rest of Batelco, particularly in light of the potential incentive to 'sweat' copper assets.

110. Finally, it is the Authority's view that a transfer of copper and fibre infrastructure into the FSE aligns with the Framework's Purpose Statement objectives. Specifically, objective 1 calling for the delivery of a Single Network is consistent with such a consolidation of Batelco's network cables and a move towards service-based competition. Having separate copper and fibre networks, operated by the rest of Batelco and the FSE, may conflict with this Single Network objective by allowing for potentially competing and duplicate infrastructures being maintained by two separate parties. If copper assets are to be within the perimeter of the Single Network, Batelco will be required to propose the mode of this transfer.

Ducts and poles

111. Ducts refer to underground tunnels that are used to house telecommunications cables, and poles refers to structures above ground on from which cables are suspended. Together telecommunications ducts and poles can be considered the most 'fundamental' form of telecommunications infrastructure by providing the foundation over which the fibre and copper networks are deployed.
112. As such, the FSE will require control of access to these ducts and poles in order to at least deploy, operate and maintain the fibre infrastructure. The FSE may also require control of access to those ducts and poles where copper network has been deployed. In the long term, the rest of Batelco and OLOs will not require access to ducts and poles as they will no longer deploy, operate and maintain cables within these ducts or poles.
113. The Authority also recognises that there may be a number of economic benefits associated with the transfer of ducts and poles to the FSE associated vertical integration. Benefits may arise from increased coordination between new duct and pole construction and deployment of the NBN. Through consolidating control over both duct and pole build and fibre deployment, the FSE may be able to minimise unnecessary duplication, constructing new ducts and poles only where required to support the NBN, resulting in potential significant productive efficiency gains.²⁹
114. In addition, the transfer of control over ducts and poles to the FSE avoids dependence on the rest of Batelco for the expansion of the NBN. Without this transfer, the FSE would rely on the rest of Batelco not only for access to existing infrastructure in order to deploy fibre cable, but also the construction of new ducts and poles required to expand the network. Transferring control of ducts and poles to the FSE would allow decisions to expand the duct and pole network to lie with the FSE, who, through the pricing framework and the need to meet NBN deployment targets, would be incentivised to invest in the required infrastructure.

²⁹ Civil works costs are typically considered to make up almost 80% of the total costs of the infrastructure being deployed [Source: Analysys Mason (2010). 'Final Report for Ofcom - Operational models for shared duct access'].

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Active equipment

115. Active electronic equipment is used to deliver data and voice services over passive copper or fibre networks and it would be required by the FSE to provide active wholesale products to downstream operators. The rest of Batelco, however, may also require the use of some active equipment to supply its wholesale and retail services following separation.
116. Where active equipment is used in the provision of specific products that are to be offered only by the FSE or only by the rest of Batelco, it follows that these assets could be controlled by the respective entity following separation. One such example could be switches and routers used only to deliver legacy voice services whose provision may not remain with the rest of Batelco as well as any service platforms used for BRE's retail offering. Conversely, OLTs used in Batelco's GPON technology, transmission equipment and core network components used exclusively to offer basic end-to-end data connectivity could be transferred to the FSE.
117. Aside from exclusively used active equipment, some active elements may be inputs in the provision of both the FSE Product and Service Set and different products offered by the rest of Batelco. These are referred to as 'dual use' assets. One such example could be MSANs currently used in Batelco's current Bitstream service³⁰ which can house multiple line cards, some of which may be for fibre based services and some of which may be for copper-based solution (e.g. voice). Another example are Digital Subscriber Line Access Multiplexers ("DSLAMs"), which are used for the provision of copper based voice and data services. Both the rest of Batelco and the FSE may require use of these assets, the rest of Batelco to provide copper based voice services and the FSE to deliver transitional products and services. It is the Authority's view that identifying the extent of an entity's control of these assets will require a careful evaluation on a case-by-case basis, as this is likely to depend on the precise use of the active equipment in question.

Exchange buildings and cabinets

118. Exchange buildings and cabinets house active equipment and other electronic components that are used to provide voice and data services. Demand for control over exchange and cabinet space, therefore, arises from demand for the housing of active equipment and other electronic components. As noted above such services may be supplied by the FSE or the rest of Batelco. There may be active equipment that would only be used by either the FSE or the rest of Batelco, or there may be active equipment that is shared by both the FSE or the rest of Batelco. Furthermore, exchange buildings and cabinets may house a combination of active equipment that would be used only by either the FSE or the rest of Batelco, or it may house equipment shared by both.
119. For this reason, a decision regarding control of the exchange builds and cabinets needs to consider, amongst other things, the products and services that will be supplied by the FSE and the rest of Batelco, and the control of the active equipment as per the discussion above. In addition, such a decision needs to take into account the criteria listed in section 3.2.2, such as alignment with EoI. In this case, consideration might need to be given to

³⁰ Batelco bit stream service RO, Batelco. Available at http://batelco.com/pdf/ref/20120531_sch_1-2-12_service_description_bitstream.pdf

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FSE treatment of OLOs vis-à-vis the BRE, and ensuring that the FSE supplies products and services on the same price and non-price terms.

International landing stations and international cable

120. International landing stations share many of the features described above in relation to exchange buildings as well as providing connectivity to international cable systems. As such, demand for control over the international landing stations arises from demand for the housing of active equipment and other electronic components required by services that may be supplied by the FSE or the rest of Batelco.
121. The Authority is currently conducting a separate review of the international connectivity supply chain. The outcomes of this review may inform the Authority's future position with respect to the treatment of international landing stations and international cable. However, the review is yet to be completed at the time of writing of this report.
122. Irrespective of the conclusion of this study, and given the strategic importance of international connectivity for operators, the Authority highlights that the FSE will be required to provide transmission connectivity to landing stations should they be controlled by either the FSE or the rest of Batelco, or any other party's landing station, at the request of downstream operators. This will allow OLOs to source international connectivity.

Land and Buildings

123. Land and buildings comprise all properties and land currently owned by Batelco other than exchange buildings and international landing stations discussed separately above. Following separation, the FSE may require separate access controlled accommodation from the rest of Batelco, for example for its offices. There are in general a range of separation options that can be considered depending of the characteristics and use of specific land and buildings. For example, some properties could be retained by the rest of Batelco with the FSE leasing out space, whilst others may be transferred to the FSE.
124. It is anticipated that specific decisions will be taken on a case-by-case-basis. However, the FSE would only be allowed to control the minimum amount of land and buildings essential for it to fulfil its functions under NTP4, deliver its products and services, and to enable the sustainability of its business case. In summary, no excessive land or buildings would be transferred in the interest of efficiency.
125. For instance, corporate offices used to provide retail services only could remain with the rest of Batelco, whilst offices used to deliver FSE products and services would be part of the FSE.

3.3 Other Assets

126. The Authority has identified a number of further Batelco assets, which are highlighted briefly for completeness. Such assets comprise for instance:

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- a. Mobile related assets such as mobile base stations, mobile towers, switches and routers.³¹
 - b. Assets related to Batelco's retail service offerings such as IP Television or Very Small Aperture Terminal ("VSAT").
 - c. Microwave links, radio towers (other than for mobile) and earth stations.
 - d. Other assets such as office equipment, vehicles, software and intangible assets except where these relate directly to FSE staff.
127. Batelco may propose if some of these assets should be controlled by the FSE, giving reasons and evidence. The Authority will review Batelco's proposal against the criteria set out in Section 3.2.2.
128. Where, in specific cases, some assets may require use or access by the FSE or BRE, the Authority will consider potential options proposed by Batelco for the separation of control.
129. In addition to assets currently owned and controlled by Batelco, there are a number of other network assets which will be considered at a future point in time. For example, there may be a limited amount of relevant network infrastructure owned by third parties, such as OLOs and other non-licensed entities. Other third parties, such as housing developers, may have deployed relatively small-scale fibre networks in some instances.
130. The Authority considers such assets outside the scope of the report. The treatment of these assets as part of this Framework will be considered at a future point in time.

The Authority's position:

131. Batelco will be required to propose whether and if so, how it will transfer control of deployment, operation and maintenance of the following assets to the FSE as part of its asset allocation plan:

- a. Fibre cable
- b. Copper wire
- c. Duct and poles
- d. Active equipment
- e. Exchange buildings and cabinets
- f. International landing stations and international cable
- g. Office accommodation
- h. Other assets

132. Batelco will be required to provide evidence to support its proposals with respect to the criteria set out in the following section 3.2.2 and the preceding discussion. The Authority will review and approve Batelco's proposals in accordance with these criteria.

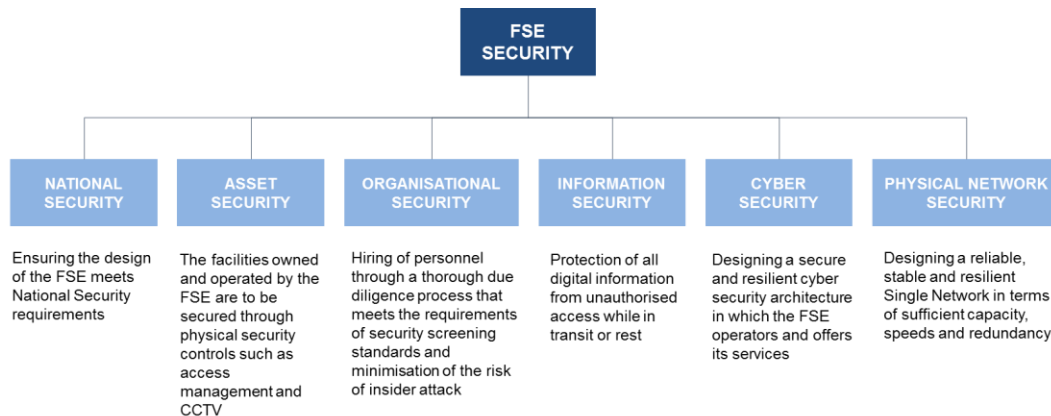
³¹ This excludes cables and ducts used as backhaul to mobile radio sites.

4 FSE and Single Network Security

4.1 Introduction

133. The Telecommunications Law sets out obligations for all license holders with regard to national security, noting that, “*every Licensed Operator shall undertake to provide, at its own expense, all technical resources, including Telecommunications Equipment, systems and programs relating to the Telecommunications Network that it is licensed to operate and which allow security organs to have access to the network for fulfilling the requirements of national security, provided that the provision of the service shall continue whilst the required technical resources are provided, giving regard to technical development and in accordance with the provisions of the regulations and decisions issued by the Authority.*”³²
134. The Authority has identified six areas that are addressed as part of this report with regard to the FSE’s security obligations, these are set out in the figure below. This section presents a high level discussion around these aspects of security without going into details around implementation. Further detail will be part of future work to be undertaken by the Authority and Batelco.

Figure 14: Components of security



Source: the Authority

135. In providing an end-to-end security solution, the Authority expects that the FSE considers the above security areas across all layers as relevant including the infrastructure layer, service layer and applications layer. Each of these security areas and international recommendations with respect to security measures are discussed in the remainder of this section.

³² Telecommunications Law (Article 78).

4.2 National security

136. The establishment of the Single Network presents a number of security-related considerations in relation to these obligations. It is the Authority's view that maintaining the security of assets controlled by the FSE as part of the Single Network is a critical priority and consequently the FSE will be obligated to ensure that the Single Network is secure and meets national security requirements. The Authority considers two existing regulations in this regard:

- a. Lawful Access regulation.
- b. Internet Safety regulation.

137. In addition to compliance with National Security requirements, the Authority expects security measures proposed by the FSE to meet international standards prescribed by organisations such as the International Telecommunications Union ("ITU") Recommendation X.805³³ and International Organisation for Standardisation ("ISO")/International Electrotechnical Commission ("IEC"). These requirements are further discussed below.

4.3 Asset Security

138. Ensuring the integrity of assets that underpin the Single Network is a key security requirement. To achieve this, standards of security that prevent access to unauthorised personnel and that protect these facilities from damage are required. This includes the safeguarding of all local telephone exchange buildings, cabinets and equivalent facilities used to house equipment required for the provision of voice and data services, including items required to support the operation of the network such as cooling, power and building services equipment.

139. To address the need to ensure the asset security of the Single Network and its supporting utilities, the Authority anticipates that the FSE's security measures should encompass both prevention of unauthorised access through the installation of security perimeters and entry controls, and protection against environmental threats including fire, floods and other forms of disaster that may affect the facilities.³⁴ Moreover, access should be monitored and logged to detect any anomalous behaviour.

140. Furthermore, in the provision of wholesale products the FSE may be required to grant access to facilities under its control to other licensed retail operators where these facilities house access service nodes which has the potential to introduce a point of weakness in the FSE's physical security. The Authority recognises that these facilities are likely to incorporate a number of existing security measures designed to mitigate third party risk as part of Batelco's Service Node Facilities Management product,³⁵ which may present a

³³ International Telecommunications Union (2003). 'Security architecture for systems providing end-to-end communications'

³⁴ Whilst the Authority required the FSE to undertake its own assessment of the types of physical security controls to be installed, examples could be ensuring cabinets and manholes can sustain reasonable forms of physical security threats (e.g. natural disasters or vandalism).

³⁵ <http://batelco.com/reference/20161017-sch-1-2-15.2-service-node-facilities-management-service.pdf>.

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natural starting point to build upon in the development of the FSE's physical security architecture.

141. The Authority further anticipates that compliance with these security standards will form part of any agreement made between the FSE and downstream operators that grants access to FSE facilities.
142. Finally, to prevent the emergence of new points of weakness within the FSE's facilities, best practice recommends the ongoing identification of areas of maintenance necessary to uphold the physical integrity of these assets.³⁶

4.4 Information Security

143. The FSE will be required to comply with the Critical Telecommunications Infrastructure ("CTI") risk management regulation. The CTI regulation defines critical telecommunications infrastructure as:
 - a. "Any telecommunications Infrastructure which is essential for the maintenance of vital societal functions related to health, safety, national security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact"; and
 - b. "Any centralised system that stores and process Personal Data."
144. This includes all aspects of infrastructure including "the basic physical and organizational systems and facilities (e.g. buildings, network equipment, power supplies, people and processes) needed for the operation of a Public Telecommunications Network."
145. Information, like other assets, is an essential contributor to an organisation's business. Information can be stored and transmitted in a number of ways including electronically, printed, displayed on film, or spoken in conversation. Regardless of the form or functionality of the information, or the means by which the information is shared or stored, information should always be appropriately protected. Organisations whose facilities are used by subscribers to process information that may include personal information, confidential data and sensitive business data, need to ensure an appropriate level of protection to prevent compromise of the information, i.e., they need to establish an effective information security management system ("ISMS").
146. The FSE will be responsible for safeguarding a substantial amount of information, encompassing not only data transmitted over the network but also data relating to the Single Network architecture. The Authority requires the FSE to ensure that all data in transit, accessed or stored across the Single Network or within the FSE systems is secure, and the dissemination of such data is to be restricted to authorised agencies in specific circumstances. This may be achieved through the implementation of appropriate encryption standards and data distribution protocols.
147. The Authority notes that the established first step risk in assessment frameworks, including the ISO 27005, is risk identification including the identification of vulnerabilities. In undertaking its risk assessment of information security the FSE may seek to first identify

³⁶ Interagency Security Committee (2015). 'Best practices for planning and managing physical security resources: an interagency security committee Guide.'

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the potential points of entry which includes entry to its physical premises and systems. Given the prior level of integration between Batelco's wholesale and retail divisions, the Authority anticipates that there may be an elevated risk of information security breach from BRE as prior to separation it is likely that Batelco was sharing certain types of information across the two business units.

4.5 Organisational Security

148. In addition to protecting the Single Network from outside attacks, the FSE should remain alert to insider risk, defined as a situation where a current or former employee, contractor or other individual with authorised access to the FSE's systems intentionally misuses this access to affect the integrity of the FSE. As these individuals are likely to be familiar with the FSE's security structure, they are able to leverage this information to avoid detection and maximise the likelihood of a successful attack. Compounded with the fact that they often have authorised access to FSE systems, insider attacks have the potential to result in greater disruption than external attacks.³⁷
149. To address the risk of insider attack, the FSE will need to ensure that appropriate measures are in place both during the hiring phase when introducing new employees, contractors and consultants to the FSE, and as part of its ongoing organisational security process to ensure that employees that originally had no malicious intent are not recruited by those wishing to do harm to the FSE and the Single Network. It will also be important to consider regular awareness trainings and adequate levels of capacity building within the FSE.
150. In developing its organisational security framework, the FSE may benefit from the use of a security maturity model such as the personnel security maturity model developed by the UK's Centre for the Protection of National Infrastructure ("CPNI") for the specific purpose of reducing the risk of insider attack. This model is set out in Figure 15 below.

³⁷ In the CyberSecurity Watch 2012 survey, 51% of respondents stated that damage caused by insider attacks were more damaging than outsider attacks [Source: CERT(2012), '2012 CyberSecurity Watch Survey. How bad is the insider threat?']

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Figure 15: CPNI Personnel Security Maturity Model



Source: CPNI

151. In addition to being cognisant of its own insider risk, if the FSE is required to grant access to its facilities to third parties it may face insider risk where third parties have not undertaken the appropriate level of due diligence relating to individuals which are then granted access to FSE facilities. To address this issue the FSE may choose to extend security compliance requirements set out in FSE facility access agreements to the need for third parties to demonstrate that appropriate organisational security measures have been taken.

4.6 Cyber Security

152. In its latest Global Risks Report the World Economic Forum identified large scale cyberattacks within the top 10 risks most likely to occur in the next 10 years.³⁸ Furthermore, in light of growing cyber reliance from digitisation, cyber-attacks are becoming increasingly widespread, sophisticated, and damaging, leading to significant disruption for users, service providers and operators alike.

153. As the sole operator of the Single Network, the FSE will be responsible for the safeguarding of a significant proportion of the Kingdom's telecommunications infrastructure which could potentially be a target for cyber-attacks. Furthermore, in the provision of active wholesale products the FSE will be responsible for large amounts of sensitive data that must be guarded from cyber-attacks.

154. To address these risks the Authority requires that the FSE implements necessary security controls to mitigate these risks, including the establishment of a secure and resilient cyber security architecture in which the FSE operates and offers its services. This cyber security architecture should reflect the current and anticipated cyber-attack environment,

³⁸ World Economic Forum (2017). 'The Global Risks Report 2017. 12th Edition'.

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identifying trends in attack data to proactively detect areas of prioritisation. Furthermore, the FSE is expected to have necessary controls in place to detect and respond to cyber incidents in a timely and effective manner. For example, current data shows that DDoS attacks are rapidly increasing in size, scale, complexity and frequency³⁹ and consequently the FSE will likely look to prioritise the protection of the network from this method of attack.

155. Furthermore, in accordance with regulation, the FSE is expected to be a key stakeholder in cyber threat intelligence sharing within the telecom sector and to disseminate such information to other key stakeholders, such as Security Organs and law enforcement agencies and any other key stakeholder, as determined by the Authority.

4.7 Physical Network Security

156. In addition to the incorporation of security measures within the FSE's security architecture which aims to minimise the occurrence of any security breaches, both cyber and physical, the Authority recognises that there will be cases where the such breaches cannot be entirely mitigated. Security agencies have identified a number of scenarios where this may be the case, which include abnormal but legitimate traffic load in response to an event, accidents and human mistakes, large-scale disasters, failure at lower layers, and malicious attacks⁴⁰.
157. Consequently, the Authority views it as prudent for the FSE to ensure the physical network security of the Single Network by developing and deploying a network with sufficient speeds, resilience and redundancy, ensuring that the network remains operational even in the event of disruptions that impact normal operation.
158. There is an existing body of guidance in relation to ensuring the end-to-end physical network security and resilience available to the FSE. One example could be the European Network and Information Security Agency (ENISA) guide to enabling and managing end-to-end resilience.

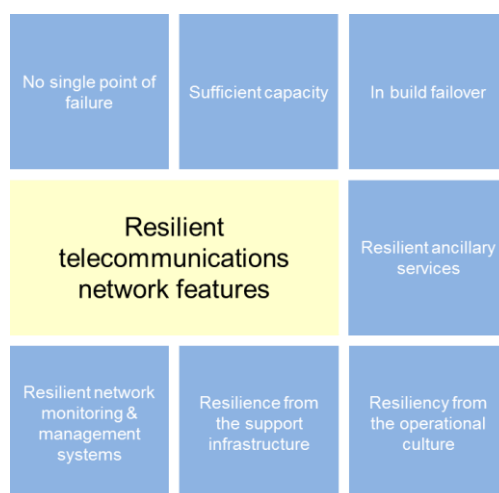
³⁹ Arbor Networks (2016). 'Worldwide infrastructure security report.'

⁴⁰ European Network and Information Security Agency (2011). 'Enabling and managing end-to-end resilience'

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Figure 16: ENISA Features of a resilient telecommunications network



Source: the Authority

159. This study identifies the following features as necessary to ensure a resilient network:⁴¹

- a. **No single point of failure.** Given that the Single Network will be made up of a number of components, including active and passive equipment and the underlying physical infrastructure, its design and deployment must take into account the resilience of each of these components to ensure that there is no single point of failure that jeopardises the resilience of the wider network. Given the Single Network will be the exclusive fixed telecommunications network in Bahrain, there would be a higher risk of a single point of failure, which should be taken into account by the FSE.
- b. **In built failover.** Where events occur which compromise the operation of a certain portion of the network, in built failover allows this failure to automatically result in a changeover to a standby working element. This requires both ensuring that there is sufficient redundancy in the system, for example through its ring topology, and implementing these automated procedures. In this way, load-sharing ensures that the failure of a single element or group of elements does not prevent the operation of the network as a whole.
- c. **Sufficient capacity.** The Single Network must be designed in such a way that all network components and interconnection links have capacity not only for the known peak activity but also a sufficient degree of headroom in the event of unanticipated peaks of traffic above the norm.
- d. **Resilient ancillary services.** The network components within the Single Network shall be supported by ancillary services such as DNS servers that are required to allow the transmission of network traffic. These ancillary services should be designed with the same degree of resilience as the network components to ensure that the network is able to operate.
- e. **Resilient network monitoring and management systems.** As discussed in Section 5, the FSE will require a suite of network management systems and a

⁴¹ Ibid.

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NOC that allows it to monitor the status of the network. The resilience of these support systems are closely tied to the operation of the network as if they fail the FSE shall be limited in the degree by which they can assure the operation of the Single Network. Consequently, the resilience of these systems plays a role in the resilience of the network as a whole.

- f. **Resilience from the support infrastructure.** As is the case with network management systems, the Single Network will rely on a number of support infrastructures. This includes FSE staff such as field engineers who deploy, maintain and repair the single network and call centre staff who handle faults reported by downstream operators, conveying these to the relevant staff and systems for diagnosis and resolution. It also relates to the underlying utilities required to operate the network including cooling systems, power supply and the security systems required to protect the Single Network from physical or cyber-attack as discussed earlier in this section. The importance of this supporting infrastructure means that they too will be required to be resilient to assure the physical network security of the network as a whole.
- g. **Resilience from an operational culture.** In addition to the technological and operational processes described above, embedding the importance of resilience in the operational culture of the FSE can offer meaningful benefits in ensuring the ongoing importance of physical network security. Through establishing policies and procedures that emphasise compliance, continuity and recovery, and scalability, this is likely to promote the consideration of physical network security in the FSE's decision making process.

160. The Authority expects the FSE to incorporate the considerations set out above as part of its proposed security architecture thereby ensuring the physical network security of the Single Network.

The Authority's position:

161. The FSE will be expected to take into account and accord with relevant industry standards and regulations in designing the security of the Single Network, the FSE Product and Service Set and its organisation by specifically considering:

- a. National security
- b. Asset security
- c. Information security
- d. Cyber security
- e. Organisational security
- f. Physical security

162. Batelco will be requested to propose how it will address the above aspects of the security of the FSE and the Single Network, which the Authority will then review.

5 FSE Systems and Processes

163. In addition to the physical assets that make up the network, telecommunications operators require a suite of support systems to maintain and deliver wholesale products over this network. The requirements of these support systems are determined by the individual needs of the operator which in the case of the FSE are:

- a. Delivery of the FSE Product and Service Set.
- b. Management, operation, design and deployment of the Single Network.
- c. Meeting the FSE's security obligations.

164. This section addresses these areas at a high level by identifying the scope of the systems and processes under consideration. Control of information contained in the FSE Systems and Processes is also discussed, as having clear controls in place is crucial, not only to meet the FSE's security obligations, but also to promote service-based competition. That is, the FSE will have access to commercially sensitive information provided to it by OLOs and the BRE, which are competitors in retail markets. If an OLO or the BRE's confidential information were to become available to one of its competitors, then this could place the OLO or BRE at a competitive disadvantage and thereby reduce the level of service-based competition. Furthermore, this section addresses at a high level the process of transitioning from Batelco's present integrated systems and processes to the functionally separated systems and processes.

165. Detailed implementation requirements for specific systems, including timelines and separation obligations, are not discussed in this report, but will be covered in future work by the Authority and Batelco. The Authority will specify requirements as part of its Separation Guidelines and Batelco is expected to provide undertakings to adhere to.⁴²

5.1 Scope of Systems and Processes

166. The importance of IT systems to telecommunications operators has long been recognised, required not only to facilitate business operations such as billing and order fulfilment, but also to manage the network itself. Furthermore, in the face of current technology trends which are anticipated to result in significant growth in data demand and greater user sophistication, both of which will place greater demands on the FSE's systems, it is the Authority's view that securing IT systems that are fit for purpose should be a priority of the FSE.

167. The FSE's systems can be broadly categorised into three varieties which together make up the wider IT systems architecture required to support the FSE:

- a. **Business support systems ("BSS")**. Systems required for the FSE to fulfil business operations relating to its customers and includes wholesale billing, order management, fault notification, and customer relationship management functions.

⁴² The Authority anticipates that such implementation plans would be part of Batelco's separation Undertakings.

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- b. **Operational support systems (“OSS”)**. Systems required to support the functionality of the network and includes network management systems, order fulfilment and provisioning, and service activation.
 - c. **Management information systems (“MIS”)**. Systems used for enterprise planning and business intelligence systems required for the formation of strategic decisions and development of investment proposals for the expansion of the Single Network.
168. The Authority anticipates that each of these individual OSS, BSS and MIS should be developed in such a way that ensures they are able to meet the demands of the current telecommunications sector. Moreover, they should lend themselves to future development in preparation of anticipated trends which could include the expansion of the NBN and associated increase in bandwidth demand to ensure that the network is “future proof”.
169. Furthermore, in addition to ensuring each individual system is fit for purpose in relation to its individual function, recent developments within the sector have identified a need for centralised data management systems that offer a holistic view across these systems in the interest of establishing a robust and efficient foundation for business operations⁴³. This demand has arisen from the fact that data held on individual support systems has traditionally been maintained within separate databases and is not integrated to produce a holistic end-to-end view.
170. It is the Authority’s view that the FSE is likely to benefit from the use of such centralised data systems to ensure that information held on its OSS, BSS and MIS systems do not sit within separate data silos but instead can be collated to provide a unified view for the purposes of management and streamlining FSE processes. The delivery and management of this process is typically undertaken through the establishment of operation centres which sit across the individual OSS, BSS and MIS, and each of which collates relevant data across these systems to meet a specific objective e.g. network management. The Authority has identified the following operation centres that it recommends are included as part of the FSE’s systems:
- a. Network operations centre (“NOC”);
 - b. Security operations centre;
 - c. Service operations centre
171. The use of **NOC** is an established practice in the telecommunications industry as well as other sectors that are responsible for the management of a network, such as transport and defence. The NOC is responsible for collating and coordinating data produced by the FSE’s network management systems (these fall within OSS), establishing a single platform to monitor, operate and troubleshoot the network. Consequently, the NOC is required to maintain the network in the face of service disruption and additionally to provide relevant information with regards to the coverage of the Single Network. The latter of these two functions is useful not only for network planning but may also be required by the FSE as part of the Single Network coverage and copper migration monitoring.

⁴³ Strategy&, PwC (2013). ‘IT and network integration in telecom companies. Creating efficiency and customer satisfaction.’

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172. The **security operations centre** is a centralised facility responsible for the FSE's security, ensuring that it is able to meet its security obligations established in section 4. Through utilising the data within the NOC and associated OSS systems, the security operations centre is able to undertake ongoing monitoring on a real-time basis to detect, analyse and resolve security threats. Furthermore, through combining data from the NOC with the FSE's BSS, the security operations centre is able to pre-empt security breaches, identify potential points of weakness in the FSE's network and areas of prioritisation for security, in addition to deriving business intelligence from user behaviours to prioritise development of future security processes.⁴⁴
173. One example of where this can lead to a more proactive security approach is the collation of data held by the NOC and BSS to identify areas of security prioritisation. Through combining security held by the FSE's order management systems with data in the NOC, the security operations centre will be able to identify areas of the network with higher anticipated activity and therefore pose the greatest risk of disruption in the event of a security attack. Once identified, these areas can be prioritised for further security measures thus increasing the resilience of the network.
174. In comparison to the NOC and security operations centre, both of which are well established, the need for a **service operations centre** is a more recent development arising from a shift in focus to ensuring service quality. Traditionally the NOC has been more technically focused, tasked with overseeing the performance of the network and monitoring network elements rather than quantifying the downstream impact on customers. Consequently, there has been limited integration of network information and customer and business context to date, resulting in an overall service quality 'blind spot'⁴⁵. Recently, the telecommunications industry has addressed this through the establishment of the service operations centre, which combines data from BSS customer operations, the NOC and associated OSS systems to present a service orientated view of the network and undertake real-time monitoring of end-to-end service quality.
175. It is the Authority's view that ensuring service quality is of particular importance in relation to the FSE as it is the only supplier of fibre based wholesale products and services. As such, licensed retail operators are dependent on the FSE to provide consistent quality services in order to serve their own retail customers. Furthermore, the establishment of a service operations centre will allow the FSE to continually monitor whether it is meeting its quality of service obligations, both those defined in its SLAs with retail operators and those set out in any QoS monitoring regime to be established by the Authority, including the QoS regulation and RO.

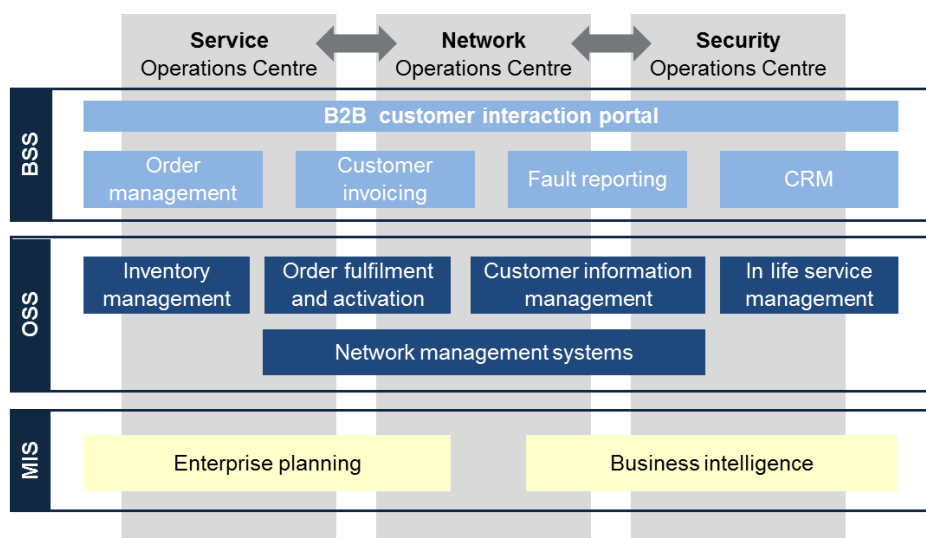
⁴⁴ National Cyber Security Centre, UK (2016). Available at <https://www.ncsc.gov.uk/guidance/security-operations-centre-soc-buyers-guide>

⁴⁵ Analysis Mason (2014). 'Service Operations Centre: enabling differentiation based on superior customer experience.'

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Figure 17: Illustrative representation of the FSE's systems



Source: the Authority

176. In addition to ensuring that the FSE's systems are fit for purpose, the Authority anticipates that when designing these systems Batelco should take into consideration the efficiency implications associated with each potential option.
177. The Authority notes that technological developments have introduced new options for the resourcing of the FSE's systems including options for cloud computing and virtualization. When technically feasible these options may offer efficiency gains, reducing capital expenditure through increased hardware and server utilisation, and reducing associated operating expenditure such as cooling.⁴⁶

5.2 FSE Systems and Processes Informational Equivalence and Control

178. In addition to considerations for the efficiency and suitability of its systems, the FSE must also ensure that its systems are consistent with the EoI and EoO requirements set out in Section 8 in particular informational equivalence and order processing. Furthermore, the Authority also requires the FSE to implement necessary controls to protect any confidential information from being disclosed to an unauthorized entity such as the other OLOs.
179. Given that the key motivation for EoI and EoO is to prevent discrimination against the OLOs, a key determinant of an acceptable level of systems separation is the potential impact on OLOs should a data breach occur. Where data leakage from a FSE system to BRE would afford it a material advantage over the OLOs, this could pose a significant threat to the level service-based competition.
180. Informational equivalence and control requires in summary that that OLOs and BRE have access to the same information from the FSE at the same time, but the FSE shall not disclose customer confidential information obtained from one downstream operator with any other without express permission by the entity that provided this information.

⁴⁶ Intel (2014). 'Realising the benefits of network functions virtualisation in telecoms networks.'

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Equivalence in order processing requires that all downstream operators, including BRE follow the same process and systems to order a FSE product or report a fault.

181. These informational equivalence and control requirements are particularly relevant to the dissemination of information from the FSE to BRE. Given that Batelco has to date been vertically integrated across its retail and wholesale business, it is likely that the systems serving these divisions are also integrated and hence its retail division is currently able to access data held by the wholesale division.
182. Consequently, the Authority expects Batelco to ensure that the FSE's systems are separated from the rest of Batelco in such a way that prevents the disclosure of information to BRE where this information is not also accessible by the OLOs on the same terms or where this information is customer confidential. At the same time, all wholesale orders or requests should be delivered equivalently across all ordering systems.
183. In line with international precedence, three levels of separation are defined:⁴⁷
- a. **Level 1 separation: User access controls.** Whilst both the FSE and the rest of Batelco would continue to share the same applications, BRE employees would be restricted from accessing functions and data relating to the FSE through user access controls.
 - b. **Level 2 separation: Application and data separation.** Under this level of separation, the FSE and the rest of Batelco will have separate applications and data, and will have access only to its own. This level of separation requires the migration of existing data to separate applications of the FSE thereby providing functionality to the FSE and preventing access by BRE.
 - c. **Level 3 separation: Physical/Logical separation.** In addition to application and data separation, physical separation requires the applications and data of the FSE and the rest of Batelco to run on physically separate hardware and support systems. In cases where the two entities co-locate their applications in the same virtualized environment or on the same cloud (i.e. relying on the same physical hardware), logical separation can be established to meet the same standards as physical separation.
184. All three levels of systems separation are theoretically able to satisfy informational equivalence by implementing measures to prevent BRE from accessing FSE applications and data through the establishment of user controls, logical separation, or physical separation. However, a greater level of systems separation that allows a higher level of control and therefore it becomes harder to breach these solutions. Consequently, each level of separation presents a trade-off between the risk of such a breach and the cost of implementation. Each level of separation presents a step change in assuring informational equivalence and control but at the same time increases the implementation costs for the FSE and the rest of Batelco.
185. Level 1 separation places the smallest burden on the FSE as although it requires the FSE to identify a level of access for each role within Batelco, establish user profiles, and undertake data tagging, it does not require the establishment of separate applications for the FSE either through the development of new systems or cloning of existing systems.

⁴⁷ Ofcom (2006). 'BT MIS Separation'. Retrieved from:
https://www.ofcom.org.uk/data/assets/pdf_file/0014/33314/statement.pdf.

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Consequently, this level of separation offers the greatest scope for a breach or informational equivalence and control as BRE employees are able to access confidential FSE data through the use of a FSE user profile with relevant data permissions. Given the risk of a breach of informational equivalence and control requirements, this level of separation is often accompanied by the requirement of external audits to ensure that access controls and access management protocols in place are of sufficient rigor.

186. In comparison, level 2 separation requires the FSE and the rest of Batelco to have separate instances of applications, thus requiring either systems cloning or new systems development for the FSE and the migration of data. Once this data is migrated, BRE employees should be unable to access FSE data and applications without accessing FSE hardware, thereby significantly reducing the risk of a breach or informational equivalence and control requirements. However, the additional complexity of establishing separate application and data migration results in both higher resource costs and a risk of disruption to Batelco and hence downstream customers.
187. Finally, level 3 results in complete physical separation, requiring the FSE and the rest of Batelco to use separate hardware, operating systems and physical support such as maintenance contracts. Although this may lead to greater costs due to duplication of hardware cost, it has the lowest risk of breach of informational equivalence and control requirements. In addition, it offers the additional benefits of contributing to a more independent organisational culture and placing BRE and OLOs on the same playing field with respect to interaction with FSE systems.
188. Furthermore, in case where such information is stored over a virtualized environment or a cloud hosted by a third party, the FSE shall ensure that necessary information security checks are put in place that prevent unauthorized disclosure of such information.
189. It is the Authority's view that the final state of all FSE systems should be physical/logical separation (level 3 separation) from those used by BRE in the interests of informational equivalence and control as well as the independence of the FSE. If systems rely on cloud, any logical separation should meet the same standards as physically separated systems.
190. Batelco will be required to show how its proposed systems separation plan meets informational equivalence and control requirements. The Authority will review Batelco's proposals.
191. Batelco will be required to propose a systems separation plan as well as a roadmap for how it is to achieve the requirements for long term systems separation set out in Section 5.2 above, and comply with informational equivalence and control requirements.
192. Irrespective of the final proposed solution for the FSE's systems, the Authority expects Batelco to take efficiency consideration into account when determining the final design of the FSE systems. This would specifically relate to aspects of systems separation, comprising:
 - a. The efficiency of systems separation.
 - b. The transitional systems separation arrangements.
193. The Authority will assess which costs associated with systems separation are considered recoverable through regulated charges (as part of the RO price resetting process). Moreover, ongoing compliance with the key high-level requirements will be monitored by the Authority as part of its separation monitoring activities.

5.3 Transitional Arrangements

194. During the transitional period, as Batelco moves to become functionally separated, full EoI for relevant products and services may not be practicable. As such, EoO could be adapted for NBN-based wholesale products and services during this period. Any non-NBN-based wholesale products and services could also be based on the principle of EoO. Therefore, as long as non-discrimination standards are met at all time, products and services could be delivered using different systems and processes for downstream operators during the transitional period.

5.3.1 Efficiency of systems separation

195. As stated above, the FSE should bear efficiency considerations in mind in relation to the design of its systems. Such efficiency considerations are a key input in the decision around the method of separating the FSE's systems. For example, the FSE may have the choice between 'system cloning' and 'new system build'. In some instances it may be more efficient to achieve the EoI requirements by cloning systems rather than building new systems and vice versa.

196. System cloning refers to the duplication of existing systems within Batelco for the use of the FSE whereas new system build requires the bottom up development of new systems designed specifically for use of the FSE alone.

197. Although system cloning offers a short-term advantage, avoiding the need to retrain FSE employees in the use of systems already well established within Batelco, it may be an inefficient use of resources. A number of Batelco's systems may have been built on the premise of a vertically integrated operator and are therefore not necessarily fit for purpose under the model of a separated FSE.

198. Furthermore, it may be the case as is common in the industry that a number of legacy wholesale systems currently in use are no longer fit for purpose and already require replacement. Consequently, the duplication of these systems for use by the FSE may be inefficient and potentially technically infeasible.

199. In comparison, although development of purpose built systems may require greater resources in terms of time and money, their bespoke nature may ensure that the FSE is equipped with systems that are fit for purpose and therefore may be the more efficient option.

5.3.2 Transitional systems separation arrangements

200. Although the long term objectives for the FSE's systems may be level 3-type separation, the Authority acknowledges that the achievement of physical/logical separation may require significant resources, both in terms of time and cost. In other separations internationally, systems separation with regards to EoI have experienced relatively long

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implementation times.⁴⁸ During the transitional period the FSE will not be required to offer products on an Eol basis and as such will not be required to establish level 3 –type separation. The Authority will therefore require the FSE to propose a systems separation plan, including key milestones as part of its Undertakings. The Authority will review Batelco's systems separation plan and proposed Undertakings.

201. As part of the systems separation plan, Batelco will need to demonstrate a timeline for achieving Eol and meeting the informational equivalence and control requirements for the relevant products and services over the course of the transitional period. At the end of the transitional period, NBN-based wholesale products and services would be supplied on an Eol basis and as such, the systems separation plan will need to consider this requirement. The Authority's specific requirements will be set out as part of the Separation Guidelines.
202. As such, the Authority will consider implementation of transitional arrangements in line with EoO, whilst Batelco prepares the necessary steps to migrate to level 3 separation. For the avoidance of doubt, during the transitional period, level 1 systems separation is the minimum degree of separation acceptable.
203. These transitional arrangements, both in terms of the level of transitional separation and the duration at which it remains at this lower degree of separation, will likely vary across individual systems and applications, and are dictated by:
 - a. The scope for discrimination in the event of data leakage.
 - b. Incremental cost and efficiency.
 - c. Requirements of information security.
 - d. The need to move from EoO in the transitional period to Eol.

The scope for discrimination should data leakage occur

204. Given that the key motivation for Eol is to prevent discrimination against the OLOs, a key determinant of the acceptable level of systems separation during this transition period should be the potential impact on the OLOs should a data breach occur. Where data leakage from a FSE system to BRE would afford it a material advantage over the OLOs, this system should be subject to stronger transitional arrangements than systems which do not pose a significant threat for discrimination.
205. For example, access by the rest of Batelco to the FSE's MIS systems relating to marketing is likely to confer a significantly lower advantage to BRE over the OLOs than a breach of the FSE's order management systems which would allow BRE access to information relating to orders placed by its competitors and consequently deduce and pre-empt the strategy of its competitors. Accordingly, it may be acceptable for the FSE's marketing MIS systems to remain at level 1 separation prior to migrating to level 3 whereas the FSE's order management systems may face more rigorous transitional arrangements such as requirements to move from level 1 separation to level 2 separation as soon as practicable before finally transitioning to level 3.

⁴⁸ For instance, the migration to full Eol compliant systems for the LLU service in New Zealand have been planned to take three years to implement.

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Incremental costs and efficiency

206. In accordance with the Purpose Statement which identifies efficiency as a key principle of the Framework, this will play a role in determining whether a system may remain at level 1 separation for a longer period of time before transferring to level 3-type separation.
207. The Authority anticipates that efficiency considerations with regard to remaining at level 2 separation will relate primarily to Batelco's existing maintenance contracts with providers. As level 3-type separation requires the rest of Batelco and the FSE to have separate hardware, supporting services, and maintenance contracts when transitioning to level 3 separation, Batelco may be required to establish new contracts in relation to these services for FSE systems. Where this does not coincide with the renewal of existing contracts that support these systems, this is likely to be inefficient, particularly in light of the fact that level 2 separation is considered already to significantly reduce the potential for EoI breach. As such, it may be justifiable for certain FSE systems to support level 2 separation until these contracts come up for renewal at which point they should transition to level 3-type separation, even where this may delay the transition by a small degree.
208. Where Batelco proposes that certain FSE systems are to remain at level 2 separation beyond the point where it is technically feasible to transition to level 3-type separation on the grounds of efficiency, the Authority anticipates that it will be required to present corroborating evidence for this conclusion.

Requirements of information security

209. The FSE has an obligation to security (further discussed in Section 4 and Section 8) which includes the responsibility to prevent unauthorised access to FSE systems. Given that the degree of separation directly impacts the ease of unauthorised access by BRE to FSE systems, it may be the case that in the interests of information security, a greater degree of systems separation will be required during the transition period, particularly in relation to systems housing more sensitive data.
210. The above notwithstanding, as level 3 separation requires physical/logical separation and will therefore require the FSE to have separate security contracts and physical hardware that may be relocated to separate storage facilities, the FSE will need to ensure that new security arrangements meet the necessary requirements prior to this transition. Where there are delays in establishing that these security measures are sufficient, there may be a knock-on impact on the migration to level 3, with systems either remaining at level 2 separation, where this has been their transitional degree of separation, or transitioning first to level 2 separation, where its transitional degree of separation was level 1.
211. Where it is agreed that individual FSE systems may operate at a lower degree of separation during the transition phase, the Authority anticipates that a systems separation plan and roadmap will be established in due course to ensure that all systems achieve the final destination of level 3 separation. This may include milestones for the proportion of data migration completed and pilots of any new systems deployed. Compliance of the FSE

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will be monitored as part of the Authority's monitoring regime to be established following the issuance of this report.

Move from EoO to Eol

212. As the FSE progresses towards offering NBN-based wholesale products and services on an Eol basis, transitional arrangements could include requirements on EoO. EoO could be applied for NBN-based products during the transitional period prior to separation, which would be migrated onto Eol on separation. At the same time, other wholesale products and services could be delivered on an EoO-basis in the longer term.
213. During the transitional period, the FSE may be able to deliver EoO products using level 1 or level 2 separation. At the transitional period end, consideration may need to be given to additional implementation steps to ensure Eol for NBN-based wholesale products and services.

The Authority's position:

214. Batelco will be required to propose a level of separation for each of its systems during the transition phase and in the long-term on the basis of the following criteria:
- a. Security of customer confidential information
 - b. The scope for discrimination in the event of data leakage.
 - c. System and process cost and efficiency.
 - d. FSE's security obligations.
 - e. Transitioning from EoO to Eol.
215. The Authority will then review and approve Batelco's proposal on the basis that Batelco meets its security obligations, promotes service-based competition, and that it enables the sustainability of the FSE business case.

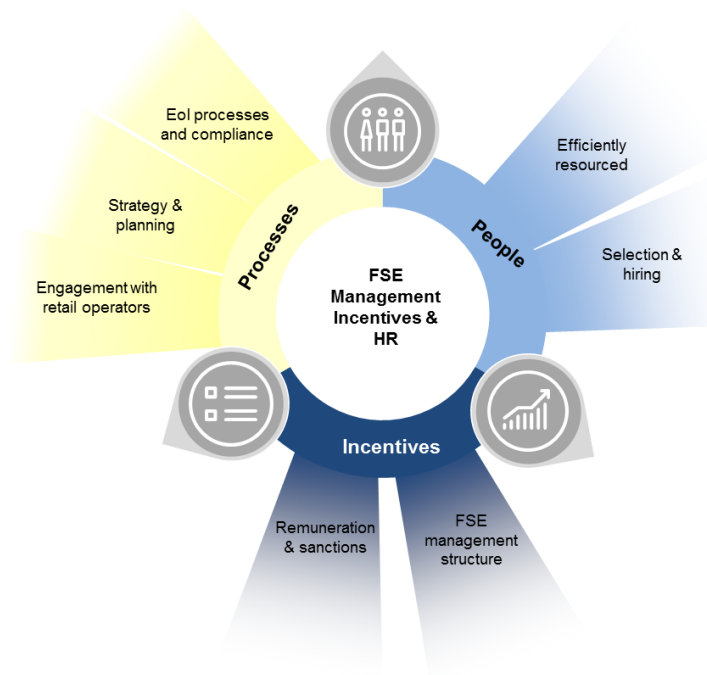
6 FSE Organisational Structure and Human Resources

216. The Authority's Purpose Statement establishes that the FSE is to be efficiently resourced and able to make decisions in its own commercial interest, independently of other licensed operators, including BRE.

217. In order to deliver its scope of business in accordance with these principles set out in the Purpose Statement, the FSE will have need for the right people, processes and incentives. In combination, these three elements make up the FSE's management incentives and human resources to ensure that the FSE:

- a. Is sufficiently and efficiently resourced;
- b. Incentivises decisions that are in the FSE's own commercial interest and independent of other licensed operators.

Figure 18: FSE HR and management incentives



Source: the Authority

218. This section sets out the high-level issues that the Authority will take into consideration when reviewing and approving Batelco's proposals regarding FSE human resources and organisation structure.

6.1 Independent and Efficient Resourcing the FSE

219. A first step in the establishment of any new business entity is the development of its resourcing strategy which will determine both its appropriate size and the way in which this capacity will be resourced. Furthermore, the Authority is of the view that a number of

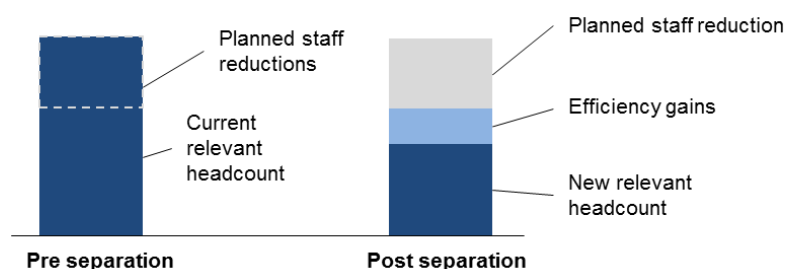
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current Batelco staff will be transferred to the FSE as part of its resourcing strategy, given their existing experience with Batelco's network and wholesale operations.

220. When determining its appropriate size, the FSE will need to balance the need for efficiency and effectiveness to reach a headcount that is both efficiently sized and sufficient to meet its scope of business as defined by its business case. This requires an understanding of the employee resource required to meet its proposed strategic and operational plans.
221. Batelco will be required to submit its proposal for resourcing the FSE, which the Authority will review and approve based on specific requirements set out in the Separation Guidelines. Batelco will be required to submit its proposals, which based on the Separation Guidelines, as part of its Undertakings.
222. A factor that the Authority will consider when reviewing Batelco's proposals will be redundancy costs, as it is of particular importance in this context. In particular, whilst the establishment of the FSE may bring some productive efficiency gains in relation to headcount, the Authority is of the view that any redundancy costs that are not due to efficiency gains would not be included in the FSE's cost base.
223. For example, any significant downsizing after staff are transferred to the FSE will only be considered if the FSE/Batelco can demonstrate that such downsizing is due to efficiency gains specific to the FSE post separation, and not part of staff reduction activities that would also have happened under an integrated structure. As illustrated in Figure 19, only redundancy costs of headcount reductions associated with efficiency gains (due to having a functionally separate FSE) will be considered. Redundancy costs associated with staff reduction programmes that would have occurred under an integrated structure will not be considered as part of the FSE's cost base.

Figure 19: Illustrative headcounts pre and post separation



Source: Authority

Redundancy costs related to planned headcount reductions (highlighted in grey) will not be considered.
Redundancy costs related to headcount reductions due to efficiency gains of having a separated FSE (highlighted in light blue) will be considered.

224. Once this process has been completed, the FSE will need to establish its selection and hiring process. In addition to the usual considerations around attracting candidates with the right skill set to allow the FSE to deliver its scope of business, the FSE may face additional considerations in light of its inception as part of a vertical separation. In the absence of structural separation, Batelco may have an incentive to resource the FSE in a way that is either inefficient or ill equipped to perform its necessary business operations if the FSE's recruitment process remains under its control. Consequently, the Authority will review FSE's proposals for addressing this point.

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The Authority's position:

225. Batelco will be required to submit its proposal for resourcing the FSE, which the Authority will review and approve based on specific requirements set out in the Separation Guidelines.

6.2 Independence of Management Incentives of the FSE

226. One of the defining motives of implementing vertical separation is a reduction in the incentive of the wholesale telecommunications operator to discriminate against OLOs.⁴⁹ Accordingly, the Authority has identified the FSE's management incentive structure, consisting of both remuneration and sanctions, to be a key dependency for ensuring that the FSE is incentivised to make decisions in its own commercial interest and that are independent of other licensed operators, the rest of Batelco included.
227. A key driver of these incentives is the degree of independence of FSE staff, especially its management, from the rest of Batelco. Greater independence incentivises non-discriminatory treatment of OLOs compared to BRE. Moreover, key strategic investment decisions are more likely driven by all stakeholders and are not excessively reliant of BRE requirements and demands. All of this could enable greater service-based competition, innovation and quality of service at more affordable prices for consumers.
228. Remuneration schemes have long been recognised as a tool to align incentives and where remuneration schemes do not incentivise the desired behaviour this can lead to negative outcomes. Where vertical separation has taken place within regulated industries, standard practice is to decouple remuneration of employees and management of the separated entity from the performance of Batelco. For example, following the functional separation of Telecom in New Zealand, all incentive remuneration for employees working for the wholesale access unit was required to "*reflect solely the objectives and performance of the NAS unit*" and "*will not compose any Telecom shares or incentives that are directly or indirectly linked to Telecom's overall performance*".⁵⁰ These restrictions are echoed in both the functional and legal separation of BT in the UK.
229. In the case of Batelco's separation, this may require the FSE to ensure remuneration for all employees and management is neither directly nor indirectly linked to the performance of Batelco. In the absence of such a requirement it is possible that instead of making decisions that are in the best interest of the FSE, managers could choose the option that is best for Batelco as a whole, including BRE, which may not be aligned with optimising the performance of the FSE.
230. In addition to remuneration, the Authority recognises that sanctions in the event of a breach of its obligations by employees of the FSE could provide another tool to ensure that the incentives are aligned with the commercial interests of the FSE. Such sanctions would not replace any sanctions imposed by the Authority on the FSE in the case of a

⁴⁹ Oxera (2009). 'Separating Incumbents: panacea or a sledgehammer to crack a nut?'

⁵⁰ Telecom (2008). 'Telecom separation Undertakings.'

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breach of any obligations. Nevertheless, the Authority may require the FSE to introduce a monitoring programme which will set out internal monitoring requirements for the FSE to oversee compliance by its employees. This monitoring programme would be designed to identify any breach of requirements by the FSE, in particular any breach of EoI.

The Authority's position:

231. The remuneration of FSE employees and management should be aligned with the performance and the business model of the FSE.

6.2.1 Independence of strategy development of the FSE and customer consultation

232. Enterprise management is a key business processes and incorporates the development of the FSE's strategic plans. These plans set out the processes by which the FSE anticipates meeting its objectives, including the delivery of wholesale products and expansion of the Single Network. As such, the Authority is of the belief that it is of critical importance that these plans are developed independently of any downstream operators, apart from the customer consultations, both to ensure compliance with EoI, and that they enable the sustainability of the FSE business case.
233. With this in mind, it is the Authority's view that the FSE would benefit from aligning with international precedence when formalising its strategy development process which sets out that members of its management team should have no roles outside the separated wholesale entity. Consequently, strategic decisions by the FSE's management should be in the best interest of the FSE only and not be influenced by considerations of individuals or entities outside the FSE, including BRE.
234. The Authority recognises that FSE's management may have reporting duties to the Batelco CEO, who may oversee both the FSE and BRE. As such, this individual may participate in the development of the FSE's high level strategy. However, the Batelco CEO shall not be involved in day to day activities of the FSE and shall comply with the EoI obligations and other non-discrimination requirements applicable to all FSE employees.
235. Furthermore, international precedent has highlighted the need for adequate customer consultation between the FSE and the retail operators it serves, the lack of which formed one of the defining motivations for the legal separation of BT in the UK⁵¹. This is of particular importance in Bahrain as the FSE will have the exclusive right to control, manage and deploy the Single Network and will therefore be the sole provider of products classified as bottleneck inputs for the retail operators. Feedback sessions held with OLOs have highlighted the need for adequate consultation of key strategic projects of the FSE. Ensuring ongoing and meaningful engagement between the FSE and licensed retail operators allows the FSE to gain a better understanding of its customers' needs and

⁵¹ Ofcom (2016). 'Strengthening Openreach's strategic and operational independence.'

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develop its strategy accordingly, thereby improving its own investment case and providing a service that meets the needs of downstream operators and hence retail consumers.

The Authority's position:

236. The management of the FSE is to make all strategic decisions in the interest of the FSE and independently from the rest of Batelco, whilst taking into account the FSE's customer consultation process.

237. The Authority recognises that FSE's management may have reporting duties to the Batelco CEO, who may oversee both the FSE and BRE. As such, this individual may participate in the development of the FSE's high-level strategy. However, the Batelco CEO shall not be involved in day-to-day activities of the FSE and shall comply with the Eol obligations and other non-discrimination requirements applicable to all FSE employees.

238. The Authority proposes that the FSE will be required to formally consult with licensed retail operators and other relevant stakeholders in relation to proposals relating to major investments or changes to the products offered by the FSE.

239. In addition, the Authority will subsequently review and approve the FSE proposals on the basis that it promotes service-based competition, enables a sustainable FSE business case, and is efficient.

6.2.2 Eol compliance processes

240. Aside from its strategy development processes, the FSE will need to adapt its remaining business processes to comply with Eol requirements which are discussed in Section 8. Additionally, it is the Authority's view that Batelco will be required to incorporate compliance processes to assess whether these Eol requirements are being met and identify any instances where this may not be the case.

241. In examining the establishment of such compliance procedures, the Authority notes that published guidance relating to internal controls and compliance with other regulatory requirements such as the prevention of bribery, capital adequacy or audit requirements may be equally applicable to the prevention of Eol breach.

242. One such example is the UK's National Audit Office guide for internal controls in relation to audit requirements, which lays out the following recommendations with respect to the capacity of an organisation to handle risk:

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Figure 20: Good practice regarding the capacity to handle risk

Key theme	Area	Good practice
Leadership	Risk management policy	• Sets out the commitment, processes and behaviours expected of the Board
		• Guidance is available on how to implement the policy
	Description of responsibilities	• Clear chain of accountability for risk from the Accounting Officer downwards
		• The responsibilities of the Executive, Board, Audit Committee and any other relevant groups/roles are clearly defined
	Communication	• Regular consultation with key stakeholders and partners on risk
Staff training	Risk management tools on intranet	• Risk management support and guidance made available to staff via intranet
	Senior management accountability	• Management clearly accountable for ensuring that appropriate guidance, support and training is available to their staff
	Risk management training	• Ongoing training to embed risk management concepts and tools into everyday business
Other items	Independent review	• Periodic review of the capacity to handle risk by internal audit
	Risk management maturity	• Benchmarking of the organisation against a risk management model, with actions in place to achieve the next maturity level

Source: National Audit Office

243. In the development of its own internal EoI controls and compliance processes, Batelco may propose, for the Authority's approval, to leverage this and other such guidance as a starting point for incorporating best practice. These internal procedures will complement any additional monitoring undertaken with respect to EoI compliance.

6.3 Monitoring and Enforcement

244. As part of its wider programme of work the Authority is developing a comprehensive monitoring regime to ensure that the FSE complies with the principles set out in this section as well as the NBN deployment targets set out in NTP4. In particular, the FSE will be required to submit a body of evidence demonstrating its compliance with the staffing, organisational, remuneration, and consultation requirements, which will be subject to the Authority's review and approval.

245. Specific details around the requirements related to the governance of the FSE, and to the Authority's approach for monitoring and sanctioning non-compliance will be set out in future work to be carried out.

246. This monitoring and enforcement process may encompass the establishment of an "equivalence committee", which may include representatives from OLOs and other stakeholders, that would provide oversight of Batelco's compliance with the FSE's equivalence requirements. This monitoring and enforcement process will be developed further in the Separation Guidelines.

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The Authority's position:

247. Batelco will be required to incorporate compliance processes to assess whether its EoI requirements are being met and to identify any instances where this may not be the case. Batelco will be required to submit its proposal for the Authority's review and approval.
248. As part of its wider programme of work the Authority is developing a comprehensive monitoring regime to provide oversight of Batelco's compliance with its equivalence obligation in addition to FSE's NBN deployment.

PART B – The New Economic Regulatory Framework

7 Introduction

249. The preceding sections of this report set out the Authority's position on a number of key components underpinning this Framework, including:

- a. **The FSE Product and Service Set.** As discussed in Section 2, the FSE Product and Service Set should comprise a range of wholesale products and services of varying degrees of quality that give both OLOs and BRE the flexibility to build their own optimised, efficient virtual networks that meet their individual, reasonable requirements for access, backhaul, aggregation, and transmission links.
- b. **The Single Network.** As set out in Section 3 the FSE will control Bahrain's relevant telecommunications infrastructure related to the access, aggregation and core part of the network, including ducts and poles as well as domestic fibre and copper cables.
- c. **Security Requirements.** The FSE as the sole party controlling the Single Network will be required to propose security measures that meet national security requirements and align with international standards as defined in Section 4.
- d. **Systems and Processes.** Based on the positions set out in Section 5, the systems and processes employed by the FSE to deliver its products, to manage, operate, design and deploy the Single Network and to deliver on its security obligations will be fit for purpose and designed efficiently.
- e. **Organisational structure and HR.** As set out in Section 6, the FSE will need to be efficiently resourced and incentivise decisions that are in the FSE's own commercial interest, independently of other operators.

250. The Framework is designed to reflect these key components. The discussion in the preceding sections highlights that a number of regulatory decisions will need to be implemented with regards to the separation of Batelco and the deployment of the Single Network. In particular, the Framework considers three areas of regulation:

- a. **Equivalence of Inputs.** The Authority's understanding and application of the Eol regime established in NTP4 that the FSE would be subject to.
- b. **Separation and Governance.** The Authority's approach to implementing the separation of Batelco.
- c. **Regulatory Pricing Framework.** The form of price regulation that would be applied to the FSE Product and Service Set. As part of this, a definition of the forms of efficiency relevant for the regulation of the FSE is presented.

251. Part B of the report discusses and analyses options for each of these core elements of the Framework and establishes the Authority's position.

8 Equivalence of Inputs

8.1 The Case for Equivalence of Inputs

252. Licensed operators in the retail market for fibre (BRE and OLOs) require access to the FSE's wholesale bottleneck inputs in order to build their own service offerings. Given the FSE's dominant position in the relevant wholesale markets following the reforms set out in NTP4, it may have incentives for discrimination in its product offerings, in general taking two forms:⁵²

- a. **Price discrimination.** The dominant operator (i.e. the FSE) offers identical products and services at different prices for downstream operators (i.e. OLOs) than its affiliated retail arm (i.e. BRE).
- b. **Non-price discrimination.** The FSE may discriminate against OLOs by other means, such as refusing to supply certain products and services or offering products and services at worse quality (in terms of timing and technical configuration, for instance).

253. To promote sustainable competition in the retail market for fibre broadband, an effective set of non-discrimination obligations on the FSE is required. Whilst the current regulatory framework provides some degree of protection from discrimination by operators determined to have Significant Market Power ("SMP") or a position of dominance,⁵³ the Authority considers that additional measures are required.

254. The Telecommunications Law and Access Regulation require that a dominant wholesale operator must offer access to its products and services on a non-discriminatory basis to all operators, including any affiliated retail arms. However, given the new rights accorded to the FSE in relation to NBN deployment and operation, the Authority and the Government are of the view that a set of stronger equivalence safeguards may be appropriate.

255. The Authority shares the Government's view set out in NTP4 that EoI is the most effective way to achieve a level playing field for all downstream operators and achieve effective non-discrimination. The Authority considers EoI to be best placed for addressing equivalence concerns associated with the new market structure, in line with international experience and regulatory best practice.⁵⁴

256. EoI refers to the regulatory principle that establishes that all downstream operators (including BRE) have access to exactly the same set of the FSE's regulated wholesale

⁵² See Authority (2007). 'Position Paper on Price and Non-Price Discrimination.'

⁵³ Article 1 of the Telecommunications Law defines an SMP operator as: "A Licensed Operator which holds 25% or more of the market share of the relevant market as determined from time to time by the Authority." And defines a dominant position as: "[A] position of economic power that enables it to prevent the existence and continuation of effective competition in the relevant market through the ability of the Licensee to act independently – to a material extent – of competitors, Subscribers and Users."

⁵⁴ EoI regimes are increasingly being implemented in a number of jurisdictions such as European Union countries (United Kingdom and Spain), New Zealand, and Singapore. The European Commission further notes that: "[EoI] is in principle the surest way to achieve effective protection from discrimination." See European Commission (2013), 'Commission recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment.'

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products and services on the same price and non-price terms, delivered using the same systems and processes. An Eol obligation removes a significant amount of discretion from the FSE by making all of its inputs available on the same basis to every downstream operator. Section 9.2 sets out the Authority's definition and understanding of Eol in more detail.

257. It is important to note that Eol does not replace existing dominance regulations currently in place to safeguard equivalence, such as the Access Regulation (or Retail Tariff Notification Regulation), but rather complements such regulation. There may remain some form of a general access obligation on the FSE as set out in the Telecommunications Law and the Access Regulation.
258. The Authority may further consider the case for amending existing laws and regulations to give effect to Eol in the long term.

8.2 The Definition of Equivalence of Inputs

259. The Authority's definition of Eol is set out in its Purpose Statement and is used as a starting point for further establishing the Authority's position on the application of Eol in practice.

Figure 21: The definition of Eol provided in the Authority's Purpose Statement

[...] This means that the [FSE] will offer its services and products to all licensed operators in the Kingdom, including Batelco's retail business unit, in accordance with the same timescales and pursuant to the same terms and conditions, including everything related to price, service levels, information about product development and launch, and utilisation of systems and processes

Source: Purpose Statement, Paragraph 16c

260. The FSE will be required to supply all downstream operators with the same products, especially considering the following five components, which are discussed in more detail below:
- Timescales.
 - Price.
 - Service levels.
 - Information disclosure.
 - Systems and processes.

8.2.1 Timescales

261. The FSE will be required to offer relevant wholesale products and services to all licensed operators in the retail market (i.e. OLOs and BRE) to the same timescales. That is, OLOs and BRE will receive the same wholesale input products or services within the same timeframe from submitting their order, will have faults restored within the same time, or will receive a response by the FSE on any queries at the same time horizon.
262. Eol alone does not guarantee that the timescales employed by the FSE, while equivalent for all downstream operators, are reasonable given the time and effort required by the

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FSE. Timescales offered by the FSE may not be suitable for downstream operators to offer their retail services in an efficient manner. In order for Eol to deliver the greatest benefits to consumers, there may be a need to review delivery timelines and processes currently employed by Batelco's wholesale division to ensure the FSE offers its services in a time-efficient manner.⁵⁵

8.2.2 Price

263. The FSE will offer relevant wholesale products and services at the same price to all licensed operators in the retail market, this includes Batelco internal trading arrangements as well as any external contracts with OLOs and BRE. That is, the same services and products should be priced equally for OLOs and BRE.
264. Price discrimination is addressed to a certain extent through the Authority's *ex-ante* review and approval process of Batelco's ROs under Article 57 of the Telecommunications Law and through the separation of Batelco with separate financial accounts. The Authority generally considers that non-price discrimination is a more significant issue to be addressed by Eol.
265. Equivalent prices for the same services for all licensed operators alone may not be sufficient to ensure that the wholesale price levels promote the regulatory objectives overall. The regulatory pricing framework discussed in Section 10 will impose price controls that will complement the Eol provisions on pricing.

8.2.3 Service levels

266. One of the intentions of the reform of the telecommunications sector in Bahrain is to drive service-based competition. High quality, flexible wholesale service levels can therefore play an important role in enabling downstream operators to differentiate their service offering based on quality.
267. The FSE will be obliged to adhere to the same QoS standards for relevant wholesale products and services for all licensed operators. That is, in addition to adhering to the same timescales and prices, all products and services will be delivered with the same specification and quality standards to both OLOs and BRE.
268. Consumers can place a high value on the QoS of their final retail product. The Authority therefore notes that it will be key for the FSE to offer an adequately high QoS for its regulated wholesale products and services.
269. As with the other components of this definition, Eol itself does not guarantee a high level of QoS. Additional measures such as Service Level Agreements ("SLAs") and Service Level Guarantees ("SLGs") will still be required. Section 9.4 discusses these components in greater detail.

⁵⁵ Whilst the Authority will consider appropriate timescales as part of defining the non-price terms in the FSE's RO, a starting point for delivery times could be the timelines employed for Batelco's retail business unit.

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8.2.4 Information disclosure

270. OLOs and BRE will have access to the same commercial information from the FSE, and this information will be made available to OLOs at the same time as BRE. Such information could be related to:

- a. **Existing regulated wholesale products and services**, such as service technical information, price terms, and timescales. This information is currently provided as part of Batelco's service descriptions and ROs, which the FSE will continue to be obliged to provide for all its regulated wholesale products and services.
- b. **New regulated wholesale products and services**, such as technical information on new products and services being developed including product launch dates.
- c. **Changes to existing regulated wholesale products and services**, such as price changes or changes in terms and conditions.
- d. **Existing and future fibre network topologies**, such as information on the FSE's current fibre network and network build plans.

271. At the same time, the FSE should not be allowed to disclose customer confidential information obtained from one downstream operator with any other downstream operator, in particular BRE. The converse situation should also hold, that is historical commercial knowledge by BRE should not be transferred to the OLOs. Such information could be related to, for instance, individual order details or forecast demand volumes submitted to the FSE by OLOs.

272. Appropriate systems, processes, and policies within the FSE will need to be established to ensure such information is not shared with BRE. This will involve an evaluation of the types of systems that are best suited for the FSE to collect, store, and communicate this type of information.⁵⁶ The establishment and separation of systems required to give effect to this requirement is discussed in Section 5.

8.2.5 Systems and processes

273. As per NTP4, FSE should be required, in the long term, to enable all downstream operators to access its NBN-based wholesale products and services using the same systems and processes. That is, BRE will use the same systems and processes, with the same degree of reliability and performance, as OLOs. This will ensure all downstream operators are able to order, install, maintain, and resolve issues with their services on equal terms. However, as per the discussion above, the Authority notes that such a requirement may not be efficient or effective during the transitional period or for wholesale products and services that fall outside the remit of the NBN.

274. In order to comply with EoI, the FSE should establish common front-end systems for all downstream operators to use. These front-end interfaces would be adopted by all downstream operators including BRE and would be the only such systems available. These systems should cover, amongst others:

- a. Pre-ordering.

⁵⁶ For instance, OLOs may require equivalent access to information on the FSE's network database.

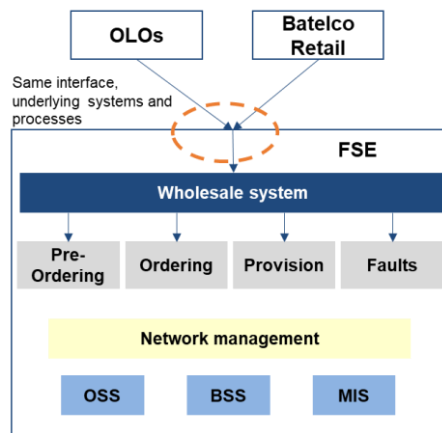
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- b. Ordering and service management.
- c. Service provision.
- d. Fault reporting and resolution.

275. This includes OSS, BSS, and MIS as well as any underlying network management systems, as illustrated in Figure 22.

Figure 22: Illustration of Eol processes



Source: the Authority

276. These Eol requirements, together with the associated monitoring regime discussed in Section 9.4, may involve the establishment of new systems as well as the separation of some existing systems between the FSE and the rest of Batelco. The Authority notes that the 'systems and processes' aspect is often the most important and burdensome component of the definition of Eol as processes and systems are integrated across various parts of Batelco. Section 5 discusses the considerations around the FSE's systems and processes in greater detail.
277. For the FSE and the rest of Batelco to make changes to systems and processes may be significant. It may consider specific cases where full system and process equivalence may not be feasible or economically efficient. There are a number of potential approaches for

the separation of systems and processes, which are further discussed in Sections 5.2 and **Error! Reference source not found..**

The Authority's position:

278. The Authority shares the Government's view that EoI should affect a range of price and non-price factors. Therefore, EoI obligations will be the centrepiece of the Framework and will be applied in relation to timescales, prices, service levels, information disclosure, and systems and processes.

8.3 Equivalence of Outputs as a transitional arrangement for Equivalence of Inputs

279. In line with international precedent, a stepping stone to achieving EoI for relevant products and services could be the implementation of EoO requirements during the transitional period.⁵⁷ An Equivalence of Output's ("EoO") regime would require the FSE to provide the same wholesale services to OLOs and BRE in terms of functionality and price but not necessarily supply these services in an identical manner.

280. EoO refers to the regulatory principle that establishes that all downstream operators (including BRE) have access to the same set of the FSE's regulated wholesale products and services on the same price and non-price terms, but unlike EoI they are not supplied using the same systems and processes. That is, EoO does not require the use of the same systems and processes to deliver equivalent outputs at the same prices for all downstream operators. This allows the FSE to potentially use different interfaces for BRE and OLOs. EoI can therefore be considered a 'stricter' principle of non-discrimination than EoO by requiring the entire wholesale production process and supply chain to be the same for OLOs and BRE.

281. Compared with EoI, EoO may be less costly and quicker to implement in the short term whilst providing the basis for improving service delivery that aligns with the long-term EoI requirements. In the long term, the FSE will be required to offer at least its NBN-based wholesale products and services on an EoI basis. EoI is generally recognised to offer a number of advantages over EoO in the long term, such as:⁵⁸

- a. It provides better incentives for the FSE to deliver efficient systems and processes and to provide high quality wholesale inputs because BRE relies on the same interface as OLOs.
- b. By requiring information equivalence, it is better suited to address information asymmetries between the FSE, OLOs, and the Authority and therefore increases transparency of process information.

⁵⁷ For example, as part of the New Zealand operational separation, a three year transition to EoI has been agreed with EoO as a starting point for certain products and services.

⁵⁸ See for example: Ofcom (2014). 'Review of the wholesale broadband access markets'; and European Commission (2013). 'Commission Recommendation.'

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- c. The use of the same systems for both internal and external supply of wholesale services simplifies the monitoring of non-price discrimination (see discussion of monitoring in Section 9.4).
- d. Because of the benefits listed above, Eol generally requires less intervention by the Authority.

282. Because Eol involves the establishment of separate and new systems and processes, there are some additional costs involved compared to other approaches such as EoO. These costs may be associated with the implementation of Eol as well as the potential duplication of some resources and functions.

283. Therefore, it may be more efficient for the FSE to ensure its products and services are delivered on an EoO-basis during the transitional period. As the separation of Batelco progresses, relevant products and services would be migrated onto Eol-based systems and processes in line with NTP4. At the end of the transitional period, relevant products and services will be required to be supplied on an Eol-basis, requiring the establishment of appropriate systems and processes during the transitional period. Other products (e.g. non-NBN-based products) could be continued to be supplied on an EoO-basis going forwards.

8.3.1 Equivalence of Inputs in the context of Batelco's separation

284. The relative importance of specific Eol safeguards will depend on the particular form of separation being adopted by Batelco. In general, stronger forms of separation are able to support a more independent management structure, hence ensuring more adequate protection against discrimination. Less stringent forms of separation may need to be complemented with stronger Eol safeguards to ensure adequate protection against discriminatory behaviour.

285. In enforcing a gradual separation of Batelco, the Authority will therefore take the necessary steps to ensure that EoO is for the respective products and services is adhered to at all times during the transitional period, with robust monitoring processes and appropriate sanctions for non-compliance. As Batelco moves towards a stronger form of separation, associated Eol safeguards may be adjusted, in line with stakeholder feedback and experience gathered by the Authority. Following the transitional period, the Authority expects that Eol is achieved at the very least for all of the FSE's NBN-based wholesale products and services and that any other wholesale products and services are compliant with other non-discrimination safeguards.

8.4 Products and Services Subject to Eol Obligation

286. As discussed in Section 8.1, Eol obligations are justified where the FSE holds a dominant position and may be able to offer its services in a discriminatory manner. Where the FSE's wholesale products and services are bottleneck inputs, it is in general appropriate to require that these are supplied on an Eol basis.

287. As such, the Authority is of the view that the FSE will supply NBN-based wholesale products and services on an Eol basis in the long term. However, some consideration needs to be given to the transitional products which are to be offered initially but which are to be phased out of the FSE's Product and Service Set. As set out in Section **Error! Reference source not found.**, during the transitional period, the FSE's products and

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services will be subject to EoO obligations, whilst transitioning to Eol for the relevant set of product and services as discussed above.

288. Some of the transitional products to be offered only initially may be costly to migrate onto Eol compliant systems. As such, the benefits of making these products fully Eol compliant may outweigh the benefits created given that the anticipation is for these products to be withdrawn from the FSE's RO in the near future. Transitional products may in some cases also exhibit relatively small demand which may warrant a more pragmatic approach to ensuring non-discrimination.
289. Where such products are supplied using the same systems and processes as their long-run alternatives, however, there would be little additional costs from supplying these on an Eol basis, alongside the products to be offered as part of the FSE Product and Service Set. Moreover, even where transitional products use different systems and processes, migrating these products onto Eol may in some cases be relatively straightforward and therefore such products could feasibly be supplied on Eol terms during the transitional period.
290. Therefore, the Authority is of the view that all of the products and services to be supplied as part of the FSE Product and Service Set will be subject to Eol in the long term. Products and services to be offered only initially, during a limited transitional period, could remain on an EoO-based system. However, the FSE should endeavour to also supply other products on Eol terms, especially where these are offered using similar systems and processes as the above.
291. However, the Authority notes that, given the transitional nature of these products, it may not be feasible to migrate all of those onto Eol. As such, where transitional products appear disproportionately costly to migrate to Eol, the Authority considers that these could be supplied subject to the existing non-discrimination regulation and QoS standards.
292. Costs of full Eol migration of transitional products could be disproportionately costly under the following circumstances, amongst others:
- a. The current and future forecast number of OLOs or end-users relying on the product and service is small compared to the costs involved in establishing full Eol.
 - b. There is an alternative, equally suitable or better product which is delivered over Eol.
 - c. The FSE commits to withdraw the product due to the lack of current or future demand.
293. The FSE will be required to consider current Batelco 'self-supplied' products separately. If such products can reasonably be transferred onto an Eol platform and if they are considered by the Authority to pose a competitive threat for downstream operators, the Authority will mandate that these are supplied on Eol terms.

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The Authority's position:

294. The Authority is of the view that NBN-based wholesale products and services will be subject to Eol in the long term. A description of these products and services will be provided as part of the FSE's RO Order.

295. Transitional products and services will be offered on an EoO basis, with relevant products being migrated onto Eol-compliant systems and processes.

8.5 Ensuring the Effectiveness of Equivalence of Inputs

296. In addition to the key definitions discussed in Section 8.2, the new Eol regime will be supported by other key features, including the separation of Batelco, the establishment of an Eol compliance monitoring regime, and QoS requirements. These ensure the effectiveness and enforcement of the regime.

8.5.1 Separation of Batelco

297. Establishing a system with appropriate incentives for all market participants to adhere to the principles of Eol is cited as one of the key aspects of successful Eol regulation.⁵⁹ The separation of Batelco is a first key step of setting up the appropriate incentive structure for the FSE to follow Eol. The FSE's incentives are therefore supported by the form of separation (see Section 10) and the regulatory safeguards highlighted in this report.

298. This organisational change is aimed at facilitating Eol and the boundaries of separation between the FSE and BRE may have implications for Eol. Moreover, given the strong inherent link to the separation of Batelco, Eol will be integrated to be a core part of monitoring Batelco's compliance with the requirements set out in this Framework.

8.5.2 Compliance monitoring regime

299. There is information asymmetry between the FSE, the Authority, and downstream operators. It may therefore be difficult to assess whether the FSE is offering its products and services to all downstream operators in accordance with the same price and non-price terms as set out by the definition of Eol. Therefore, an Eol monitoring regime is required to support the implementation of Eol in practice.

300. The Authority is currently developing a comprehensive monitoring regime that will ensure the FSE is compliant with its Eol obligations as defined in Section 8.2 as well other requirements set out in this Framework. This will constitute a separate document to be published by the Authority and will include:

⁵⁹ See for example Nordicity (2014). 'Implementing an Equivalence of Inputs Regime in Canada's Telecommunications Market.'

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- a. The definition of a set of Key Performance Indicators (“KPIs”) measuring the FSE’s compliance with the EoI regime and overall performance.⁶⁰ These KPIs will facilitate a comparison between products and services provided by the FSE to BRE and those provided to OLOs. The precise product parameters to be measured will be developed at a later stage in consultation with key industry stakeholders and could cover the following areas, amongst others:⁶¹
 - i. Ordering processes.
 - ii. Provision of services.
 - iii. Quality of service (see below).
 - iv. Fault repair times.
 - v. Migration between regulated wholesale inputs.
- b. The establishment of a transparent reporting framework that requires these KPIs to be published at regular intervals. These reports will also contain a ‘gap analysis’ indicating where the FSE is falling short of its EoI obligations and where there may be discrepancies in service provision between OLOs and BRE.

301. To ensure monitoring and potential enforcement (discussed below) can be carried out effectively, it will be important to establish appropriate data collection processes and obligations. The KPI’s highlighted above will need to be based on detailed data and robust analyses to be produced at regular intervals. This will help the Authority to identify any potential discrimination between downstream operators or other forms of non-compliance.

8.5.3 Quality of Service requirements

302. As has been highlighted in the discussion above, EoI alone may not be sufficient to guarantee a high quality of service for the FSE’s products. Given the FSE’s market power in the provision of wholesale services, it may lack the competitive pressure to offer high quality inputs to downstream operators and improve QoS over time. Service quality issues have been reported in other separations internationally. For example, in the UK, OLOs, consumer groups, and individuals have reported dissatisfaction with the service quality offered by the wholesale access provider Openreach.⁶² Another example is Australia, where consumers have experienced relatively low speeds and service quality.⁶³

⁶⁰ KPIs are intended to give an indication of the FSE’s overall performance and relative performance compared across BRE and OLOs. They do not set minimum or absolute performance standards which would typically be set as part of Service Level Agreements (“SLAs”).

⁶¹ This is in line with European Commission (2013). ‘Commission recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment.’

⁶² See for example Towerhouse LLP (2016), ‘Legal separation of Openreach from BT: necessary steps to secure effective independence, transparency and to promote competition and investment.’

⁶³ Technology Policy Institute (2016). ‘The End of Australia’s National Broadband Network’ retrieved from: https://techpolicyinstitute.org/wp-content/uploads/2016/07/Sorensen_Medina_TheEndofAustraliasNationalBroadbandNetwork.pdf.

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303. As part of the QoS Regulation⁶⁴ the Authority has already identified a number of key QoS performance targets which are relevant to some of the FSE's service offerings. The Authority may take additional steps to ensure the FSE delivers appropriate service quality to all downstream operators by considering the introduction of new QoS performance targets in future ROs of the FSE. These targets could be based on historical observations, international benchmarks, and leading best practice.
304. Moreover, the Authority will require the FSE to develop and update associated SLAs and SLGs for the FSE to enter into with downstream operators. SLAs specify the QoS requirements and indicators to be followed by the FSE while SLGs could include appropriate penalties should the FSE fail to meet its SLA obligations. It is the Authority's view that SLAs and SLGs should be centred on quantifiable metrics and KPIs to ensure objective reporting.

8.5.4 Sanctions for non-compliance

305. Compliance and enforcement with the Eol obligations set out above is a key feature ensuring the effectiveness of the Framework. As part of the compliance monitoring regime, the Authority will consider means for sanctioning and enforcing any non-compliance with the Eol obligations specified in this Framework. This will involve putting in place processes for:
- a. Identifying any cases where non-compliance appears to have occurred.
 - b. Investigating such cases as well as the underlying reasons for the breach of compliance.
 - c. Implementing appropriate enforcement mechanisms to ensure future compliance.
306. The Authority has at its disposal, a range of potential options to enforce Eol (step c). Whilst such mechanisms are explored as part of the compliance monitoring regime, these could in principle take the form of financial penalties on the FSE, compensation for OLOs, other regulatory measures (such as considering the introduction of specific products and solutions or other enforcement action for breach of its licence (as per Article 35 order of the Telecommunications Law).

8.5.5 Adaptability of Equivalence of Inputs

307. As Eol is implemented into all relevant FSE systems, processes, and ways of working, there may be additional requirements raised by OLOs or complications faced by the FSE. As Batelco's separation progresses, Eol requirements and safeguards may need to be adjusted to be fit for purpose and to align with the potentially new incentive structures.
308. Moreover, as the industry and service requirements adapt to new market trends, so should, in the Authority's view, the Eol framework. Amendments could affect the FSE's products, which are subject to Eol following reasonable requests by downstream operators, or they could impact initial timescales for the establishment of certain Eol systems requirements as they are deemed too ambitious by the Authority.

⁶⁴ See Authority (2014). 'Draft Quality of Service Regulation (2017)' retrieved from: <http://www.tra.org.bh/media/document/Draft%20revised%20QoS%20Regulation.pdf>

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Equivalence of Inputs

309. The Authority will follow a transparent process for incorporating amendments to the general Eol obligations set out above as necessary. The Authority would collect responses and feedback from downstream operators through a number of channels, such as through public consultations, individual meetings, or industry forums. Details around the adaptability of the Eol regime will be set out in the Authority's separation guidelines and monitoring regime reports that will be published in due course.

8.5.6 Role of existing laws and regulations

310. There may be situations in which OLOs demand a different set of wholesale inputs than BRE. This may therefore create incentives for the FSE to offer such inputs at discriminatory, albeit equivalent price and non-price terms to OLOs and BRE (which does not require these inputs) by pricing these relatively high or offering worse QoS.
311. Because Eol does not replace but rather complements existing regulatory instruments, the existing laws and regulations⁶⁵ will continue to apply to ensure that the FSE continues to have a non-discriminatory obligation for all relevant wholesale services that are demanded by OLOs but not BRE. Additionally, the Authority may consider the implementation of additional QoS requirements for such services where it deems necessary.

⁶⁵ For example, the Access Regulation, Quality of Service Regulation and Retail Tariff Notification Regulation.

9 Separation of Batelco

312. Vertical separation has become an established instrument for regulatory bodies to achieve outcomes that are not possible under a vertically integrated incumbent and has been used specifically within the telecommunications sector since 1982, which marked the vertical separation of AT&T in the US. The ITU has noted that “*there has been a tremendous amount of interest around the world recently in functional separation as a regulatory remedy in the telecommunications sector*”⁶⁶ reflected by a spate of vertical separations in Europe, New Zealand, and Australia.
313. The primary benefit of vertical separation is the reduction of both the incentive and ability of the incumbent operator to use their control over bottleneck inputs to discriminate against the other retail operators which compete against the incumbent’s own retail branch⁶⁷, thereby promoting greater competition in the retail layer while at the same time incentivising investment.
314. However, the Authority acknowledges that vertical separation does include drawbacks including the loss of vertical efficiencies. As discussed in the Purpose Statement, economic theory posits that vertical integration can lead to productive efficiencies, which are not fully achieved through contracted relationships, or the loss of coordination of investment. Furthermore, the process for achieving vertical separation may lead to significant costs or disruption particularly during the transitional period, the scale of which will depend on the specific model of vertical separation undertaken.
315. In addition to the drawbacks set out above, vertical separation has practical difficulties associated with the establishment of the demarcation line and its suitability over time. Although aims to separate monopoly elements from competitive activities of the incumbent operator may be clear from a theoretical perspective, the complexity and integration of telecommunication networks may offer technical difficulties both in the location and implementation of a clear demarcation boundary⁶⁸. Furthermore, there is a risk that technological advancements may render this demarcation no longer suitable in future⁶⁹.
316. This lack of a clear point of demarcation is problematic as once established, retrospective changes to the demarcation boundary are difficult and may introduce uncertainty to the sector. No final decisions on the separation of Batelco can be made without the appropriate information on potential benefits and costs of a specific option being available. A gradual, incremental implementation of separation has the advantage of allowing the industry to adapt the long term state, whilst at the same time ensuring that all decisions can be based on adequate analysis and information relevant to the context of the Bahrain market.

⁶⁶ International Telecommunication Union (2008). ‘Breaking up is hard to do: The emergence of functional separation as a regulatory remedy.’

⁶⁷ Jamison, A.M., Sichter, J. (2008). ‘Business separation in Telecommunications: Lessons from the U.S. Experience.’

⁶⁸ OECD (2003). ‘The benefits and costs of structural separation of the local loop.’

⁶⁹ ARCEP (2007). ‘Functional Separation: pros and cons.’

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317. As such, the Authority will follow a gradual, incremental approach to implementing separation of Batelco to minimise the disruption to the organisation whilst at the same time ensuring the NTP4 objective of separation is achieved in the long term.
318. Models of vertical separation span across a broad spectrum, ranging from the weakest accounting separation to full ownership (structural) separation, with a variety of options between these two extremes. Cave (2006)⁷⁰ categorises a number of models of vertical separation that lie between accounting and structural separation in terms of rigour, namely the 'six degrees of separation', which can be broadly categorised into 3 groups:
- a. **Non-physical separation.** Models of separation that do not require physical separation of assets and inputs but merely a change in the transactions boundary and are therefore considered the weakest forms of separation. Models of separation within this category include accounting separation, which requires the retail and wholesale divisions to maintain separate profit and loss statements and balance sheets to promote pricing transparency and identify price discrimination, and virtual separation, which places additional equivalence obligations on the incumbent.
 - b. **Operational separation.** Models of separation that require physical separation of assets and inputs into a separated unit⁷¹. This category includes functional separation models where the separated unit remains part of the incumbent, and legal separation models where the separated unit is established as a separate legal entity. However, under all models of operational separation, the separated unit remains under the same ownership as the incumbent.
 - c. **Structural separation.** Full ownership separation requiring the wholesale unit to be spun off from Batelco. This is the strongest form of vertical separation.

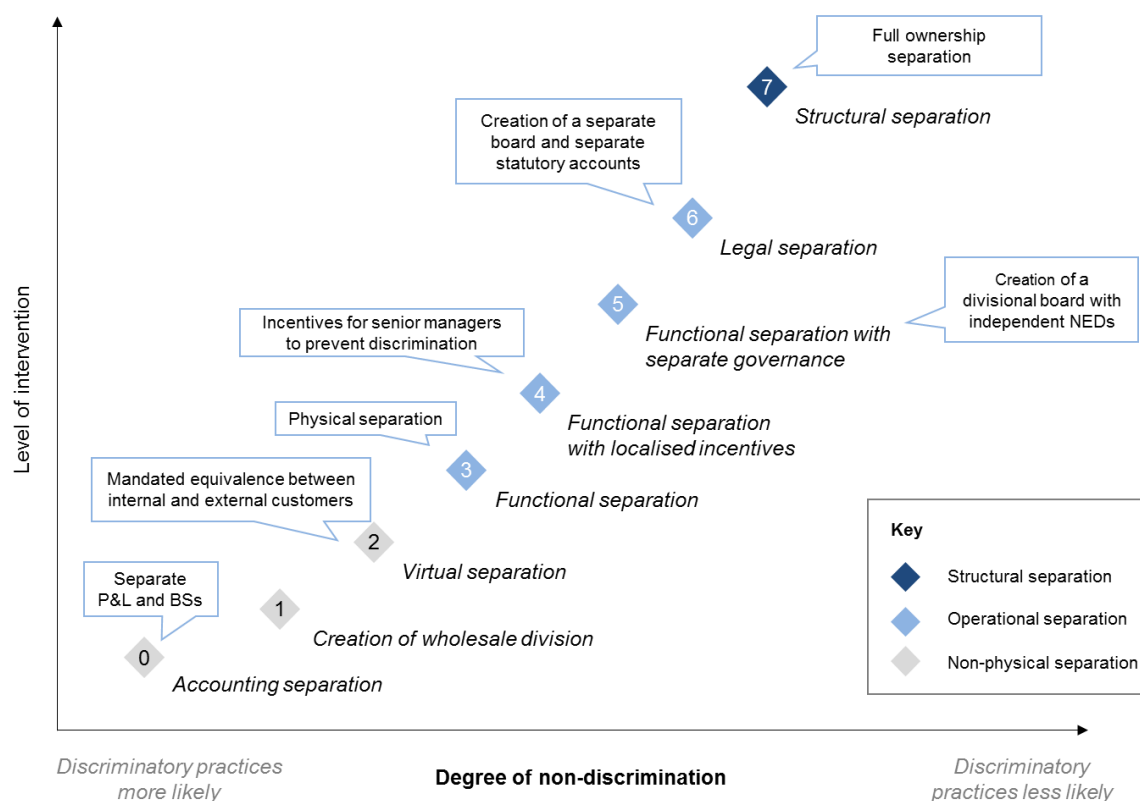
⁷⁰ Cave, M. (2006). 'Six Degrees of Separation: Operational Separation as a Remedy in European Telecommunications Regulation.'

⁷¹ The Authority notes that use of the term 'operational separation' is not consistent across the literature. For the purposes of this document, the use of 'operational separation' refers specifically to models of separation that require physical separation but fall short of full structural separation.

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Separation of Batelco

Figure 23: Martin Cave's degrees of separation



Source: the Authority

319. As illustrated in Figure 23, each successive model of separation builds on the preceding level, incorporating the features of its predecessor alongside additional requirements to form a more rigorous model of separation. For example, virtual separation requires both accounting separation and the creation of a separate wholesale division, in addition to mandated equivalence requirements between internal and external customers. In this way, each successive 'degree of separation' offers an increasingly rigorous model of separation, cumulating at full structural (ownership) separation. Furthermore, with each increasing degree of separation, both the potential benefits and the associated cost and potential disruption required for its achievement increase⁷², representing a trade-off between the likelihood of discrimination and the degree of intervention required to achieve it.
320. The Authority considers that in its current state, Batelco best aligns with the model of non-physical separation referred to as 'creation of a wholesale division'. Although Batelco currently has a separate wholesale division and is subject to accounting separation regulation⁷³ it is not yet subject to equivalence requirements characteristic of virtual separation. As Batelco moves away from this relatively low degree of separation towards stronger models of operational separation, this will yield greater benefits along with

⁷² ARCEP (2007). 'Functional Separation: procs and cons.'

⁷³ Authority (2004). 'Accounting Separation Regulation', 02 August 2004, LAU RN 004.

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additional costs and operational risks. The magnitude of these costs will depend on the final model of separation and will increase as this approaches legal separation.

321. As has already been discussed in the preceding section, the NTP4 mandates that the FSE shall adopt “effective measures to ensure” the delivery of services to the Incumbent Operator’s retail business unit(s) and its competitors on “an equivalence of inputs basis”. NTP4 also acknowledges that full legal separation cannot materialise in the short term so that it demands the Authority “take[s] the measures necessary to adopt, implement and enforce effective functional separation on a *gradual basis*.”⁷⁴
322. This decision to introduce functional separation on a gradual basis rather than moving immediately to more rigorous forms of separation such as legal or structural separation is well established in international precedence, and reflects the motivation of vertical separation, namely the promotion of non-discrimination and EoI. For example, although the UK incumbent operator BT is currently undergoing legal separation of Openreach (its access services business unit), this was preceded by the functional separation of Openreach in 2005 intended to promote equality of access in fixed telecoms, including the achievement of EoI and effective and sustainable competition. It was not until Ofcom, the communications regulator, concluded in its 2015 Strategic Review of Digital Communications that despite functional separation, BT remained able to discriminate against its competitors, was BT required to undergo further legal separation from Openreach⁷⁵. Consequently, the additional requirement for legal separation of BT over and above functional separation was motivated by the failure of existing measures to achieve regulatory objectives of EoI and competition.
323. The Authority considers it important to emphasise that the underlying motivation behind the separation of Batelco is the promotion of EoI which the Authority considers to be the foremost non-discrimination remedy. The Authority is also mindful that more rigorous models of separation are accompanied by substantially increasing costs which may question the rationale behind more aggressive forms of separation if non-discriminatory safeguards, specifically EoI, are achievable through less intrusive means. In light of these considerations, the Authority considers it premature at this stage to presume the form of separation of Batelco, but rather it shall, in line with Government’s policy, implement and enforce separation on a gradual basis after assessing the proportionality of its different forms. The final level of separation will depend on Batelco’s adherence to the requirements set out in the Framework as well as future documents produced by the Authority such as the Separation Guidelines. If Batelco is found to not be in compliance with such requirements, the Authority could consider options such as mandating legal separation.

⁷⁴ Para. 24(g) of the NTP4, emphasis added.

⁷⁵ Ofcom UK (2017). ‘Delivering a more independent Openreach.’

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The Authority's position:

324. The Authority is fully committed to ensure that NBN-based wholesale products and services are delivered on a non-discriminatory basis to guarantee the conditions for fair, effective and sustainable competition. Accordingly it shall ensure that Government's direction on the provision of NBN-based wholesale products and services.
325. The Authority shall adopt effective non-discrimination rules which are essential to creating a level playing field between BRE and OLOs. The Authority believes that EoI is an important non-discrimination remedy which a sure way to achieve effective protection for non-discrimination.
326. The Authority is also cognisant that there is no one-size-fits-all system of regulation and that there are hybrid forms of regulation (and separation) to ensure the effectiveness of non-discriminatory obligations. Accordingly, in any future decision it might take, it will not be necessarily limited by any particular academic model of separation.
327. The Authority is also mindful of the fact that different levels of separation may entail substantially increasing costs which would question the rationale behind an aggressive form of separation if the non-discriminatory safeguards are achieved through less intrusive (and less costly) means. As such it will, in line with Government's policy, implement and enforce separation on a gradual basis and after assessing the proportionality of its different forms taking into consideration any steps undertaken by the incumbent operator to transfer network assets to a functionally separate entity.
328. During the transitional period, the Authority will establish a robust mechanism for monitoring compliance of Batelco and the FSE particularly with regard to the delivery of EoI and achieving the NBN deployment and performance targets.

10 Regulatory Pricing Framework

329. There are a number of different approaches to regulatory pricing frameworks that could be considered. The appropriate approach to pricing the FSE's products and services depends on the objectives to be achieved, the incentives that the regulator wants to establish as well as the types of products and services to be supplied in future.
330. The Authority notes that under a phased approach to separation, a number of specific considerations around the regulatory pricing framework are required. In general, it is acknowledged that the pricing framework will require a degree of flexibility to balance transitional needs with long term objectives.
331. Moreover, the pricing approach that has been adopted may vary in line with market conditions and the form of separation employed by Batelco, especially as this relates to the FSE's efficiency and incurred costs. In the interim period, the Authority will take into account transitional needs of all operators and evaluate incentives created to ensure a smooth transition to the long term FSE Product and Service Set.
332. In this section, the Authority sets out the principles and objectives that should guide the design of the regulatory pricing framework in order to adequately address these issues. The remaining sections set out options for the design of the pricing framework and consider how these may support the objectives.
333. The Authority notes that the following discussion only provides a high level view of the form of regulation to be adopted and the principles that will underpin the choice of specific frameworks.⁷⁶ Detailed decisions on the form and nature of pricing frameworks adopted will be determined once there is a full understanding of the products and services.

10.1 Key objectives of the pricing framework

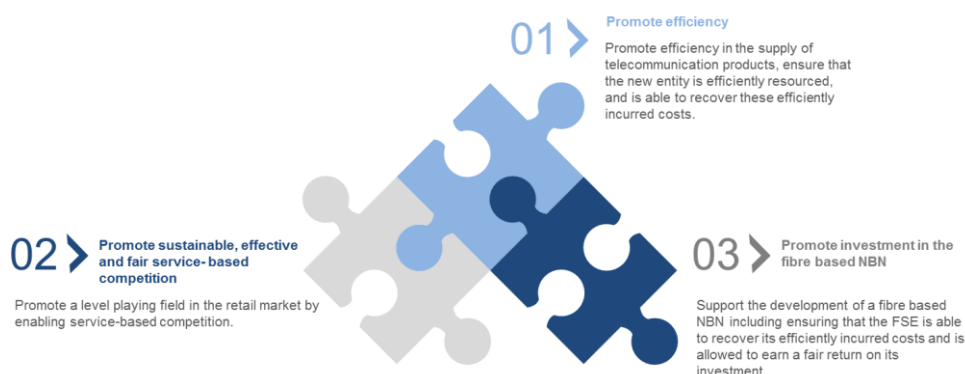
334. In determining the appropriate pricing framework, the Authority will seek to promote the relevant objectives set out in the Purpose Statement and as outlined in the figure below.

⁷⁶ The Technical Annex to the document provides more detail on the technical and strategic considerations that will underpin the approach adopted. This will be further refined in later documents.

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Figure 25: Objectives of the pricing framework



Source: the Authority

Objective 1: Promote efficiency

335. A stated objective in the Purpose Statement is to: “*Promote efficiency in the supply of telecommunications products and services in the telecommunications market of Bahrain,*” In addition, the Framework should “*Ensure that the new entity is efficiently resourced*” and “*able to recover its efficiently incurred costs.*”
336. The pricing framework can promote this objective by providing the FSE with appropriate incentives to improve efficiency. Over time, the pricing framework should allow cost efficiency gains to be passed on to the FSE’s customers and eventually to end users in the form of lower prices, without unduly harming the FSE’s efficiency incentives. In doing so, the promotion of efficiency also contributes to increasing take-up of fibre-based retail products and the migration from copper to fibre.
337. Improvements in efficiency over time may also depend on incentives to innovate and invest in cost-effective solutions. The pricing framework should encourage such efficiency improvements, which may occur through the roll-out of an advanced fibre network and introduction of innovative products.

Objective 2: Promote competition

338. A stated objective in the Purpose Statement is to: “*promote service-based competition in the telecommunications market that is fair, effective and sustainable.*” This includes ensuring not only that the FSE operates on an EoI basis that is largely addressed by other provisions, but also a wider non-discrimination requirement on the FSE to ensure that it does not use methods to discriminate against OLOs whilst still strictly fulfilling EoI.
339. The pricing framework can play a key role in preventing such discrimination through preventing pricing abuses which harm competition in the retail market. These include margin squeeze mechanisms such as excessive FSE pricing that does not permit the OLOs to make a profit, thereby stifling competition, or more nuanced approaches such as implementing relative pricing of products that favours BRE over the OLOs.
340. Furthermore, service quality and innovation at the wholesale level, including investment in “future proof” fibre networks, may be important enabling factors to support ‘sustainable’ retail competition over time in addition to playing a role in the achievement of high quality services. Consequently, the pricing framework should provide appropriate service quality

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incentives for the FSE which will be supplemented by additional measures including the potential inclusion of additional products within the FSE Product and Service Set and QoS targets.

Objective 3: Promote investment in a fibre-based NBN

341. The Purpose Statement sets a key aim to “*support the development of a fibre-based National Broadband Network*”. The pricing framework will play an important role in preserving the FSE’s incentive to invest in the NBN by enabling the FSE to recover its costs over time. As set out in the Purpose Statement, it is important that the FSE is “*able to recover its efficiently incurred costs and is allowed to earn a fair return on its investment*”. In this context, a fair return compensates the FSE for the opportunity cost of investing in the NBN, taking into account an appropriate risk premium.
342. The Authority recognises that the Government will play a role in influencing investment by setting targets for NBN deployment. In the Authority’s view, the pricing framework will play an important role in complementing these targets by providing adequate investment incentives; these will help to minimise the likelihood of specific targets being missed and more broadly support NTP4 policy objectives including in relation to “future proof” and state-of-the-art infrastructure.
343. Furthermore, by incentivising investment in the fibre-based NBN, this increases its coverage and thereby the proportion of the population to which retail operators are able to offer fibre-based products. Combined with lower prices resulting from incentivising efficiency, these objectives of the pricing framework work together to promote take-up of fibre-based products across Bahrain.
344. It is important to acknowledge that the pricing framework may involve some trade-off between objectives, such as promoting competition and preserving investment incentives. Low prices facilitate effective service-based competition. However, high prices may allow a faster recovery of investment costs and therefore provide stronger investment incentives, which may ultimately benefit consumers in the longer term.

10.2 An Overview of Regulatory Approaches

345. There are various types of pricing frameworks implemented by regulators depending on the context at sector level and nationally, as well as the regulator’s duties and objectives. In the long term, the FSE is envisioned in NTP4 to be a utility-style entity deploying Bahrain’s NBN fibre infrastructure. Thus, pricing frameworks used by utility regulators in different countries provide useful benchmarks.
346. To set a backdrop for subsequent analysis, this section begins by discussing the two main approaches to pricing regulation at a high level: rate of return regulation and incentive regulation.

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Figure 26: Summary of high-level regulatory approaches

Rate of return regulation

- Regulated entity is allowed to recover the costs incurred in the provision of services, including a fair return on capital.
- Commonly used in utilities sectors

Incentive regulation

- Regulated entity is provided incentives to reduce costs.
- Prominent forms of regulation are revenue and price cap controls.

Source: the Authority

347. In practice, many specific pricing frameworks combine elements of both approaches. More specific methodologies relevant to broadband markets are discussed subsequently in the remainder of this section, specifically in the context of the objectives set out above.

Rate of return regulation

348. Under this approach, also known as ‘cost-plus’ regulation, the regulated entity is allowed to recover the costs incurred in the provision of services, including a fair return on capital, but it is typically not allowed to earn higher revenues than this. This means there is an implicit cap on the prices that may be charged. Prices under this type of regulation could be considered fair both from a consumer and firm perspective, insofar as they enable investments and ongoing costs to be recovered whilst ensuring prices are not excessive.

349. Although rate of return regulation is cost-based overall, it does not imply that each individual product-specific price must reflect the costs of providing that product. For example, the operator may be given flexibility to price its products subject to its total revenue not exceeding the estimated revenue requirement.

350. The core motivation for rate of return regulation is to incentivise investment, whilst also maintaining reasonable price and/or profit levels. These incentives are provided by allowing the regulated entity to earn a fair rate of return on investment. Moreover, investors are allowed to recover sunk investment costs through a stream of depreciation allowances.

351. The promotion of investment incentives may come at a cost of increased risks for the firm’s customers, and indirectly end users. For instance, an exogenous increase in costs will be passed on to customers in the form of higher prices. This risk allocation may be inequitable, as end users have smaller financial capacities to absorb these risks.

352. There are other possible risks associated with rate of return regulation:

- a. It may provide limited incentives for productive efficiency. If any costs incurred in the provision of services are recoverable, the operator may have little incentive to reduce costs. This may be exacerbated in a dynamic setting if regulators act to pass on cost inefficiencies to consumers in the form of higher prices.
- b. Information asymmetry between the regulator and operator may lead to adverse outcomes. The regulator has limited information on the operator’s true costs and may find it difficult to verify forecasted costs. Thus, the operator has an incentive to overstate its costs, which may lead to excessively high prices.

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- c. A guaranteed rate of return may encourage the operator to over-invest and build up excessive capital stock.⁷⁷ The substitution towards capital-intensive business plans may result in an excessively high capital-labour ratio, which may represent an inefficient use of capital.

353. Key characteristics of rate of return regulation are represented in the Building Block Model ("BBM"), which is used by regulators to estimate a revenue requirement that allows the regulated entity to recover its efficiently incurred costs.
354. BBM-based pricing frameworks are widely used in Europe and elsewhere in the regulation of utilities, rail infrastructure, and airports. In telecommunications, this type of regulation is being used in Australia to regulate wholesale services and incentivise investment in support of national broadband objectives. New Zealand also plans to use a similar approach from 2020 to regulate wholesale broadband services. BBM is discussed in the section below.

Building Block Model with Regulatory Asset Base

355. Under BBM, the regulated entity is allowed to recover the efficiently incurred recurring cash costs of operating and maintaining its infrastructure and providing the regulated services. Opex may include direct costs (such as input materials and labour) and indirect costs (such as corporate overheads). Regulators may take various steps to try to ensure that only the efficient level of opex is taken into account and to minimise any incentives for the regulated entity to deliberately inflate its opex forecasts.

Figure 27: Key concepts in the BBM

Revenue requirement: This consists of several 'building block' cost components: opex, return on capital (RAB), depreciation allowances, any applicable tax allowances, and various incentive components. Once calculated, this revenue requirement can be used to impose price controls on the regulated entity, for example in the form of a maximum allowable revenue cap.

Financial Capital Maintenance ("FCM"): Under FCM, the regulated entity will be compensated for efficiently incurred expenditure, so that its financial capital is maintained over time. In line with FCM, regulators typically take steps to ensure that only efficient levels of opex and capex are included in the revenue requirement.

RAB: This can be defined as the value of assets within the regulated entity necessary to carry out the functions of the business.⁷⁸ The RAB plays an important role in incentivising investment, as the revenue requirement explicitly includes a return on the RAB.

Updating the RAB: Over time, the RAB is typically increased by capital expenditure and decreased by asset disposals and depreciation.

Source: the Authority

356. Based on the revenue requirement, the regulator may choose from alternative forms of price control. The BBM is often used in the regulation of firms providing homogeneous goods (such as utilities and airports). In these cases, the standard approach is to set an

⁷⁷ This is known as the Averch-Johnson effect. Averch, H., & Johnson, L. L. (1962). 'Behavior of the firm under regulatory constraint.' *The American Economic Review*, 1052-1069.

⁷⁸ Helm, D. (2009). 'Utility regulation, the RAB and the cost of capital.' *Competition Commission Spring Lecture*, 3.

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overall revenue cap, or a revenue yield cap expressed on a per-unit basis equivalent to the revenue requirement, thereby permitting the incumbent to recover its costs whilst preventing its ability to make excessive returns through monopoly pricing.

357. Where there are multiple heterogeneous products, as is the case for wholesale telecommunications products, this overall revenue cap can be complemented by additional measures including the setting of price caps on specific products or product baskets. These options are discussed in further detail in Technical Annex A. This price control may be complemented by demand forecasts to ensure that any product-specific prices align with the revenue requirement.

Incentive regulation

358. In contrast to rate of return regulation, incentive regulation focuses on providing incentives for cost reduction. The key mechanism is the independence of prices from the actual costs controllable by the operator. As prices are allowed to diverge away from controllable costs, the regulated entity has an incentive for cost efficiencies because it profits from the difference between prices and actual costs.

Figure 28: Overview of incentive regulation⁷⁹

There are various forms of incentive regulation in practice, with the more prominent ones being price cap and revenue cap approaches. These forms of regulation involve setting a maximum allowable price or revenue path for regulated services in a specified period. This path is largely independent of the actual production costs incurred by the operator.

On a given price path, the operator may be allowed to adjust prices according to exogenous variables such as overall inflation. One of the most prominent forms of incentive regulation is 'CPI – X', where CPI is the Consumer Price Index, a measure of inflation, and X represents expected efficiency savings.⁸⁰ Under this regulation, prices of services are allowed to increase by (CPI – X)% every year until the next price review is conducted. Typically, the efficiency factor is estimated by the regulator to reflect technological progress or falling input prices over time, for example based on benchmarking analysis, historical data, and forecasting.

Under 'CPI – X' regulation, the regulated entity has strong incentives to reduce costs because it profits from any efficiency gains in excess of X. The profits from cost savings may be invested back into operations, which in turn may promote product innovation and further efficiency savings. Moreover, these efficiency savings may be passed on to consumers over time.

Source: the Authority

359. Incentive regulation generally involves less demanding data requirements than rate of return regulation. Thus, there may be less scope for the operator to exploit the problem of information asymmetry to its advantage, supporting transparency and accountability.
360. In contrast to rate of return regulation, the operator now bears the risk of any adverse and unexpected market conditions. This is because the extent to which the operator can pass on exogenous costs through higher prices is limited to (CPI – X)%. Thus, customers and

⁷⁹ For more information see for example Arblaster and Jamison (1998). *Introduction to the Fundamentals of Incentive Regulation*.

⁸⁰ Littlechild, S. (1983). 'Regulation of British Telecommunications' Profitability.' *London: HMSO*.

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end users face limited exposure to price risk at least until the following price review. Equally, the operator may receive large profits from unexpected cost reductions that are not passed on to consumers, which may lead to inequitable outcomes.

361. Incentive regulation presents a different set of potential limitations:

- a. Investment incentives may be relatively weak, since capex is not explicitly accounted for in setting price controls. There is no guarantee that sunk investment costs can be recovered with a fair return. Thus, the regulated entity may have to absorb the risks of failed investments. While this may help to ensure that investment plans are prudent, investment incentives overall may be reduced.⁸¹
- b. At any given time, the price of services may not reflect underlying costs, which may adversely affect allocative efficiency. The divergence between prices and costs may be substantial if the regulatory period is long.
- c. The regulated entity may be over-incentivised to reduce costs, which could be at the expense of service quality. To the extent that maintaining and improving service quality incurs higher costs, excessive cost reduction may have a detrimental effect on service quality. Thus, it may be prudent to complement incentive regulation with service quality standards.⁸²

362. In practice, there may be challenges in consistently providing incentives for cost efficiency. For example, if past efficiency gains are taken into account to update future expected efficiency savings, there may be a perverse incentive for the operator not to reduce costs towards the end of a regulatory period.⁸³

363. Applications of incentive regulation are typically seen in Long-run incremental cost ("LRIC") pricing. This is a prominent pricing approach adopted by several regulators, including those in the telecommunications sector. Ofcom, the regulator in the UK, has used LRIC models among other approaches to set wholesale prices for the wholesale access provider, Openreach, which was functionally separated from BT in 2005 in a bid to promote competition and non-discriminatory access to wholesale inputs.⁸⁴ LRIC is discussed in the section below.

LRIC based pricing

364. Whereas the BBM is predicated on recovering the operator's efficiently incurred costs, LRIC models in the telecommunications sector estimate the forward-looking incremental cost of providing a particular regulated service, typically for a hypothetically efficient

⁸¹ Ofwat, the water regulator in England and Wales, modified price cap regulation to incentivise investment. Water prices are allowed to increase by $(RPI - X + K)\%$, where K represents capital investment requirements. RPI refers to the retail price index, which is an alternate measure of inflation used in the UK.

⁸² Ofcom, the telecommunications regulator in the UK, imposes minimum service requirements on Openreach with penalties levied for breaches of these requirements.

⁸³ This dynamic incentive problem is also known as the ratchet effect. Weitzman (1980). 'The "ratchet principle" and performance incentives.' *The Bell Journal of Economics*, 302-308.

⁸⁴ Ofcom. (2005). *Ofcom accepts undertakings from Board of BT Group plc on operational separation* [Press release]. Retrieved from <https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2005/ofcom-accepts-undertakings-from-board-of-bt-group-plc-on-operational-separation>.

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operator. The reference to long-run means that all costs are treated as being variable, and that the operator is able to undertake capital investment to increase production capacity.

365. Key differences between LRIC-based pricing approaches and the BBM include the fact that under LRIC-based frameworks, it is not necessary to maintain a RAB over time, updating it in line with the actual investments made by the regulated entity. Instead, implementation of LRIC-based frameworks in the telecommunications sector tend to rely on cost forecasts for a hypothetically efficient operator.
366. A second key difference between the two frameworks is that LRIC-based frameworks necessarily entail price controls on individual products. On the other hand, BBM frameworks provide alternative options for setting price controls, which may include restrictions on individual product pricing or only on the revenue that may be earned.

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Figure 29: Key concepts in LRIC-based pricing frameworks⁸⁵

Long run incremental cost (LRIC). The LRIC of a specific product is the difference between the total costs of producing all products offered by the regulated entity and the total costs incurred in an alternative scenario where the product under consideration is not produced, all else being equal.

Measures of LRIC. There are alternative measures of LRIC, which differ according to the allocation of common costs across products and the level of incremental quantity used for the product in question. Common measures include:

- a. **Pure LRIC.** This measure considers a single service and does not include any allowance for common costs.
- b. **LRIC+.** This measure of LRIC includes an appropriate allocation of common costs and non-network costs that are not directly attributable to specific products.
- c. **Long-run average incremental costs ("LRAIC").** When LRIC is divided by the relevant pre-determined increment in quantity produced, LRAIC is obtained for a unit of the product.
- d. **Standalone costs ("SAC").** The SAC is the cost of producing incremental amounts of a product on its own, including all relevant common costs. As such, it is typically higher than the measures mentioned above.

Bottom-up ("BU") models. BU-LRIC models are commonly used by telecommunications regulators internationally. These models are used to design a hypothetically efficient network based on a network engineering approach and on assumptions about the costs associated with different network components. This approach allows for an understanding of cost drivers and provides the ability to test the sensitivity of costs to key variables such as retail demand.

Top-down ("TD") models. TD-LRIC models use regulatory accounting data to allocate historical costs to individual products according to specified allocation rules. This approach reflects the existing network and its associated inefficiencies. The TD-LRIC model is data-intensive and requires the timely submission of regulatory accounts; otherwise, historical costs may be rendered obsolete.

Source: the Authority

Specific pricing frameworks

367. As a summary, rate of return regulation can be a particularly effective approach to promote investment, while incentive regulation may be more effective in promoting efficiency. Since regulators often have multiple objectives, which include the promotion of investment alongside efficiency objectives, there is likely to be a trade-off between these objectives. In practice, a variety of specific regulatory frameworks are used, with most regulators adopting hybrid approaches to achieve their objectives.

368. To establish a position on the preferred type of regulation of the FSE in the long term, the Authority considers BBM and LRIC, summarised in Figure 30.

⁸⁵ For further background information see the Authority's 2011 Position Paper *Development, implementation and use of bottom-up fixed and mobile network cost models in the Kingdom of Bahrain*.

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Figure 30: Summary of alternative pricing frameworks considered for Bahrain

Building Block Model with Regulatory Asset Base	Long-run incremental cost
<ul style="list-style-type: none"> • An implementation of rate of return regulation, allowing recovery of costs and a fair return on capital. • Can include various mechanisms that draw on the principles of incentive regulation to incentivise efficiency. 	<ul style="list-style-type: none"> • Reflects principles of incentive regulation in that the regulated entity can benefit by outperforming efficiency expectations. • Often used to set price caps on the basis of a hypothetical efficient operator.

Source: the Authority

369. The Authority has considered additional pricing frameworks such as the Efficient Component Pricing Rule ("ECPR"). However, these are not considered suitable for the regulatory pricing framework of the FSE due to limited alignment with Bahrain's regulatory objectives and practical implementation issues. For example, in the case of ECPR, its underlying economic rationale is to induce efficient market entry which is not aligned with the direction of Bahrain's telecommunications sector. Furthermore, as the same wholesale service may be used to produce a variety of retail services, each of which is priced differently, different prices may need to be determined for the same wholesale service depending on the final retail services for which it is used as an input. This unintuitive approach may give rise to arbitrage opportunities.

10.3 Proposed Approach for the Regulatory Pricing Framework

370. The Authority is of the view that a BBM-based pricing framework is best suited to achieving the regulatory objectives in the long term as the FSE moves towards a stronger form of separation. The framework will be complemented with appropriate regulatory instruments in line with the characteristics of the specific products and service that will be offered by the FSE, as well as efficiency and market conditions. This approach balances the objectives of incentivising investment in a fibre-based NBN, promoting efficiency, and creating a level playing field for retail operators in Bahrain.

371. In the interim period prior to the separation of Batelco, the Authority will take into account the transitional needs of all operators and evaluate incentives required to ensure a smooth transition to the long term FSE Product and Service Set. However, the discussion in this section focuses largely on the long term outcomes the Authority wishes to achieve as part of the regulatory pricing framework. As such, the pricing framework considered below will require the appropriate degree of separation of Batelco in order to align with the objectives outlined in Section 10.1.

372. During the transitional period, the Authority will continue to follow its current pricing framework. At the same time it will take steps to ensure that transitional products and services are priced appropriately to align with the long term objectives of this Framework. As such, some features of the long term pricing framework may be applied during the transitional period where the Authority is of the view that this is in line with a gradual

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approach to separation. Once the FSE is issued its licence, the Authority will move to a BBM-based pricing framework as set out below.

373. This section begins by evaluating the BBM and LRIC approaches in the context of the objectives established in Section 10.1. Subsequently, the limitations of this proposed approach are discussed along with potential solutions, recognising that both models present their own unique drawbacks.

10.3.1 Evaluation of proposed approach against the key objectives

Objective 1: Promote efficiency

374. The pricing framework should promote productive, allocative, and dynamic efficiency in the supply of telecommunications services, whilst promoting dynamic efficiency by incentivising investment and innovation over time.
375. With regard to productive efficiency, both LRIC-based and BBM models have the potential to provide strong incentives for the FSE to minimise costs as the incumbent is allowed to retain a proportion of its efficiency gains as profit.
376. In BBM models, cost efficiency incentives are delivered through determining the revenue-requirement on an *ex-ante* basis. When the operator incurs lower costs than its forecast level through cost efficiencies, it is typically allowed to keep some, or all, of the difference as profit. Conversely, when the operator incurs higher costs than allowed for, it may have to absorb a loss. Under LRIC-based pricing frameworks, independence of prices from actual costs means that the operators has a strong incentive to reduce its costs. The operator's target is to be at least as efficient as the hypothetically efficient operator, otherwise higher production costs from less efficient production may lead to losses.
377. Whilst allocative efficiency will ultimately depend on the specific pricing approach employed, the forward looking nature of LRIC-based frameworks risks that prices may be unrelated to actual costs as long-run costs are hypothetical and difficult to model. Conversely, the BBM promotes a degree of allocative efficiency because the revenue requirement consists of cost components. Thus, there is an implicit mechanism to ensure that prices do not diverge away from costs across all products as a whole. However, allocative efficiency may not be achieved at an individual product level; if for example the operator has flexibility to price its products subject to an overall RAB based revenue cap, product-specific prices may not reflect costs. This notwithstanding, BBM allows the option of introducing price controls on some specific products should regulators wish to strengthen the degree of allocative efficiency.
378. Over time, dynamic efficiency is achieved under the BBM, as the FSE would have incentives to invest in new solutions that could lead to lower costs in the longer term, knowing that it will be allowed to recover efficiently incurred capital.
379. Under LRIC-type pricing frameworks, dynamic efficiencies relate primarily to the promotion of infrastructure based competition as LRIC prices can be used to convey 'build or buy' signals to potential market entrants, encouraging more cost-efficient operators to enter the market. However, this differs from the key objectives for Bahrain's telecommunications sector.

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Objective 2: Promote competition and create a level playing field

380. In principle, both LRIC and BBM frameworks can promote effective retail competition through preventing wholesale prices being set at unregulated monopoly levels. However, successful retail competition also relies on supply of wholesale products that meet the reasonable requirements of downstream operators which supports innovation in the retail layer.
381. As outlined below, the BBM framework can provide strong investment incentives while still constraining wholesale price levels through allowing the FSE to recover its costs whilst restricting its returns through the overall revenue cap. In the long-run, this framework should promote sustainable retail competition and allow for a wide range of differentiated retail services on the basis of price and quality.
382. In comparison, as the LRIC framework bases price controls on a theoretical efficient operator and may not reflect the FSE's actual costs, this could encourage an excessive focus on low wholesale prices at the expense of incentives for higher quality services and investment in "future proof" networks. However, the issue at hand can be resolved through a QoS framework or licence commitments. Under the BBM, tools are available to balance this risk, as the regulator can set the appropriate level of efficiency incentives by controlling the extent to which the regulated entity is allowed to profit from efficiency gains.
383. The Authority also considers the implications of the pricing framework on the ability of the FSE to discriminate against the OLOs, thereby stifling retail competition. A BBM framework with a revenue cap set equal to the revenue requirement would confer a significant degree of pricing flexibility to the FSE who may have an incentive to use this flexibility to undertake cross subsidisation and margin squeeze. However, this can be addressed through additional measures as part of the BBM pricing framework, including the use of individual price caps on certain products. It should be noted that this is reliant on such additional tools, which could increase the need for regulatory oversight.
384. The relatively high regulatory certainty associated with BBM could further lead to a lower cost of capital. This could lead to lower wholesale prices and ultimately lower prices faced by end-users.

Objective 3: Promote investment in a fibre-based NBN

385. To encourage fibre investment in support of NTP4 objectives, the pricing framework needs to ensure that the FSE has the opportunity to recover investment costs while providing adequate incentives for efficient investment. The BBM is designed to incentivise large-scale infrastructure investment and therefore appears inherently more suitable for promoting key investment objectives. Conversely, a LRIC framework would not offer the same assurances with regard to cost recovery and effective NBN deployment.

Cost recovery

386. Given the magnitude of investments required to deploy the NBN, investment decisions may depend greatly on the expected rate of return on capital, the degree of risk, and the time taken to recover costs. There may be potential for substantial uncertainty over these factors, for example due to uncertainty about future broadband demand and the migration to fibre services.

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387. The BBM may be more suitable to achieving cost recovery due to a cost-based revenue requirement and the maintenance of a RAB, with a return on capital explicitly included in the revenue requirement that is used to set price controls. Furthermore, through introducing price controls on individual products as part of this BBM framework that reflect value- or demand-based pricing, it is possible to develop a programme of price differentiation that allows greater cost recovery for products with lower elasticities thereby maximising social welfare whilst ensuring the FSE has incentives for investment. Finally, the consistent process of updating the RAB over time provides a degree of stability that may reduce investment risk and facilitates long-term business planning. These features may provide effective incentives to undertake investment.
388. In comparison, there is substantial risk of under-recovery of actual fibre investment costs under LRIC frameworks based on a hypothetical efficient operator. The possibility of making a loss on fibre investment, even if it does not materialise, may reduce investment incentives, and may particularly discourage non-essential investment that could improve service quality and innovation.

Copper investment

389. While fibre investment is key to achieving NTP4 objectives, there should equally be incentives to discontinue unnecessary investments in the copper network, as this is not a long-term objective in Bahrain. Further copper investment risks delaying the migration to fibre and may increase costs through the parallel running of copper and fibre networks.
390. The FSE should be incentivised to shut down the copper network when the profit from operating a fibre network exceeds that from running two networks, taking into account relevant shutdown costs. However, from an equity perspective, there may still be a need to incentivise limited copper investment in areas not covered by NBN deployment.
391. LRIC models may disincentivise copper investment if prices are modelled on hypothetical long-run costs of operating a single fibre network or if the models assume that copper is phased out. Such prices would encourage the FSE to switch off the copper network as soon as it is profitable to do so, in order to move towards the hypothetical efficient network model.
392. Although less relevant in the Authority's view, the BBM can similarly be used to provide incentives to discontinue any future copper investment. The inclusion of any new investment made by the FSE in the RAB can be made subject to pre-determined criteria, for example, should the FSE decide to invest in copper rather than fibre (or a wireless solution) in an area not currently connected, this could not be considered as part of the RAB.

Migration from copper to fibre

393. The pricing framework should consider the impact of relative prices of wholesale copper and fibre access services on the migration to fibre. For example:

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- a. A copper price that is too low could limit end users' propensity to subscribe to more expensive fibre services, which in turn may result in weak incentives for fibre investment, potentially harming end user's interests in the long run.⁸⁶
- b. A copper price that is too high could mean that the FSE is able to earn high profits from copper services and therefore faces limited incentives to invest in fibre, potentially harming end users both in the short run (through high copper prices) and long run (through lower fibre deployment).⁸⁷

394. While recognising risks associated with pricing, there may still be benefits from the FSE retaining a degree of pricing freedom. In particular, setting cost-based fibre prices may not facilitate the migration process if fibre costs are relatively high in the short-run. Thus, there may be a case to move away from cost-based prices at least in the short-run to stimulate fibre demand. As fibre subscriptions increase, the case for cost-based prices may become more attractive.

395. The BBM can provide regulatory flexibility to facilitate the migration from copper to fibre, managing the various risks outlined above through some of the following mechanisms, for example:

- a. **Initial value of RAB.** The value of existing copper assets can be set to allow cost recovery without incentivising unnecessary further investment in copper, which would delay migration.
- b. **Depreciation.** Different depreciation profiles may be used for different assets to reflect differences in expected utilisation over time. The depreciation method can be adjusted to influence the time path of the revenue requirement over time, as appropriate.

396. However, in the absence of additional regulatory controls such as price controls, a single revenue cap based on the revenue requirement may disincentivise the FSE to promote take up of fibre products which are likely to have a higher price than copper alternatives, delaying migration from copper. This can be addressed through the use of additional price controls to allow varying degrees of flexibility in the pricing of fibre and copper subject to meeting an overall revenue requirement.

397. Under a LRIC framework, prices for each product would be cost-reflective, which may limit pricing freedom that could facilitate the migration process. While these prices are economically efficient in theory, it may be difficult to model the migration process given the uncertain demand for fibre. Thus, there is a risk that prices may send inaccurate signals to end user and thus potentially delay migration.

⁸⁶ Plum Consulting. (2011). *Copper pricing and the fibre transition – escaping a cul de sac*.

⁸⁷ WIK-Consult. (2011). *Wholesale pricing, NGA take-up and competition*.

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Table 1: Summary of evaluation of BBM and LRIC approaches

Objective	BBM	LRIC
Promote efficiency	<ul style="list-style-type: none"> ✓ Tools available to incentivise productive efficiency. ✗ Tools could increase the degree of regulatory oversight needed. ✓ Dynamic efficiency supported by investment and innovation incentives. ✓ Converts a degree of allocative efficiency as prices based on cost components. 	<ul style="list-style-type: none"> ✓ Encourages productive efficiency by basing prices on a hypothetically efficient operator. ✗ Dynamic efficiency may be reduced, as incentives for innovation may be weaker. ✗ Does not guarantee allocative efficiency as prices are not based on actual costs
Promote competition	<ul style="list-style-type: none"> ✓ Overall levels of Wholesale prices are constrained, enabling effective price-based competition. ✓ Incentives for investment and innovation support competition over quality as well as price. ✗ Greater degree of pricing flexibility that may allow discrimination against the OLOs; however, this can be largely addressed through additional price caps as part of the BBM framework. ✓ Greater regulatory certainty may lead to a lower cost of capital. 	<ul style="list-style-type: none"> ✓ Wholesale prices are constrained, enabling effective price-based competition. ✗ Weaker incentives for investment and innovation may mean scope of competition focuses on price rather than quality and product differentiation.
Promote investment in fibre-based NBN	<ul style="list-style-type: none"> ✓ Investment incentives supported by allowing cost recovery and including fair return on capital in revenue requirement. ✓ Capex reviews can ensure investment supports objective of “future proof” fibre-based NBN. ✓ Individual price caps can promote value-based pricing for specific products allowing greater cost recovery whilst maximising consumer welfare. 	<ul style="list-style-type: none"> ✓ LRIC-based prices can include a return on capital employed, based on hypothetical estimated costs. ✗ No explicit cost recovery mechanism based on actual costs, so investment incentives may be weaker.

Source: the Authority

Other considerations around BBM

398. Whilst the BBM framework appears most likely to promote the regulatory objectives, it has some inherent limitations that may need to be addressed. In some cases, this requires consideration of the trade-off between different objectives.

399. BBM-based regulation has been typically applied to sectors such as utilities that may have significantly different characteristics compared to Bahrain’s fixed broadband market. At a high level, this means that standard applications of the BBM framework may have limitations that need to be addressed in order to apply it in a telecommunications context:

- a. The fixed broadband market involves a large number of heterogeneous products (including a range of speeds offered for each type of service). Existing applications of the BBM often involve a single homogeneous product, so the revenue requirement can straightforwardly be converted to a price cap if desired. Similarly,

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the issue of relative prices does not arise in many applications of the BBM, whereas it may be an important issue in the regulation of the FSE.

- b. Sectors such as utilities may be significantly more stable and predictable than the more dynamic telecommunications sector, with firms generally able to recover their costs. There may be greater potential for inaccurate forecasting in the fixed broadband market, and it is possible that the FSE's ability to fully recover costs in the first few years may be limited if fixed broadband uptake remains low initially.

400. The BBM provides sufficient flexibility to address these challenges along with others, while the international precedent from Australia and New Zealand provides useful guidance for applying the framework to fixed broadband operators subject to NBN objectives.

401. The key risks and associated with BBM-type pricing frameworks and the regulatory and pricing tools to mitigate such risks are summarised in the table below. A detailed discussion of these risks and mitigations is provided in Technical Annex A.

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Table 2: Summary of risks with the BBM framework

Risk	Description	Mitigation
Cross-subsidisation and margin squeeze	In the absence of further price control mechanisms, the FSE would retain a high degree of pricing flexibility with a potential for cross-subsidisation and margin squeeze.	Telecommunication regulators who have adopted the BBM approach have incorporated price control mechanisms such as anchor pricing. Examples include Australia, where the regulatory framework supports a single maximum revenue cap with price caps for individual wholesale services
Demand risk	Prices derived from the revenue requirement are designed to fully recover costs and a rate of return. Low demand may therefore lead to higher prices that may not maximise uptake of ultra-fast broadband services.	This may be addressed through the use of appropriate price controls which limit the price of certain fibre products or baskets of products
Capex bias	There may be an incentive for the FSE to pursue excessively capital-intensive business plans ('capex bias') because once new assets are entered into the RAB, the FSE is allowed to recover investment costs and earn a return on capital.	A regulatory review of business plans may help to reduce any tendency towards capital-intensive business plans.
Inaccurate forecasts	The effectiveness of BBM relies on the accuracy of the FSE's forecasts. Due to information asymmetry, the FSE may have an incentive to submit inaccurate forecasts of opex and capex.	Various mechanisms are available to address discrepancies between forecast and actual costs, which can help to shield the FSE from short-term risks of under-recovery while discouraging deliberately inflated forecasts.
Price instability	The risk of exogenous demand or supply shocks are largely borne by wholesale customers, which may indirectly affect end users.	The BBM framework has flexibility to include measures to promote price stability, such as pricing principles or other restrictions on individual product prices.

Source: The Authority

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The Authority's position:

402. The Authority's view is that a BBM-based pricing framework is best suited to achieving the regulatory objectives in the long term as the FSE moves towards a stronger form of separation as standalone utility style operator. This framework provides adequate incentives for investment in a fibre-based NBN while supporting the efficiency and competition objectives.
403. The Authority recognises that there are potential risks associated with the BBM framework. However, the BBM framework provides sufficient flexibility to address these challenge. As such, a number of appropriate regulatory and pricing tools will need to be considered to mitigate such risks, which would be informed by relevant international experience.
404. The BBM framework will be complemented with appropriate regulatory instruments in line with the characteristics of the specific products and service that will be offered by the FSE, as well as efficiency consideration and market conditions.
405. During the transitional period, the Authority will continue to follow its current pricing framework. At the same time it will take steps to ensure that transitional products and services are priced appropriately to align with the long term objectives of this Framework. As such, some features of the long term pricing framework may be applied during the transitional period where the Authority is of the view that this in line with a gradual approach to separation.
406. Further detail on the implementation of the BBM framework and relevant regulatory instruments will be developed following the finalisation of the FSE's products and services.⁸⁸

⁸⁸ The key components of the proposed BBM pricing framework are set out in Technical Annex C each of which will be re-examined and updated as necessary as part of the RO reset process.

Technical Annex A: Regulatory Pricing Framework

Rationale for a Regulatory Pricing Framework

407. The need for a regulatory pricing framework arises from the FSE's market power. Economic theory suggests that with freedom to set prices at a market level, monopolies set profit-maximising prices such that marginal revenue equals marginal cost. However, such prices may be higher than those under perfect competition, leading to the monopoly providing lower quantities of output to the market than would be the case in a competitive market and consequently, allocative inefficiencies.
408. Furthermore, since the FSE will be the sole provider of a number of 'bottleneck' inputs required by all downstream operators to offer retail products, downstream operators will take input prices as given. Consequently, above cost wholesale monopoly prices are likely to be passed on to consumers in the form of higher retail prices, likely reducing retail demand and limiting uptake of broadband services.
409. High monopoly prices may also create consumer equity concerns. That is, the above cost wholesale prices set by an unregulated monopolist could mean that only relatively well-off consumers would be able to benefit from NBN deployment and fibre broadband.
410. In addition, absent pricing regulation, the FSE might also employ a number of cross-subsidisation and margin squeeze mechanisms:
- a. **Cross subsidisation across different types of products.** The FSE could charge high fibre prices for one type of product and use the returns from this to subsidise other products, say based on copper, that would not fully meet downstream operators' requirements. This could delay the migration to the FSE Product and Service Set.
 - b. **Cross subsidisation between OLOs and BRE.** High wholesale prices for products demanded primarily by the OLOs could be used to cross subsidise the wholesale price of products used mainly by BRE. By therefore increasing input prices for OLOs, the FSE would enable BRE to offer lower prices in the retail market, whilst not strictly breaching EoL.
 - c. **Margin squeeze.** By setting above cost wholesale prices, excess returns earned by FSE could be used to cross-subsidise BRE, so allowing it to set lower retail prices than OLOs are able to offer and harming retail competition.
411. Finally, from an efficiency perspective, lack of competitive pressures arising from exclusivity may mean that an unregulated FSE has limited incentives to pursue efficiency in its investments and operating costs. This could lead to lower levels of service quality, reliability, or innovation and jeopardise the Purpose Statement objectives for effective NBN deployment and efficiently delivered services.
412. The use of a regulatory pricing framework is therefore a core channel through which the Authority can prevent potentially undesirable outcomes arising from the FSE's market power. This does not, however, mean that all FSE's prices should be set equal to some estimate of marginal or incremental cost. Rather, the pricing framework offers the Authority

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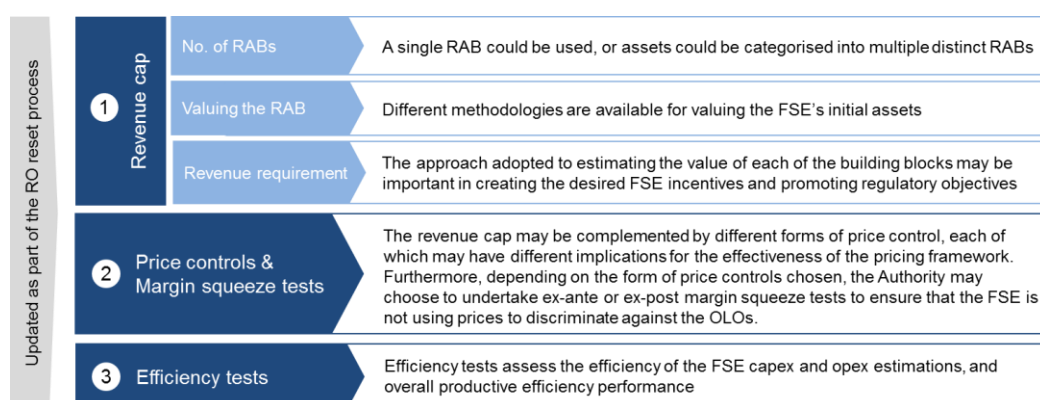
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a controlled opportunity to make use of the FSE's market power, which it derives from its position as the exclusive provider of fixed wholesale data products and services, to implement value-based pricing for relevant products. In turn, this can be used to assist the Authority in achieving its core regulatory objectives, including the recovery of efficiently incurred cost, maximising take up and incentivising investment.

Components of the BBM

413. The BBM is a pricing framework that offers a degree of flexibility in its specific design and implementation. It offers the option to incorporate additional price controls such as price caps to supplement the overall revenue cap arising from the RAB based revenue requirement. Indeed, it can also be supplemented with a number of other economic tests, including margin squeeze and productive efficiency tests, to assess whether the pricing framework is facilitating the regulatory objectives.

Figure 31: Key components of the BBM pricing framework



Source: the Authority

414. Each component of the BBM highlighted in the figure above is discussed in turn in the remainder of this section.

Revenue Cap

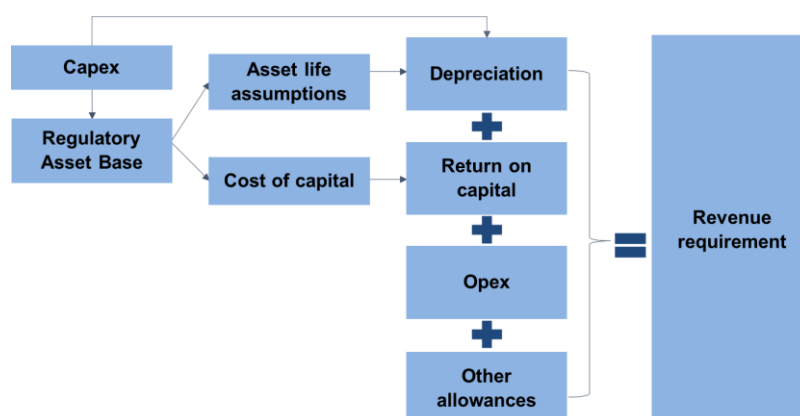
415. The revenue cap is a defining feature of BBM pricing frameworks, set in accordance with the revenue requirement which itself is determined by the RAB. In setting a total revenue requirement aligned with the FSE's revenue requirement, this pricing framework aims to ensure that wholesale prices overall are not higher than the level needed to compensate an efficiently run operator, whilst providing a fair return on its investment. Consequently, investment incentives should be preserved whilst constraining the ability of the FSE to use its monopoly power to set excessive prices.

416. The key components that make up this revenue requirement are set out in the figure below.

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Figure 32: Components of the revenue requirement



Source: the Authority

417. There are a number of considerations in relation to the establishment of the revenue cap, the majority of which relate specifically to the RAB which underpins the BBM model:

- a. Choosing the number of RABs.
- b. Valuing the RAB.
- c. Updating the RAB.
- d. Calculating the revenue requirement.

The rest of this section addresses each of these points in turn.

Choosing the number of RABs

418. As emphasised in Section 10.2, a key design feature of the BBM is the RAB. To implement the BBM, the Authority will need to determine how many RABs the FSE's assets should be divided between. The broad options are to maintain a single RAB consisting of all the FSE's assets, or multiple RABs based on a classification of different types of assets.

419. In the FSE's context, multiple RABs may be established based on:

- a. **Network architecture.** Separate RABs could be established for network infrastructure and physical (non-network) assets. For example, a RAB for network infrastructure may include fibre and copper assets, whereas any other fixed assets would be included in a separate RAB.
- b. **Product categories.** Different types of services are produced from different assets. For example, copper and fibre services are provided on the copper and fibre networks respectively. Thus, there may be a case to establish separate RABs according to high-level categorisations of products, such as copper and fibre.

420. A potential advantage of establishing multiple RABs is that different WACCs may be applied to different RABs according to their respective asset profiles. For example, fibre assets might be considered riskier than copper assets because of the uncertain demand for fibre. Providing a higher rate of return on fibre assets may offset this risk and incentivise fibre investment.

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421. Further, the number of RABs is related to the choice of price control, which is discussed in more detail in the relevant section below. Briefly, maintaining multiple RABs facilitates the calculation of separate revenue requirements for different asset categories, which may be used to derive price controls that are specific to each category. For example, separate price controls may be established for copper and fibre services or more granular categories. While this may have benefits in terms of regulating the relative prices of different products, it risks being excessively prescriptive and the Authority considers that alternative options are also available to achieve this (as discussed in the relevant section below).
422. There are also important practical disadvantages with using multiple RABs:
- a. Some telecommunications infrastructure will be common to multiple services. When particular assets are required in order to offer multiple different types of wholesale products, the allocation of these common assets across separate RABs may not be straightforward and may rely on complex estimation of utilisation factors. Indeed, as the definition of individual RABs becomes more granular, the division of assets between these RABs will become increasingly challenging.
 - b. Estimating different WACCs for each RAB is likely to be a challenging and contentious process, for which there is limited precedent in the regulation of broadband markets. As such, it may be difficult for the Authority to establish values in a transparent and accountable manner.
 - c. Both of the above factors risk adding substantially to the administrative burden of the regulatory pricing framework, while the complexity involved may increase the risk of adverse effects from setting inappropriate definitions of asset categories and WACC values.
423. Consistent with these challenges, the use of a single RAB is prevalent in existing BBM frameworks across sectors, while telecommunications regulators and industry in Australia and New Zealand have both expressed a preference for the use of a single RAB, receiving industry support.⁸⁹

Valuing the RAB

424. The valuation of the initial RAB, based on the assets held by the FSE at the outset of the implementation of the new pricing framework, is critical. The initial value will continue to influence the value of the RAB in future periods, because the RAB is carried forward until the initial assets are fully depreciated. Furthermore, the initial RAB affects the revenue requirement and therefore the level of wholesale prices, which in turn will impact the initial consumer demand and investment incentives.
425. A key consideration for the valuation of the initial RAB is the cost recovery of legacy assets:
- a. A low RAB for legacy assets may mean that the FSE is unable to recover its sunk investment costs.

⁸⁹ ACCC. (2010). *Review of the 1997 telecommunications access pricing principles for fixed line services*; New Zealand Ministry of Business, Innovation & Employment. (2016). *Telecommunications Act Review: Options Paper*.

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- b. A high RAB for legacy assets would increase the revenue requirement as long as these assets have not fully depreciated, which may lead to higher wholesale prices and incentives for the FSE to delay investment in fibre.

426. Thus, the valuation of the FSE's assets plays an important role in ensuring cost recovery and incentivising fibre investment.
427. Regardless of the valuation method chosen, the value of the initial RAB should account for existing assets' accumulated depreciation. This will ensure that the FSE does not over-recover its costs by virtue of being a natural monopoly.
428. The valuation of the initial RAB may be conducted based on various methods. The three main methods are summarised below.

Figure 33: Asset valuation methods

Income-based approaches	Cost-based approaches	Market-based approaches
<ul style="list-style-type: none"> • An income-based approach would take into account the future cash flows that can be expected from an asset • This approach values assets based on the net present value of the estimated sum of future cash flows accruing to the assets. 	<ul style="list-style-type: none"> • For Historic Cost Accounting ("HCA") the valuation is based on the historic costs of assets adjusted for accumulated depreciation, potentially with indexation to account for inflation. • For Current Cost Accounting ("CCA") the valuation is based on current market costs of replacing the assets, adjusted for accumulated depreciation. 	<ul style="list-style-type: none"> • A market multiples approach would consider the value of the asset by reference to listed companies or transactions of assets of similar characteristics

Source: the Authority

429. The income-based approach has the potential to quantify an asset's true economic value, but it presents several disadvantages in the context of the FSE's assets. There is substantial uncertainty involved in modelling future cash flow streams, particularly for the FSE as a newly created entity, which may lead to inaccurate estimation. This risk is exacerbated by the speed of technological change in the market and the uncertainty over future demand for different wholesale services.
430. Market-based approaches do not appear valid in the current scenario given the lack of data on relevant transactions to be taken as a basis.
431. CCA and HCA are the two cost-based approaches commonly used in the valuation of telecommunications network assets internationally. When comparing CCA and HCA, various factors should be taken into account:
 - a. HCA is a widely understood approach based on actual historical financial accounts.⁹⁰ On the other hand, CCA is more theoretical and may require relatively complex modelling, increasing the administrative burden and the risk of inaccurate estimation.

⁹⁰ Note that this requirement may be problematic if accounting regulations have changed over time.

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- b. HCA allows for the recovery of actual costs incurred in investing in the Single Network, which incentivises investment by the FSE as it provides assurance that the FSE is able to recover its costs. In comparison, CCA seeks to estimate the net current replacement cost, which may differ significantly from the historical transaction value. Even where price and inflation trends result in a higher CCA value in comparison to HCA, this methodology introduces uncertainty with regard to the ability of the FSE to recover its costs, thereby evoking a risk premium and negatively impacting investment.
- c. A rationale for using CCA is that technological (in)efficiencies in previous investments can be accounted for by considering current market solutions and costs, whereas HCA uses actual incurred costs related to all previous investments regardless of their efficiency from a present day perspective.
- d. Whilst CCA is based on a sound theoretical rationale, it typically requires subjective assumptions in practice. For example, due to technological progress, assets now available may offer substantially higher quality, flexibility, and revenue-generating capacity than legacy assets. Given this, replacement costs may need to be adjusted for quality, which may require a degree of judgement with potentially large impacts on the valuation.⁹¹ That is, CCA is generally aimed at answering the theoretical question of 'what if assets were released to the market today?' Therefore, this approach involves substantial regulatory discretion and risk of an inappropriate valuation, while being potentially subject to challenge from OLOs. In comparison, the HCA is a transparent and objective approach as it relies purely on actual costs incurred (subject to depreciation).
- e. A general criticism of CCA valuation is that, where the CCA valuation of assets is higher than the HCA valuation, adopting the CCA methodology without any further adjustment allows the regulated entity to over-recover relative to its actual costs incurred. A specific occurrence of this may be seen if fibre is used as the Modern Equivalent Asset ("MEA") for copper⁹² while fibre networks are largely yet to be built; this risks overcompensating operators and weakening the incentives for further fibre investment.⁹³

⁹¹ For example, the Body for European Regulators for Electronic Communications (BEREC) has stated, "If the MEA has greater functionality and/or flexibility than the existing technology, a methodology is then required to 'abate; or reduce the MEA costs for the services of a reduced 'quality.'" The European Competitive Telecommunication Association (ECTA) has stated that, when fibre is taken as the MEA of copper, "one should in this context not take the total cost as equivalent to copper, but only that portion which would be required to offer the same level of service. However, this kind of assessment is inevitably subjective." See BEREC and ECTA responses to the 2011 European Commission Questionnaire on costing methodologies for key wholesale access prices in electronic communications.

⁹² For example in Switzerland "ComCom announced the system modification to a fibre valuation of the copper local loop as Modern Equivalent Asset (MEA) as of 1 January 2013." WIK Consult (2012). Analysis of alternative methods of price regulation.

⁹³ For example, the Centre for European Policy (CEP) has stated in 2011, "in a single MEA model the SMP operator would be compensated for a fibre network which is largely not yet built, which could potentially result in unjustified higher copper prices." ECTA has similarly stated, "if copper prices were calculated on the basis of fibre costs in circumstances where the dominant firm has not yet built fibre, it would compensate operators for investments they have not yet made and may never make. This would provide very little incentive to actually make those investments, since excess compensation would be received regardless." See CEP and ECTA responses to the

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432. Batelco currently produces separated regulatory accounts using both HCA and CCA, meaning that relevant data should be available for the purposes of RAB valuation under either approach.
433. The Authority acknowledges that the CCA approach is relatively prominent in telecommunications regulation internationally, though this is in the context of network cost modelling rather than initial RAB valuation under a BBM framework. For example, a 2013 Recommendation by the European Commission favours the CCA method: “NRAs should value all assets constituting the RAB of the modelled network on the basis of replacement costs, except for reusable legacy civil engineering assets.”⁹⁴ However, this recommendation is made in relation to BU-LRIC+ pricing frameworks and objectives of encouraging wholesale market entry, which does not reflect the policy context in Bahrain and the proposed BBM pricing framework. Therefore, CCA is not widely used in utility-style regulatory pricing frameworks based on RAB, which the Authority has taken as a benchmark.

Table 3: Summary of options for initial RAB valuation

	Historical Cost Accounting (HCA)	Current Cost Accounting (CCA)
Advantages	<ul style="list-style-type: none"> Widely understood approach Objective, transparent, and verifiable Relatively simple – low administrative burden Allows full recovery of previous capital costs thereby incentivising investment by the FSE 	<ul style="list-style-type: none"> Accounts for technological inefficiencies in current network
Disadvantages	<ul style="list-style-type: none"> Does not account for any technological inefficiencies in current network Can distort “build or buy” decisions, where a downstream operator has a choice for sourcing inputs. 	<ul style="list-style-type: none"> Less transparent A theoretical concept that is aimed at answering a ‘what-if’ question May require subjective assumptions that can be challenged Without considering any further adjustments, can risk providing over-compensation to the FSE

Source: the Authority

434. Finally, the Authority notes that the aims and objectives when determining the choice of asset valuation methodology depend significantly on the individual context underlying the need for such an evaluation. For example, considerations when determining the method of asset valuation as part of a corporate spin-off are very different from those within a

2011 European Commission Questionnaire on costing methodologies for key wholesale access prices in electronic communications.

⁹⁴ European Commission. (2013). Commission Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment.

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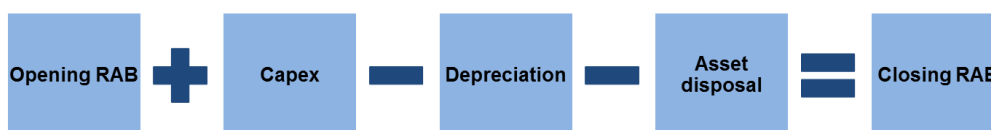
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regulatory pricing framework context, and would take into consideration additional options such as income and market-based methodologies.⁹⁵

Updating the RAB over time

435. Having determined the initial RAB, it will be necessary to update the RAB over time. However, any revaluation of assets, especially if done on a frequent basis, risks creating uncertainty for operators and investors, as this may affect price controls and profits. Therefore, it is important to have a transparent, consistent, and predictable process for updating the RAB over time.
436. The standard method most commonly adopted to update the value of the RAB is the 'roll forward' approach, which updates the RAB by adding capex incurred since it was last valued and subtracting depreciation and asset disposals that occurred over the same period. This would effectively mean that the HCA approach continues to be applied consistently over time.

Figure 34: Updating the RAB under the 'roll forward' approach



Source: the Authority

437. In theory, an alternative method could be to systematically revalue the RAB as part of each review, potentially using alternative methodologies.⁹⁶ This approach would risk giving the Authority substantial discretion to change the valuation of assets, thus increasing uncertainty for the FSE and potentially weakening the credibility of the framework. Any re-valuation could lead to substantial windfall gains or losses. Each re-evaluation of the RAB may also require substantial resources, which could increase the administrative burden of the Framework.

Calculating the revenue requirement

438. The revenue requirement is a core component of the BBM pricing framework as it dictates the overall revenue cap, so it is crucial that the appropriate steps are taken in its calculation. Since the revenue requirement is estimated *ex-ante* for the subsequent regulatory period, forecast inputs are used. This section sets out the approach to estimating forecast amounts for each of the elements (see Figure 32, page 106) that may influence the revenue requirement, namely:

- a. Capex.
- b. Opex.

⁹⁵ Income-based valuation approaches determine the value of assets based on their ability to generate revenue for its owner whereas market-based valuation methods use various market multipliers to determine a valuation that takes into account the existing market conditions.

⁹⁶ Australia Energy Regulator. (2005). Review of the Electricity Transmission Revenue and Pricing Rules.

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- c. Return on capital.
- d. Asset life assumptions.
- e. Depreciation.

439. The general principle followed by BBM frameworks is that the regulated entity submits forecasts, which are reviewed, potentially adjusted, and ultimately approved by the regulator. There may also be a need for the regulator to review actual financial information *ex-post* and compare actual values to those previously forecasted. The issues to be considered as part of this process are discussed below.
440. The section concludes with a discussion of how the revenue requirement may be updated over time when the FSE has over- or under-recovered its costs in a given period.

Capital expenditure

441. Capex may be incurred to build network and non-network assets. Examples of the former may include ducts, cables or active equipment, while the latter may include essential computer software or offices. It is expected that the majority of the FSE's capex will be incurred on network assets given its focus as a utility infrastructure entity.
442. Forecasts should identify the major investment projects planned over future years, with the associated business rationale and expected costs. Supporting evidence could include evidence of expected costs and evidence of any drivers of investment that require improvement in the current network, which could include NTP4 targets as well as increased demand in terms of subscribers and data volumes.
443. Since these forecasts directly affect the revenue requirement and hence wholesale prices, it will be important for the Authority to review these forecasts. As discussed in the section highlighting the rationale for a regulatory pricing framework, there may be incentives for the FSE to over-state its capex forecasts or to pursue excessively capital-intensive business plans in order to inflate the estimated value of the RAB. The review of investment plans may play an important part in mitigating these risks and creating incentives for efficient investment.⁹⁷
444. Although a review of investment plans is essential as part of BBM-based pricing frameworks, the Authority does not intend to be prescriptive in determining the type and level of investment the FSE should make. The Authority acknowledges that the FSE should be able to set out investment decisions in response to market signals. Thus, the obligation is on the FSE to propose and justify its business plans and the associated levels of capex.
445. Capex reviews may be based on pre-determined criteria that determine whether and to what extent planned investments are included in the RAB. Criteria should reflect the overall principles and objectives, in particular with regard to investment efficiency and promotion of NTP4 objectives, while maintaining a transparent and consistent process. On this basis, potential criteria are outlined below.

⁹⁷ For more information, see for example Alexander and Harris (2005). *The Regulation of Investment in Utilities*.

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Figure 35: Potential criteria for capex reviews

Prudency
<ul style="list-style-type: none">• Investment should be based on sound business planning and evidence. The FSE should demonstrate and quantify to the Authority the business need of any major investment plans.
Efficiency of investment
<ul style="list-style-type: none">• Investment should be implemented at the lowest possible costs.• For example, the FSE may be required to hold competitive tenders for outsourced work.
Efficiency of financing
<ul style="list-style-type: none">• Investment should be funded at the lowest possible cost of capital in line with the risk/return profile.• The FSE may be required to submit its financing plans for regulatory review.
Consistency with regulatory objectives and targets
<ul style="list-style-type: none">• Planned investments should be shown to be working to promote NTP4 objectives and the deployment and performance targets set out in NTP4.• For example, large-scale investment in copper assets may not meet this condition.

Source: the Authority

446. In line with the regulatory objectives, these criteria should help ensure that the FSE can only recover its efficiently incurred costs and that investment is effective in promoting NTP4's vision for Bahrain.
447. The FSE will be required to produce capex forecasts and submit these to the Authority for its review. In the Authority's view, capex reviews should be based on the FSE's submitted plans and evidence, with reference to criteria of prudency, efficiency of investment, efficiency of financing, and consistency with NTP4 objectives.⁹⁸
448. As well as considering capex forecasts, BBM-based frameworks often include a backward-looking element. *Ex-post* reviews will consider any retrospective adjustments to previously forecasted RAB values based on a review of how actual capex compares to forecasted capex.
449. *Ex-post* reviews of capex may be particularly important because there are various reasons why actual capex could vary substantially from forecasts. This could be due to factors outside of the FSE's control, such as external delays to projects, but also controllable factors such as its investment efficiency and any incentives to deliberately deviate from investment plans. Therefore, reviewing actual capex levels may be important in ensuring appropriate incentives.
450. There are different options available for determining any adjustments to the RAB, based on a review of actual capex incurred:
- a. The forecast level of capex could consistently be used. However, this approach may undermine investment, as the FSE may have an incentive to reduce actual capex below forecasted levels, for example by cancelling or delaying projects.
 - b. The actual level of capex could consistently be used. Again, this could distort investment incentives, as the FSE may have a limited incentive to maximise efficiency of planned investments where this would reduce capex below the forecasted levels.

⁹⁸ As stated in Section 9, the FSE will also likely be required to submit such plans to the Batelco Group Board.

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- c. A more balanced option may be to review incurred capex and require the FSE to submit evidence explaining any deviation from forecast values. This is in line with the approach taken by several European regulators. The regulator may then establish to what extent any capex underspend or overspend was efficient. For example, efficient overspend could be due to completing additional projects ahead of schedule, whereas inefficient overspend could be due to failures to identify the least-cost solutions.
451. For the third option discussed above, the framework could include a 'sharing factor' to allow some or all of the efficient underspend/overspend to be added to the RAB, but not any inefficient underspend/overspend, thus helping preserve investment incentives. In this way, *ex-post* upward adjustments to the RAB reflect only efficient investments so as not to weaken the FSE's incentives to minimise costs.
452. A further mechanism that could be used is 'dead bands'.⁹⁹ These bands specify a threshold below which any deviation of actual capex from forecast capex does not lead to any *ex-post* adjustment, which may help avoid the administrative burden associated with conducting reviews in cases where the magnitude of such deviations are relatively small.

Operating expenditure

453. Opex includes all expenditure related to the operation, maintenance, and administration of the FSE's business. Consistent with regulatory objectives, the forecast level of opex should reflect the expected efficient costs incurred in the FSE's operations.
454. In general, opex may be forecasted using either of the following approaches, or a combination of both:
- a. **Top-down.** Opex from recent years are projected forward using efficiency assumptions related to cost drivers. These forecasts reflect existing network architecture.
 - b. **Bottom-up.** An analysis of individual network elements and cost structures is used to forecast opex. This could be based on the FSE's costs or on a hypothetical efficient operator.
455. The information asymmetry between the Authority and the FSE remains an issue in opex forecasts. In particular, the FSE may have an incentive to overstate its forecasts of opex to be included in the revenue requirement.

Given this, regulators may carry out their own analysis of the evidence and assumptions made in business plans, complemented by independent studies where appropriate. For example, a regulator's review of opex forecasts may consider the following benchmarks:

- a. **Historical.** Batelco's relevant wholesale opex in recent years.
- b. **Industry.** Relevant wholesale opex of Batelco or OLOs in recent years.
- c. **Regional.** Other relevant wholesale broadband providers' opex, such as in the UAE and Qatar. These countries can be seen as having similar characteristics to Bahrain and therefore relevant opex figures could be used as benchmarks.

⁹⁹ Ofwat. (2014). *Final price control determination notice: company-specific appendix – Wessex Water*.

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456. It is important that opex and capex forecasts are jointly reviewed because proposed investments into the NBN may have a significant influence on the level of opex expected. Further, this joint review may reduce the risk of capex bias as it may consider whether the proposed forecasts appear disproportionately capital-intensive.
457. If there appear to be significant discrepancies, the Authority may require the FSE to justify its own forecasts as well as provide further evidence supporting its figures. This could ultimately lead to a revision of the FSE forecast numbers based on the Authority's discretion.
458. As with capex, the design of the framework needs to consider whether any adjustment mechanisms are needed in the event that actual opex differs from the previously forecasted opex levels.
459. Overall, opex may often be more stable and predictable over time compared to capex. This may favour greater reliance on forecast values rather than *ex-post* comparisons of actual and forecast opex. Nevertheless, there are various reasons why opex may vary over time, including efficiency gains or losses, as well as exogenous shocks to production volumes, labour costs, or electricity costs. In order to achieve the objective of allowing recovery of efficient costs while minimising the risk of over-recovery, it may be necessary for frameworks to include mechanisms that consider actual opex as well as forecast opex.
460. Where actual opex deviates from forecast values, the pricing framework may include provisions to determine:
- a. To what extent any unanticipated efficiency savings are passed through to customers, and over what time period this takes place.
 - b. To what extent any unanticipated increases in efficient costs are passed through to customers, and over what time period this takes place.
461. With regard to efficiency savings, if regulators are able to fully 'claw back' any efficiency gains made in the previous period instead of allowing the regulated entity to benefit from these, this is likely to reduce incentives to pursue cost efficiencies. To support efficiency incentives, several regulators use 'glide paths' or carry-over mechanisms that allow the firm to retain a proportion of efficiency gains, even in the subsequent regulatory period. Similarly, where costs are higher than expected, these mechanisms mean that a proportion of overspend is passed on to customers on a gradual basis. The Authority notes however that such efficiency incentives would need to be carefully balanced against a potential loss in allocative efficiency which would accrue if the regulatory period or glide path is too long.
462. In this manner, carry-over mechanisms are able to balance the incentive to achieve cost efficiencies through allowing the FSE to retain a proportion of these efficiency savings whilst limiting its incentives to over-estimate opex as may be the case if it was permitted to retain the full differential.

Return on capital

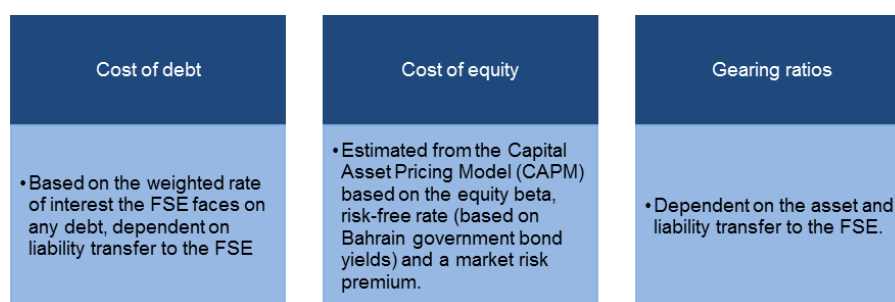
463. The WACC is used in BBM-based frameworks to calculate the return on the RAB. The WACC captures the overall cost of capital for the FSE to finance its investments by accounting for its gearing ratio.

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464. The return on the RAB is a key component of the revenue requirement, in line with the regulatory objective of allowing the FSE to earn a fair rate of return on its investments. An appropriate WACC has the potential to incentivise investment while still protecting the FSE's customers from high prices.
465. In calculating the WACC, it may be appropriate to account for the commercial risks related to the FSE's investments by including a commensurate risk premium. The WACC applied may be in real or nominal terms, as long as a consistent approach is used throughout the implementation of the BBM.
466. The inputs required to calculate the WACC are shown below.

Figure 36: Inputs for WACC calculation



Source: the Authority

467. Aspects of the WACC calculation may require analysis and benchmarking, for example in relation to the forward-looking assumed risk-free rate for the regulatory period, the equity beta, and the risk premium. A transparent process will provide clear justification for the assumptions made in calculating the WACC and consider all available evidence.
468. A process for updating the WACC over time will be required, as this will affect the revenue requirement. The estimated WACC may vary over time for various reasons. For example, the risk-free rate may vary due to changing macroeconomic conditions. The review process should therefore consider each input used to calculate the WACC so that it can be updated accordingly.
469. The Authority notes that maintaining a single RAB implicitly results in the same WACC used for both fibre and copper assets. Although this stands in contrast with a number of European countries which allow a 'fibre premium' over the normal copper WACC¹⁰⁰ to reflect the higher risk associated with fibre over copper, it is the Authority's view that a number of these risks may not be applicable in Bahrain.
470. This is primarily due to differences in the regulatory objectives of Bahrain and Europe. Regulators within Europe are focused on the promotion of not only competition in retail products but also infrastructure layer competition.¹⁰¹ The FSE would not face such infrastructure based competition as it would manage, operate, and deploy the Single Network providing significant demand assurance in relation to its fibre investment.

¹⁰⁰ Dot.econ (2012). 'Regulatory policy and the roll-out of fibre-to-the-home networks: A report for the FTTH Council Europe.'

¹⁰¹ BEREC (2016). 'Challenges and drivers of NGA rollout and infrastructure competition.'

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Asset life assumptions

471. Asset life assumptions affect the revenue requirement in several ways:

- a. They influence the depreciation charge in each year of an asset's life, which is part of the revenue requirement. For this reason, the asset life may influence the choice of depreciation method (discussed below).
- b. They affect each asset's value in the RAB. For example, old legacy assets that have large accumulated depreciation will have low values.

472. There are two concepts of asset life:

- a. **Economic life.** This is the expected duration over which an asset yields cost effective revenue generation and therefore reflects the period over which this asset is likely to remain in service by the FSE.
- b. **Technical life.** This is the duration over which an asset can physically function regardless of whether or not it is cost effective to do so. Technical lives can be longer than economic lives.

473. Although an asset's technical life is typically determined by the characteristics of the asset, it may offer a more transparent and objective approach in comparison to the expected economic life, which depends on market conditions and therefore may be uncertain.

474. However, economic lives offer a benefit in relation to ensuring equal treatment of an asset over time. Where the technical life is longer than the economic life, using the technical life would mean that depreciation will continue to be included in the revenue requirement even for assets that are no longer economically useful, making the revenue requirement higher in this period. This potentially leads to prices that do not support allocative efficiency and equity over different time periods compared to using economic lives.

475. Furthermore, where technical lives are longer than economic lives, which is not uncommon, this will lead to stranded assets of the FSE. Although the asset is still physically able to perform its function, it is not optimal for the FSE to continue its operation, and therefore if technical useful lives are used it would result in a premature write-down. Finally, the use of economic asset lives is well established in relation to both HCA methodology and wider functions such as lease terms and cost modelling.

476. In determining the assumed useful life of the FSE's assets, the Authority will review the useful lives provided in its regulatory accounts. This will include benchmarking against comparator countries, as has been the case to date when the Authority has reviewed Batelco's reference offer. Where the Authority judges that modification is required to better reflect best practice the final useful lives for assets may differ from the value in the Financial Accounting Reporting ("FAR").

Depreciation

477. The purpose of including depreciation charges in the revenue requirement is to allow the FSE to recover the cost of its assets. Therefore, the sum of depreciation charges over an asset's life should equal its value.¹⁰²

¹⁰² This assumes an asset's scrap value is zero.

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478. Depreciation may be calculated using a number of different methods. These include:
- a. **Straight-line.** Depreciation charges are equal every year throughout an asset's life. This method is often used due to its simplicity and consistency over time.
 - b. **Accelerated/decelerated.** Under accelerated depreciation methods such as 'sum of digits' depreciation, a greater proportion of the assets cost is recovered at the beginning of the asset's life relative to straight-line depreciation. The opposite applies for decelerated depreciation.
 - c. **Economic.** Economic depreciation takes into account the demand and cash flows generated over an asset's remaining life. The remaining value of an asset would therefore be equal to the net present value of the cash flows this asset will generate in future. A proxy for such depreciation is annuity-based depreciations, which takes into account the cost recovery of an asset (i.e. depreciation plus a return on capital). Tilted annuity methods typically result in higher larger depreciation charges at the beginning of the asset life.
479. The chosen depreciation method may reflect the nature of the assets in terms of asset lives, technical roles, and demand. In the context of NTP4, the depreciation profile could reflect different demand paths. For example, if copper is gradually phased out, applying straight-line depreciation to copper assets may benefit current users at the expense of future users, because future prices will continue to reflect the same annual depreciation charges for copper even as its utilisation declines.
480. Straight-line depreciation also may make it difficult for the FSE to recover all of its fibre investment in time in addition to affecting other upgrades to support the network, as some assets may have a short economic life and therefore are depreciated quickly.
481. Given the diverging expected time paths of fibre and copper demand, a possible approach could be as follows:
- a. Accelerated depreciation may be applied to copper so that associated costs are recovered more quickly, with depreciation falling in line with copper utilisation.
 - b. Decelerated depreciation may be applied to fibre assets to reflect expected increasing utilisation, which may have benefits in terms of increasing downward pressure on prices in the short term.

These two measures would offset each other but only partly, due to different asset lives and values.

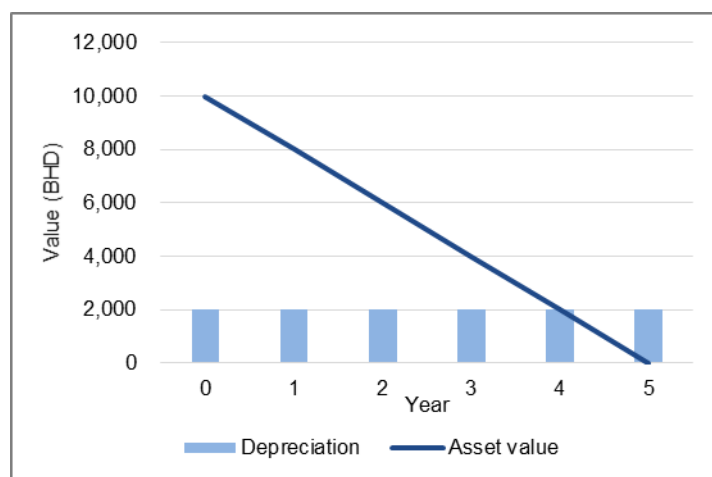
482. However, as with asset lives, it may be important to maintain a consistent approach with the methodology used for asset valuation. Where HCA is used to value assets, it may be most appropriate to use standard straight-line depreciation, as used in Batelco's accounts, in order to ensure transparency, objectivity and consistency of methodology.
483. Economic depreciation could be used to derive a more realistic path for cost recovery, taking into account future demand and cost changes. One of the drawbacks of using economic depreciation (such as tilted annuity approaches) is that it is dependent on assumptions and forecasts of the market. This risk appears especially high in the case of fibre investments, with uncertain demand and future cost profiles. Another weakness of this approach is that certain unexpected market movements or information could potentially result in significant changes in forward looking revenue requirements.

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484. The Authority notes that the choice of depreciation method may affect the stability of wholesale prices through its impact on the revenue requirement. An advantage of straight-line depreciation is the consistency of the year-on-year depreciation input into the revenue requirement over the useful life of an asset and hence the greater stability of wholesale prices.

Figure 37: Depreciation and asset value profile under straight-line depreciation



Source: the Authority
Indicative example of straight-line depreciation over 5 years

485. Furthermore, where this asset needs to be replaced, any increase in the depreciation portion of the revenue requirement will only be due to an increase in asset prices and will therefore reflect the FSE's costs. Consequently, in the absence of significant price shocks for replacement capex, material increases to the revenue requirement due to depreciation will occur only when the FSE increases its asset base through new capex.

Other allowances

486. The Authority may consider including other allowances as appropriate.

Mechanisms for cost recovery

487. Though the revenue requirement will be set to allow the FSE to fully recover its costs, there is no guarantee that it is able to do so over any given time period. For example, if cost or demand forecasts are inaccurate, the FSE may over- or under-recover its costs.

488. A specific risk is that the FSE could persistently under-recover its costs during the initial years of the new pricing framework. This risk may arise due to large upfront costs involved in NBN rollout to meet NTP4 targets. These costs may only be recoverable over a long period of time, as demand for fibre gradually increases. To achieve the objective of cost recovery, the FSE should be allowed to recover any deficits relative to the revenue requirement in subsequent years.

489. There are alternative mechanisms available to support cost recovery. BBM-based pricing frameworks in other sectors often use an adjustment mechanism through which any under- or over-recovery in one time period affects the revenue requirement in a subsequent period. For example, an under-recovery of 100 in a previous year could lead to an upward adjustment of the revenue requirement in subsequent years by a maximum

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of 100.¹⁰³ This type of mechanism is particularly suited to stable sectors, where forecasts are relatively predictable and there is no persistent tendency to over- or under-recover.

490. If there is a risk of the FSE persistently under-recovering during an initial period of high fibre investment, the mechanism above would result in the revenue requirement being continuously adjusted upward over time. Then, a more appropriate mechanism may be to maintain a 'cost recovery account', as used by Australia's ACCC in regulating NBN Co. This account can be used to track the cumulative deficit between the revenue requirement and actual revenue. The cumulative deficit may accrue interest to account for the fact that costs are only recovered in the future. Under the ACCC's framework, until this account breaks even, a revenue cap is not enforced, ensuring that the FSE is eventually allowed to exceed its revenue requirement sufficiently to fully recover its previously incurred costs.
491. Whilst this mechanism can ensure that take-up is not hindered by increases in wholesale prices (due to high costs and low take-up), there could be some disadvantages. For instance, a potential downside of such a cost recovery account could be that the FSE may have incentives to 'gold-plate' its network, pursuing capex heavy investments over other, more efficient investment alternatives. Similarly, given that a revenue requirement may not be enforced until the account balances, there could be a risk of excessive prices which could limit the take up of the FSE's products and services. As such, the Authority will consider carefully the appropriate price caps on individual products or baskets of products as discussed in the section below.

Price Caps and Margin Squeeze Tests

Price cap controls

492. Price caps place a limit on the price that the FSE is able to set, and can be applied either at the individual product level, or as a weighted average price cap on a basket of products. Once this initial value is set, the price cap may evolve throughout the regulatory period along a set path, most commonly CPI-X, where CPI is a measure of inflation. Under this form of price cap control, the maximum annual price increases permitted is CPI-X% where X represents an efficiency measure determined to be achievable by the operator. The use of price cap price controls normally includes *ex-post* reviews to ensure that price caps are being adhered to.
493. Regulators commonly use a blend of revenue and price caps to take a hybrid approach to pricing regulation. In this way, price caps can be used to address limitations presented by revenue caps. This has been seen in Australia where NBN Co, the incumbent wholesale fibre operator, is subject to economic regulation by the Australian Competition and Consumer Commission ("ACCC") based on a BBM approach.¹⁰⁴ The regulatory framework involves a single maximum revenue cap, as well as maximum price caps for individual wholesale services. Other examples include New Zealand which plans to implement a

¹⁰³ This adjustment may account for inflation and interest rates.

¹⁰⁴ ACCC. (2015). 'NBN Co Special Access Undertaking – Long Term Revenue Constraint Methodology 2013-14: Final Determination and Price Compliance Reporting 2013-14.' Retrieved from <https://www.accc.gov.au/system/files/LTRCM%20Final%20Determination.pdf>.

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BBM approach to wholesale price regulation consisting of a revenue cap combined with price caps for basic anchor services.¹⁰⁵

Benefits of price cap controls

494. As discussed in section outlining the rationale for a regulatory pricing framework, the BBM framework has a number of potential limitations that the Authority will seek to address as part of the regulatory pricing framework. A number of these issues arise from the high degree of pricing flexibility afforded to the FSE under an overall revenue cap, and can therefore be addressed through the use of price caps. These are listed below:
- a. Margin squeeze and cross-subsidisation;
 - b. Lack of price stability;
 - c. Risk of limited incentives to maximise take-up of fibre alternatives.
495. By targeting price caps on individual products or baskets of goods commonly demanded by the OLOs, the ability of the FSE to raise these prices is restricted, therefore limiting the degree of cross-subsidisation possible for wholesale products demanded by BRE. In this way, use of price cap controls can prevent margin squeeze mechanisms that favour BRE, thereby promoting competition in the retail layer.
496. Additionally, price caps offer additional stability to the market with regard to the price of wholesale broadband products. Once the initial price is set, price caps under a CPI-X model have an established path within the regulatory period, facilitating more accurate planning for downstream operators around their input costs and therefore promoting service level investment.
497. The use of price cap controls can also address in part the issue of limited incentives to promote take-up of fibre products. Although it will always be the case that under a revenue cap, if the realised demand exceeds forecast demand the FSE will be required to reduce the price of fibre products to satisfy this cap, price caps can reduce mechanisms by which the FSE can choose to reach its revenue requirement through increased prices rather than demand. By placing price caps on products provided by the FSE, the FSE will only be able to reach its revenue requirement through increasing quantity.
498. Finally, enriching the BBM framework with appropriate price controls gives the Authority the flexibility to leverage the FSE's market power to achieve regulatory outcomes through the use of alternative pricing approaches. After setting the initial value of the price cap, the FSE then has the choice to base its prices for other products on a number of pricing approaches. This includes cost-based approaches which would incorporate elements of incentive based regulation, but also includes for value or demand based pricing approaches where this is better suited to the objectives of increasing investment and fibre uptake.
499. Examples include the use of Ramsey pricing where individual prices reflect the price elasticities of services. In the case of residential customers who may exhibit a higher price elasticity this could result in lower fibre prices, increasing take-up, whereas for products serving the enterprise segment that may have lower elasticities this could lead to a greater

¹⁰⁵ New Zealand Ministry of Business, Innovation & Employment. (2016). 'Telecommunications Act Review: Options Paper.'

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mark-up above marginal cost, thus allowing the FSE to recoup more of its costs and incentivise investment. Not only does value-based pricing allow the achievement of regulatory objectives, in the case of Ramsey pricing it also does so in a welfare maximising manner¹⁰⁶ and promotes allocative efficiency¹⁰⁷ whilst allowing the FSE to remain financially feasible.

500. Irrespective of the style of price cap controls chosen to form part of the BBM pricing framework, the Authority may undertake *ex-post* checks to ensure that these price caps have been complied with by the FSE.

501. It is the Authority's view that the regulatory pricing framework will likely include the use of price controls to address the risks associated with a single revenue cap. This would include the use of *ex-post* checks for compliance

Form of price cap controls

502. The benefits of including price caps as part of the BBM framework having been established, this section now sets out a high level overview of the potential forms of price control. However, the final choice around the specific form of price caps within the regulatory pricing framework will be determined as part of the RO Process.

503. The choice of the form of price cap control presents a trade-off between the benefits arising from pricing flexibility, namely the ability of the FSE to set prices in a way that best supports its commercial success and enables investment, and the limitations discussed in the section outlining the rationale for a regulatory pricing framework. The Authority is able to influence the degree of pricing flexibility of the FSE through the choice of 'level' at which price caps are set. In principle, price caps could be set at the product basket level (e.g. mass market access links) or on individual products (e.g. 100Mbit/s Bitstream), either through anchor pricing or more extensive individual price caps.¹⁰⁸

504. The Authority sets out three high level forms of price cap controls:

- a. **Weighted average price caps ("WAPC") on product baskets.** Products within the FSE's product set are separated into product baskets. A cap is then placed on the weighted average price of products within this basket. The weights attached to each price within the basket is typically reflective of that product's share of total revenues in the previous period, although alternative weights can be chosen to reflect regulatory objectives. This form of price control allows the FSE to retain pricing flexibility within the product basket subject to the overall WAPC.
- b. **Anchor pricing.** Under anchor pricing, individual price controls are placed on specific products, referred to as 'anchor products', with pricing freedom for all other products subject to the overall revenue cap. The use of anchor prices constrains the FSE's pricing flexibility in two ways:
 - i. The anchor price complements the revenue cap, implicitly affecting the pricing of other products under the revenue cap;

¹⁰⁶ The World Bank (2000). 'Telecommunications Regulation Handbook.'

¹⁰⁷ Tirole, J (2014). 'Market Power and Regulation.'

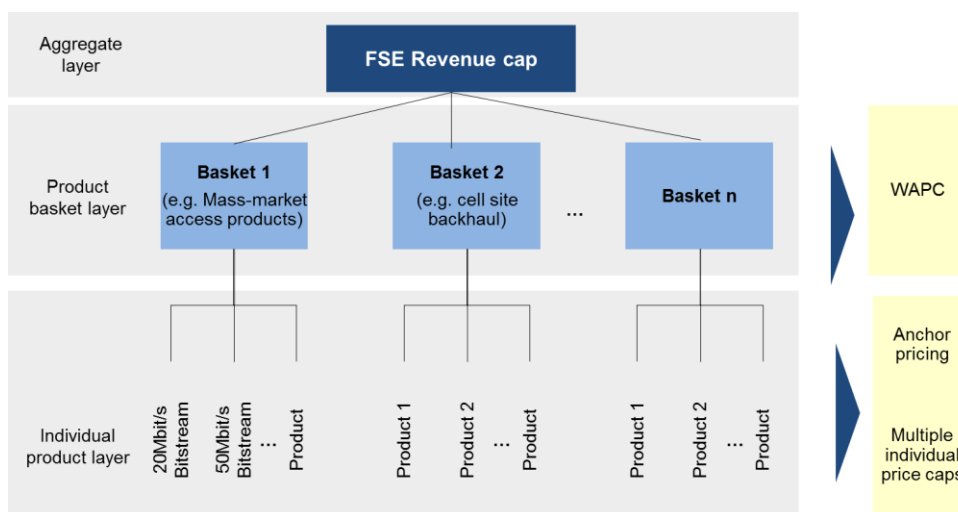
¹⁰⁸ The Authority recognises that it is possible to use a WAPC at the aggregate level. However, this is considered redundant in the presence of an aggregate revenue cap.

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- ii. If the anchor price is set on a product that is a substitute for other wholesale products offered by the FSE, the FSE may be limited in its ability to set excessive prices for these substitutes as downstream operators may consume the anchor product instead. For example, the regulated price of a slower product may ensure that ultra-fast broadband prices cannot be set too high, otherwise customers and end users will continue using the slower product.
- c. **Individual price caps.** This places a number of price caps on the individual products across the FSE's product set. This form of price control confers the lowest degree of pricing flexibility on the FSE.

Figure 42: Potential layers of price cap control



Source: the Authority

505. The remainder of this section outlines the relative benefits and drawbacks of the price cap controls set out above.

WAPC at the product basket layer

506. Setting price controls at the product basket layer provides a balance between the benefits of pricing flexibility and its limitations. In allowing the FSE pricing flexibility between products within a basket, the FSE is able to better align prices with its commercial interests, thereby increasing its financial performance and investment abilities. However, WAPC are also able to address the limitations of pricing freedom to a degree, particularly in relation to the lack of price stability and ability to undertake margin squeeze.

507. WAPCs require the FSE not to exceed the cap for the weighted average prices of a basket of products, which are likely to be grouped based on their substitutability. These weights can be based on sales volume, cost shares, or revenue shares and can even reflect relative use by the OLOs by assigning a greater weight to products with higher OLO demand. As prices with heavier weights have a greater impact on the weighted average,

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they are less likely to be changed,¹⁰⁹ offering a degree of pricing stability to the retail market and promoting service level investment.

508. Furthermore, setting a cap on the weighted average of prices within each product basket reduces the ability of the FSE to undertake margin squeeze as it cannot charge excessive prices within any individual basket, else it risks breaching its WAPC. It also prevents cross-subsidisation between product baskets, which it may have an incentive to undertake. For example, it may be the case that BRE has a lower demand for cell site backhaul links than the OLOs, instead demanding fixed access links as a fixed broadband provider. These two products are likely to sit in separate product baskets and therefore be subject to separate WAPCs, preventing cross-subsidisation.
509. Furthermore, WAPCs have an advantage in that they create a link between the marginal revenue of a product within a basket and its price. As a result of this relationship, WAPCs may result in efficient pricing structures as suppliers will have an incentive to set higher prices for inelastic products and lower prices for products with higher price elasticities.¹¹⁰ This is the basis for the Ramsey pricing approach discussed earlier, leading to allocative efficiency and an increase in social welfare.
510. One drawback of WAPCs is that the FSE will continue to have pricing freedom on relative prices within product baskets, potentially leading to margin squeeze. Although in theory products should be grouped into baskets based on their substitutability and therefore OLOs should be able to substitute freely between products preventing margin squeeze, in practice this may not be the case if they require different service specifications from the BRE.
511. This illustrates the importance of identifying appropriate product baskets when using WAPCs to address margin squeeze. Consequently, the effectiveness of this style of price cap will depend on the availability and accuracy of information required by the Authority such as volume data, which may be need to be provided by the FSE or Batelco. Due to the informational asymmetry between Batelco and the Authority, this may provide an opportunity for it to present or manipulate the data in a way that leads to the establishment of product baskets that allow discrimination against the OLOs.

Anchor pricing

512. Revenue caps, either overall or for a basket of goods, may be combined with price restrictions for selected products, following the principle of anchor pricing. This approach involves regulating the price of lower quality products while allowing pricing flexibility for higher quality products. As an example of anchor pricing, second-class postal stamps in the UK have been subject to a price cap, while the price of first-class stamps has not been regulated.¹¹¹
513. By allowing pricing flexibility over faster broadband products, the FSE may be incentivised to invest in high-quality fibre products in line with consumers' willingness to pay in addition to investing in any technology that reduces operating costs. If the FSE is not restricted in

¹⁰⁹ Bhattacharyya, S.C (2011). 'Energy Economics: Concepts, Issues, Markets and Governance.'

¹¹⁰ Decker, C (2014) 'Modern Economic Regulation: An Introduction to Theory and Practice.'

¹¹¹ Price control. *Royal Mail Group*. Retrieved from <http://www.royalmailgroup.com/about-us/regulation/price-control>.

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the price it can charge for non-anchor products, it may have strong incentives to promote the migration to ultra-fast broadband services.

514. Given that a large part of the ability for anchor pricing to prevent margin squeeze and excessive pricing by the FSE relies on the substitution effect, the choice of anchor product is of critical importance in determining its effectiveness as a deterrent. It would be key for anchor pricing to be complemented by overall revenue caps given that anchor products can only serve as imperfect constraints on other products. Furthermore, this selection of anchor products must also balance the need to encourage investment in the NBN.
515. The choice of anchor products will need to consider the following factors:
- a. **Substitution.** An anchor product should impose a genuine constraint of demand substitution between itself and the unanchored products within the same basket. Otherwise, regulating an anchor product that is used by few consumers and not seen as a substitute for unanchored products may have little impact. For this reason, it will be important to periodically review and update the selection of anchor products, as Ofcom has done recently in the UK.¹¹²
 - b. **Technology.** Given the planned investment in NBN and potential decommissioning of copper, a copper-specific anchor product may not be an effective anchor product in the medium term. Therefore, basic or 'entry level' fibre anchor products may be required to anticipate the future closure of the copper network and to encourage the utilisation of the fibre network.
 - c. **Future relevance.** An anchor product needs to be relevant for users in the foreseeable future, in line with expected market trends, such as the rising demand for faster broadband and data usage over time.¹¹³
 - d. **Market share.** The market share of the anchor products should not be too high. If the set of anchor products captures a large majority of the market, the hybrid approach discussed here may become too prescriptive in the range of product prices that are controlled, with the associated risks. This may reduce the scope and incentive for the FSE to innovate and price differentiate.
 - e. **Potential discrimination.** While EoI obligations mandate that wholesale prices are uniform for all downstream operators, it could be that particular product baskets are required only by specific downstream operators, which could lead to the FSE being able to set relatively high prices for specific operators. In this case, it may be important to select anchor products within such baskets.

¹¹² Ofcom has chosen superfast broadband as a new anchor product to constrain the pricing of ultra-fast broadband services.

¹¹³ This consideration is reflected in the proposal for a 100Mbit/s anchor product in New Zealand from 2020

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Figure 43: Summary of principles for the selection of anchor products

Substitution	Technology	Future relevance	Market share	Potential discrimination
<ul style="list-style-type: none"> Anchor products should impose a genuine constraint on other products through demand substitution 	<ul style="list-style-type: none"> Consider whether copper and/or fibre anchor products are appropriate 	<ul style="list-style-type: none"> Anchor products should remain relevant at least over the duration of the regulatory period 	<ul style="list-style-type: none"> Anchor products should capture a significant market share, but not a large majority 	<ul style="list-style-type: none"> The selection should consider whether product baskets are substitutable or whether OLOs rely on specific baskets

Source: the Authority

516. Once the initial set of anchor products is chosen, regulatory reviews will need to consider whether the set of anchor products continues to be adequate, given changes in technology and consumer demand. At the same time, clarity over the minimum duration of the anchor product set should be provided in order to give the FSE stability in support of investment incentives. If the market stabilises over time, revisions to the set of anchor products may be required less frequently.
517. In addition to the choice of products that will act as anchor products, consideration must also be given to the way in which they are priced. If the anchor price is set too low, this may make superior services relatively expensive, limiting the incentive for the FSE's customers and end users to migrate to faster services. However, if the anchor price is set too high, this could allow the FSE to earn relatively high profits from existing users of anchor products, potentially limiting the incentive to invest in superior products.
518. Consequently, as anchor products must be priced in a way that balances these incentives, it may not be possible to apply value-based pricing methodologies whilst maintaining their effectiveness in preventing excessive pricing.

Individual price caps

519. Price controls at the individual product layer offer little to no pricing flexibility to the FSE, determining a price cap or range of allowable prices for each individual product sold. This is theoretically the method of price control that minimises the ability of the FSE to abuse its monopoly position through removing its ability to margin squeeze or cross-subsidise wholesale products in a way that discriminates against the OLOs.
520. Furthermore, by setting individual price caps on the majority of products, this allows the FSE to target specific products for which value-based pricing may be beneficial either to allow a price greater than marginal cost where that product is relatively inelastic to allow for greater cost recovery and therefore promote investment, or in the case of wholesale products required to deliver residential fibre broadband, set a price below margin cost to promote take-up.
521. However, although if implemented accurately individual price caps offer benefits in terms of minimising the risk of pricing abuse, increasing price stability, and increasing the ability of the Authority to use alternative pricing methods, it leads to a significant regulatory burden to produce individual revenue, cost, and demand forecasts in the setting of these prices. Furthermore, issues of informational asymmetry may lead to opportunities for the FSE to misrepresent this information to its benefit.

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Margin squeeze test

522. In light of the concerns around the FSE's ability and incentive to undertake margin squeeze in a way that discriminates against the OLOs, the Authority is of the view that, price controls should be supplemented by regular margin squeeze tests. These tests would investigate the margin between FSE wholesale products and BRE retail products.
523. The use of margin squeeze tests is set out in the Authority's Retail Tariff Notification Guidelines. A margin squeeze test should assess "[...] *whether an efficient, hypothetical non-integrated competitor would, under the notified retail tariff, be able to earn a positive margin on its retail service* ".¹¹⁴
524. Within each of these tests there are a number of methods that are open to the Authority both *ex-ante* and *ex-post*, the appropriateness of each will be determined to reflect the regulatory objectives of the Authority and in conjunction with the choice of pricing control.
525. The choice of price controls and margin squeeze tests would be made on the basis of the objectives of the pricing framework, namely to promote efficiency in the supply of wholesale products, sustainable, effective, and fair service-based competition, and investment in NBN. Further, it may be informed by feedback from stakeholders, FSE demand and cost considerations, and the FSE business model and financial case.

Risks and Mitigation Instruments Associated with the BBM-framework

Cross-subsidisation and Margin Squeeze

526. Establishing an overall revenue cap limits the total revenue that the FSE is able to earn, thus mitigating in part the risk of margin squeeze through excessive pricing for all wholesale products. However, in the absence of further price control mechanisms, the FSE will retain a high degree of pricing flexibility within this revenue cap.
527. Consequently, there may still be scope and incentive for the FSE to undertake margin squeeze and cross-subsidisation between wholesale products in a way that discriminates against the OLOs and benefits BRE. This can be done through setting higher wholesale prices for products consumed mainly by the OLOs and lower prices for products consumed primarily by BRE, thereby allowing BRE to pass on lower prices to its retail customers and stifling competition at the retail layer.
528. To address this issue, telecommunication regulators who have adopted the BBM approach have incorporated price control mechanisms such as anchor pricing. Examples include Australia where the regulatory framework supports a single maximum revenue cap with price caps for individual wholesale services, and New Zealand which proposes to introduce BBM style pricing regulation with a revenue cap combined with price caps for basic anchor services.

¹¹⁴ For more detail on the Authority's analysis, please refer to Authority (2010). 'Retail Tariff Notification Guidelines', paragraphs 62- 68.

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Demand risk

529. Although the risk of low initial demand for fibre is present under any pricing framework, the BBM's explicit mechanism to allow cost recovery may exacerbate this risk. The BBM is predicated on cost recovery and incentivising investment by forecasting costs to calculate the revenue requirement. By construction, while prices derived from the revenue requirement are designed to fully recover costs and a rate of return, this may lead to higher prices that may not maximise uptake of ultra-fast broadband services.
530. Furthermore, as revenue is driven by both price and demand, the FSE may not be incentivised to maximise uptake of fibre products. If demand for fibre products, which are likely to be more costly than copper alternatives, is greater than forecast demand, the FSE will have no choice but to cut prices. Instead, the FSE may choose to set fibre prices as close as possible to the monopoly profit-maximising level to reach its revenue cap, thereby limiting demand and risking take-up of fibre.
531. Again this may be addressed through the use of appropriate price controls which limit the price of certain fibre products or baskets of products. In this way, in order for its revenue cap to be binding and therefore to cover costs incurred, the FSE will need to increase demand. An alternative way to address demand risks could be by the approach employed to recover capital costs. For instance, the profile for capital cost recovery could be skewed to ensure lower prices in initial periods.

Capex bias

532. There may be an incentive for the FSE to pursue excessively capital-intensive business plans ('capex bias') because once new assets are entered into the RAB, the FSE is allowed to recover investment costs and earn a return on capital. For example, there may be incentives to pursue costly or unnecessary investments aimed at 'gold plating' the network.
533. The risk of capex bias may need to be considered against the objective of a "future proof" NBN. The uncertainty in the telecommunications sector and the development of new technologies may mean that capex considered unnecessary at the time investments were made could be important in the longer term to ensure that the NBN is "future proof." Given the importance of investment in a "future proof" NBN, a risk of capex bias and excessive investment may be preferable to a risk of under-investment.
534. A regulatory review of business plans may help to reduce any tendency towards capital-intensive business plans. Criteria for permissible capex can help to mitigate the risk of capex bias. Where actual capex levels are higher than the previously forecast levels, this could be subject to an *ex-post* review.

Inaccurate forecasts

535. The effectiveness of BBM relies on the accuracy of the FSE's forecasts and any relevant information used to calculate the revenue requirement. Due to information asymmetry, the FSE may have an incentive to submit inaccurate forecasts of opex and capex. For example, costs can be deliberately overstated in order to inflate the revenue requirement, leading to opportunities for increased short-term profits. However, regular regulatory

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reviews provide an opportunity for any such persistent tendencies to be identified and addressed in the forecasts for the subsequent period.

536. Inaccurate forecasts may lead to over- or under-recovery of forecast costs by the FSE. Over-recovery of costs represents a risk to consumers insofar as prices could have been lower, whereas under-recovery represents a risk to the FSE that could affect cash flow and investment incentives. Various mechanisms are available to address discrepancies between forecast and actual costs, which can help to shield the FSE from short-term risks of under-recovery while discouraging deliberately inflated forecasts.

Price instability

537. Since the BBM's underlying principle is to allow the operator the opportunity to recover its costs, the risk of exogenous demand or supply shocks are largely borne by wholesale customers, which may indirectly affect end users. Under a revenue cap, the regulated entity will respond to any shocks by adjusting prices accordingly to achieve the revenue requirement. As a result, end users may face price instability if these shocks are passed on through retail prices.
538. However, the BBM framework has flexibility to include measures to promote price stability, such as pricing principles or other restrictions on individual product prices that are applied in addition to a revenue cap. These are discussed in further detail in the section below.

Dynamic considerations

539. The FSE may consider the dynamic effects of its decisions on both current and future profits, particularly when a regulatory period spans multiple years. For example, if the FSE achieves large efficiency gains in the current regulatory period, this may undermine future profits because the regulator may impose higher efficiency targets for the next period. Mechanisms are available to address this, such as 'carry over' mechanisms that control the extent to which efficiency gains are passed through over time, allowing the framework to strike a balance between allowing profits from higher efficiency and allowing customers to benefit from lower prices.
540. Reductions in capex may occur due to strategic postponement of planned investment, as well as increased investment efficiency. The pricing framework may include *ex-post* reviews of capex to ensure that the RAB value cannot be inflated strategically in this way, thus helping to mitigate these undesirable incentives. A separate regime to monitor and enforce NBN deployment targets will be important in order to preserve investment incentives.

Evaluating the Efficiency of the FSE

541. One of the key objectives of the pricing framework is the promotion of efficiency. The economic definition of efficiency covers three broad areas:
- a. **Allocative efficiency.** This occurs when there is an optimal distribution of goods and services that reflect consumer preferences.

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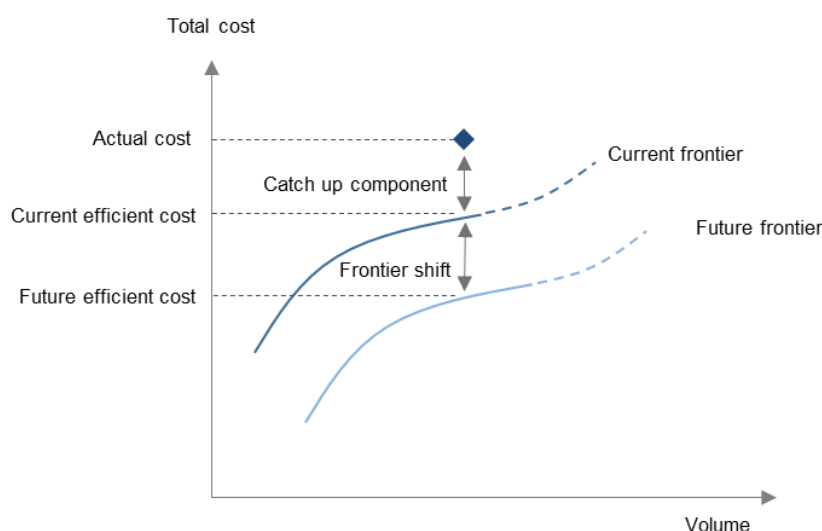
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- b. **Productive efficiency.** This refers to the production of outputs at the lowest possible cost (for a given level of quality), ensuring there is no inefficiency or waste in production.
 - c. **Dynamic efficiency.** This refers to improvements in efficiency, which occur over time through investment and innovation. Dynamic efficiency can in some circumstances be related to allocative and productive efficiency (collectively referred to as 'static efficiency').
542. As discussed above the BBM pricing methodology largely addresses the issues of dynamic and allocative efficiency through ensuring that the FSE will be able to recover its cost of investment and linking the revenue requirement to the FSE's actual costs. The Authority now examines the issue of ensuring the FSE is productively efficient, which is likely to require the use of efficiency tests.
543. As set out in Section 10.2, incentive regulation such as LRIC-based frameworks may offer stronger incentives for the FSE to ensure it is efficiently resourced than the BBM model. As BBM guarantees the FSE is able to recover its costs, it risks limiting its incentives to minimise costs and may promote 'gold plating.'
544. However, there are a number of tools available to the Authority under the BBM model of pricing regulation, both in relation to revenue and price caps, to enhance its efficiency properties:
- a. **Revenue caps.** The determination of revenue caps is based on the FSE's revenue requirement and therefore relies on capex and opex forecasts. As highlighted above, if these forecasts do not capture efficient costs, including efficiency of investment, financing, and operating costs, this will result in the calculation of a revenue cap that is too high to incentivise efficiency.
 - b. **Price caps.** Efficiency comes into play with regard to price caps through two mechanisms: establishment of the efficiency factor and the price reset process. Under price caps the price path is determined by $CPI-X$ where X represents the efficiency factor which provides a mechanism to incentivise efficiency. Furthermore, to promote productive efficiency, the initial price on this price path will be updated periodically to reflect cost changes over time.
545. Whilst there is no commonly used explicit definition, productive efficiency in regulated sectors typically reflects the difference between an operator's actual cost performance and the performance of a fully efficient operator, that is, the minimum cost that is required to provide a specific level of output for a given quality.
546. In a number of regulatory reviews, the productive efficiency factor reflects two key types of efficiency:
- a. The frontier shift, e.g. cost savings due to future service delivery optimisations.
 - b. The 'catch-up' component, e.g. cost savings to catch-up with the comparable most efficient operator. This captures cost inefficiency, technical inefficiency and input allocative inefficiency.

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Figure 44: Breakdown of the efficiency factor



Source: the Authority

Measurement of the FSE's productivity

547. There are a number of alternative approaches to efficiency estimations that have been applied in the literature as well as by regulators. Broadly, four methodologies are applied to measure the efficiency factor:¹¹⁵

- a. Top-down cost benchmarking.
- b. Bottom-up cost modelling.
- c. Cost reviews.
- d. Total factor productivity.

Top-down cost benchmarking

548. Top-down approaches focus on observed aggregate costs and compare the cost performance of different comparators, taking into account that differences in costs across operators may arise due to factors outside of an operator's control as well as differences in the level of efficiency.¹¹⁶

- a. Scale, environmental, or other factors outside providers' control.
- b. Those due to actual inefficiencies.

549. Top-down benchmarking may be undertaken through econometric techniques, involving the development of statistical models that allow for the estimation of the relationship between costs and a number of cost drivers. Once these drivers are controlled for, the

¹¹⁵ See for example. FTI Consulting (2015). 'BT Leased Lines: Efficiency benchmarking -Critiquing the efficiency approach used by Ofcom'.

¹¹⁶ Stochastic frontier analysis (2003), S. C. Kumbhakar, C. A. Lovell, Cambridge University Press.

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residual cost is attributed to being the catch-up component. Three alternative techniques have been typically utilised by regulators to measure efficiency:

- a. **Corrected Ordinary Least Squares (“COLS”)**. COLS is based on a conventional regression model and measures inefficiency from the estimated model residual, where the most efficient operator is considered the one with the smallest residual.
- b. **Corrected Panel Regression (“CPanel”)**. CPanel is similar to COLS but applies the regression to a data sample that comprises both cross sectional and time-series data, i.e. several telecommunications operators over multiple time periods.
- c. **Stochastic Frontier Analysis (“SFA”)**. SFA allows for the residual to be decomposed into two elements, the “true efficiency” and a random fluctuation in efficiency. This allows the SFA technique to account for measurement error and other transient influences that may otherwise bias the efficiency factor, which is not possible under CPanel or COLS methods.

550. An alternative approach is data envelopment analysis (“DEA”) which aims to compute all different combinations of inputs that are required to produce a particular level of output informed through the FSE’s demand forecasts. The most efficient combination of inputs then determines the efficiency frontier. Accordingly, this technique is more data than theory driven in comparison to econometric techniques.

551. Although top-down benchmarking is applicable to both the evaluation of revenue and price caps, it is particularly useful in determining the efficiency factor for the price path as it uses actual data from comparator operators and is therefore more likely to reflect an achievable efficiency factor after controlling for cost factors such as environmental factors. This is evidenced by its widespread use in regulated utilities such as in the UK or in Germany where regulators Ofgem¹¹⁷ (power), Ofwat¹¹⁸ (water), or the German Federal Network Agency¹¹⁹ use econometric top-down methods to inform the efficiency factor.

Bottom-up cost modelling

552. Bottom-up cost modelling aims to develop detailed models of an efficient operator such as a scorched earth or scorched node LRAIC model. Once this is developed it can be compared to current costs to estimate the catch-up potential.

553. The use of bottom-up cost modelling is widespread and established within telecommunications regulation and is of particular relevance to verifying that capex, and to a lesser degree opex forecasts, reflect efficient planning and resourcing.

554. As bottom-up scorched node models seek to model the theoretical efficient operator within the existing network topology, they are able to estimate the cost efficiencies that should be achievable by the FSE whilst taking into account the fact that the FSE will inherit core network nodes whose locations are already determined and may no longer be optimally placed. Consequently, these models should be able to provide an efficient benchmark for

¹¹⁷ Ofgem (2012). ‘RIIO-GDI: Final Proposals – Supporting document – Cost efficiency.’

¹¹⁸ Ofwat (2014). ‘Cost assessment – advanced econometric models.’

¹¹⁹ BNetzA (2016). ‘Efficiency Benchmarking in the Energy Sector’.

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the FSE's capex and opex forecasts and therefore the efficient revenue requirement of the FSE.

555. Furthermore, scorched node LRIC models are commonly used as the foundation for LRIC-based pricing as they are able to determine the prices that would arise from the theoretical efficient operator. Although the Authority is not proposing the use of an incentive based pricing framework, these LRIC based prices arising from bottom-up cost modelling can provide a useful triangulation point for the establishment of initial prices for anchor products or other products that face price caps.

Cost reviews

556. In addition to the development of econometric or technical models, cost reviews offer another way in which to quantify the achievable efficiency savings. Cost reviews can be either top-down or bottom-up:

- a. **Top-down.** Top-down cost reviews involve benchmarking FSE assumptions, costs, and prices against comparator operators to understand its relative performance and offer an alternative to top-down cost benchmarking where this is not feasible either due to data or other restraints.
 - b. **Bottom-up.** This involves expert examination of an operator's product processes and expenditure with the aim of identifying potential initiatives that can be introduced to achieve efficiency gains. This approach was used by Postcomm in the 2005 Royal Mail price cap reviews in the UK.¹²⁰
557. Cost reviews can provide a valuable tool both for review of opex and capex forecasts, determining the efficiency factor and during the price reset processes, through identifying what is achievable on today's efficient frontier and therefore should be factored into the FSE's plans in accordance with its responsibilities for efficient resourcing.
558. Furthermore, the use of top-down benchmarking is particularly useful in the evaluation of the FSE's opex and capex forecasts as it is able to compare the underlying assumptions in addition to actual outcomes used by the FSE against those used by other operators. By comparing the assumptions used, the Authority will be able to understand whether any deviation from good practice reflects the unique environment of Bahrain or whether they require updating.

Total Factor Productivity

559. Total Factor Productivity ("TFP") refers to the additional output achievable from a given set of inputs where all other variables are held constant. A TFP index can be constructed using historical data by subtracting input growth from output growth to measure productivity to develop a measure of efficiency gains due to technological advances. Once established, this TFP trend can be extrapolated forwards to assess expected cost changes.
560. This methodology is typically less used by regulators as it can be heavily assumptions-driven, and the weighting of individual outputs within the index may be debated.

¹²⁰ NERA (2013). 'Approaches to measuring the efficiency of postal operators.'

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Furthermore, in relation specifically to the telecommunications sector, it is likely that historical data, which will largely relate to copper based services, do not provide a good basis on which to predict trends in fibre technologies.

Reference Offer Reset Process

561. The RO order is a key regulatory tool to promote effective competition. It allows the Authority to ensure that the FSE sets fair, reasonable, and non-discriminatory price and non-price terms for all of its regulated wholesale services. An important aspect of the framework is the RO reset process, which is the set of provisions that determines how prices in the RO are to be reviewed and updated over time.
562. In relation to the pricing framework, RO orders may be used to set prices which satisfy the chosen pricing framework. Under utility-style regulation, this would be done periodically according to the regulatory cycle by reviewing the FSE's proposed prices and evidence that these comply with the revenue requirement and any price cap controls in place.
563. In the event that the FSE wishes to introduce new services, the reset process should allow the Authority, as appropriate, to include these services in the pricing framework in the same manner as for existing regulated services.
564. This section first discusses how the reset process will be guided by the principles and objectives in the Purpose Statement. Next, the frequency of price reviews is discussed by taking into account the economic consequences and practical issues associated with reviews. The section then discusses the process and practical steps that the Authority anticipates will be needed in order to update prices over time.

Principles of the reset process

565. A robust reset process is important to ensure that the pricing framework continues to be effective over time. The design of the reset process may directly affect the FSE's incentives and the uncertainty faced by the FSE and its customers. In turn, this can impact retail competition, growth, and innovation in the market.
566. In order to achieve the key regulatory objectives while taking into account regulatory best practice, the reset process should reflect the guiding principles in the Purpose Statement:
- a. **Efficiency.** To promote allocative efficiency, the reset process may update prices in line with cost changes over time, so that resources are allocated to produce broadband products most valued by consumers. At the same time, the reset process should allow the FSE to benefit from efficiency gains in order to preserve incentives for productive efficiency.
 - b. **Equity and fairness.** The reset process may help to promote equity by periodically reviewing prices in light of evolving market conditions. For example, it may help ensure that the burden from any unexpected cost changes is fairly distributed between the FSE and the downstream operators.
 - c. **Consistency.** When the pricing framework is applied over time it is important for its application to be consistent, otherwise substantial uncertainty may be created for the FSE. Consistency may be achieved by ensuring that any changes to price controls are based on the same criteria over time.

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- d. **Adaptability.** While being applied consistently, the reset process should be adaptable to changing circumstances. This would include the introduction of new services, so that these can be regulated under the pricing framework where appropriate, while preserving the FSE's incentives to invest in new services.
- e. **Accountability and transparency.** The Authority's approach to resetting the RO should be set out clearly. It may be appropriate to take steps to ensure that all market participants understand this process and are able to contribute their views. As much as possible, any adjustments made by the Authority should be based on objective and transparent criteria so that the reset process is predictable.

Frequency of reviews

567. A key aspect of the reset process is the frequency with which reviews take place. Regulatory periods of around five years are typical for BBM-based regulation, though the vast majority of these instances relate to sectors such as utilities, which may be significantly less dynamic than the telecommunications sector. Given this, reviews in the telecommunications sector are often more regular. For example, in Australia, the regulation of NBN Co is based on annual reviews for the first ten years, followed by longer regulatory periods thereafter.
568. However, the frequency of reviews may have implications for the degree of uncertainty experienced by the FSE and other market players. This is important because the Purpose Statement includes an objective of "*ensuring regulatory certainty to all market participants, Subscribers and Users*". It may also affect the promotion of efficiency and the risk of regulatory failure. These issues are outlined below, along with relevant practical considerations.

Uncertainty

569. A key consideration when determining the frequency of reviews is the level of uncertainty faced by market players. However, there is no clear relationship between these two factors. In some circumstances, more frequent reviews may increase uncertainty, whilst in other circumstances, they could help to reduce uncertainty. For example, in periods of high macroeconomic uncertainty, firms may be more exposed to exogenous shocks to market demand or their costs. More frequent reviews could be beneficial by helping to ensure that the regulatory pricing framework adapts quickly to changing circumstances.
570. In addition, the broadband market in Bahrain appears relatively dynamic and subject to substantial uncertainty, given the currently limited uptake of fixed broadband services and potential migration to fibre services. This supports the case for frequent reviews, particularly during the early stages of deployment and service uptake, as forecasts on which revenue requirements are based could be subject to a significant margin of error.
- 571.
572. However, another key consideration is the regulatory certainty provided by longer regulatory periods. While frequent reviews may mitigate the FSE's exposure to changing market conditions, they may contribute to higher regulatory uncertainty in the sense that both the FSE and its customers are subject to more frequent regulatory interventions.

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573. Given that assets typically have long lives, there may be a business risk for the FSE when prices are guaranteed only for a relatively short period (depending on the form of price control). Frequent price reviews create an unstable environment for the FSE's business, which in turn may harm investment incentives.
574. Therefore, the frequency of price reviews should be set to strike a balance between mitigating market uncertainty without exposing the FSE to excessive regulatory uncertainty.

Efficiency

575. More frequent reviews may help to ensure that prices are reflective of underlying costs while preserving investment incentives. This promotes allocative efficiency by updating prices in line with any significant cost changes, especially when costs are subject to significant and frequent fluctuations.
576. The importance of frequently updating prices for allocative efficiency is related to demand elasticity – if demand is very inelastic, there is limited impact on outcomes from updating prices. However, in the case of fixed broadband services, end user demand may be elastic due to fixed broadband not being seen as a necessity and due to the existence of a widely used substitute (mobile broadband).
577. Conversely, less frequent reviews may help to promote productive efficiency by providing the FSE with greater incentives to achieve and profit from efficiency savings while prices remain unchanged.

Risk of regulatory failure

578. In general, any regulatory intervention carries a risk of regulatory failure, which occurs when the intervention does not have the intended effect. Regulatory failure may occur for a number of reasons, including when analysis relies on inaccurate data, when there are defects in the pricing framework, or when the intervention is affected by administrative, political, or legal issues.
579. More frequent reviews may help to mitigate the risk of regulatory failure by providing opportunities to address any errors or shortcomings of previous interventions. When an entirely new regulatory framework is created, it may be prudent to conduct frequent reviews at least initially.

Practical considerations

580. Regulatory reviews may involve a large administrative burden, though this may depend on the depth of the review and the process itself. In determining the frequency of reviews, regulators need to take into account the available capacity and resources to conduct these reviews. For example, where complex modelling or detailed analysis of business plans and forecasts are required, frequent reviews may be less feasible.
581. Where reviews take a forward-looking approach, it is common practice for regulators to align regulatory cycles with the development of the regulated entity's business plans. Having frequent reviews may require the FSE to produce business plans that do not align with the investment cycle.

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582. Any decision on the frequency of reviews should take into account the feasibility of completing reviews under different timeframes. For example, the annual reviews conducted in Australia are backward looking, whereas the process for conducting forward-looking reviews and producing forecasts may be more complex. Therefore, forward-looking reviews may require more time compared to backward-looking reviews (the steps involved are discussed in this Technical Annex).
583. Another practical consideration is the time lag between the end of a financial year and the availability of financial information for that year. Price reviews may rely on accurate historical financial information, as well as forecasts. Thus, it is important that this time lag is minimised to ensure that the financial information in price reviews is relevant to the regulatory period.

Evaluation

584. The Authority's view is that market stability is essential to achieving NTP4 objectives under utility-style regulation, and this may be facilitated by longer regulatory periods. This will mean the FSE and OLOs will have a stable regulatory environment to operate in, which may then increase investment incentives. Moreover, long regulatory periods impose less regulatory burden on the FSE and OLOs, allowing them to focus resources on their business operations.
585. At the same time, the Authority recognises that there is substantial market uncertainty in the short term, as well as potential uncertainty over the impact of the new framework. More frequent reviews in an initial period may be appropriate to mitigate these risks.

Updating prices over time

586. Assuming the price control methodology remains unchanged, each regulatory review prior to the start of a regulatory period will calculate the new revenue requirement for the forthcoming regulatory period by updating the RAB and each building block component: the return on capital, opex, and depreciation. The new revenue requirement will then be used to apply price controls in the forthcoming period.
587. Furthermore, the Authority may choose at this point to re-evaluate the price cap controls in place as part of the BBM pricing framework, updating them as necessary to reflect the current regulatory objectives.
588. This section considers some of the procedural aspects involved as part of this process. It outlines the steps that will be taken to calculate the revenue requirement, select baskets or individual products subject to price caps controls, and set prices. It concludes by considering how the pricing framework will deal with the introduction of any new products over time.

Procedural aspects and information requirements

589. The stages and logistics involved in conducting periodic price reviews are largely dependent on the length of the regulatory period. In countries and sectors where reviews are conducted every five years, the process may take around two years due to the relatively large scope of reviews. This partly reflects the greater uncertainty when making

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forecasts over a longer time period, which necessitates a thorough review. In general, the review process may involve several stages,¹²¹ including some or all of the following:

- a. Developing a strategy for the review.
- b. Requesting and analysing business plans and other information submitted by the regulated entity (and potentially from other market players).
- c. Determining the proposed forecasts and price controls.
- d. Allowing the regulated entity (and potentially other market players) to comment on the proposals, submitting revised plans or additional evidence as appropriate.
- e. Analysing revised and additional information.
- f. Finalising the forecasts and implementing the price control. Depending on the form of price control, this may involve reviewing prices proposed by the regulated entity in order to assess whether these are permissible.

590. When conducting more frequent reviews, such a process may not be feasible and may be disproportionate. The process should take into account practical feasibility as well as issues relating to data availability.

Steps involved in updating prices over time

591. As discussed above, there are a number of tasks that must be completed in order to conduct regulatory reviews and finalise the price controls and product-specific prices in the FSE's RO. The Authority will confirm this process in due course, however it is currently anticipated that this would involve the following activities, amongst others:

- a. Reviewing demand, opex and capex forecasts submitted by the FSE.
- b. Reviewing the valuation of the initial RAB.
- c. Calculating the WACC.
- d. Establishing the FSE revenue requirement.
- e. Considering appropriate price cap controls.
- f. Informing the FSE of the revenue cap, as well as any price cap controls. On this basis the FSE will submit its proposed RO, including anticipated future prices across the regulatory period.
- g. The Authority issuing the FSE's RO Order which will be subject to public consultation.

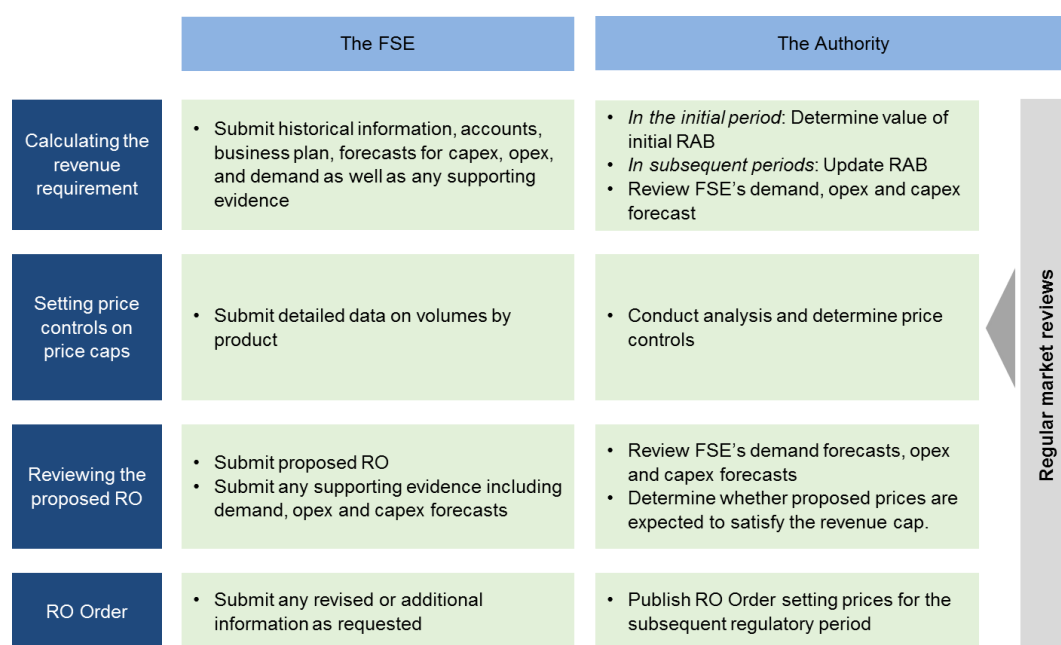
592. All of these steps, but in particular setting the price controls, will be supported by the outcomes of the Authority's regular market reviews. The key steps involved and the parties responsible for each step are summarised at a high level below.

¹²¹ World Bank. (1993). *Utility Regulation – A Critical Path for Revising Price Controls*; World Bank. (1999). *Resetting Price Controls for Privatized Utilities: A Manual for Regulators*.

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Figure 45: Summary of key steps and responsibilities involved in price reviews



Source: the Authority

Setting prices through an RO Order

593. As shown above, an RO Order would ultimately be used to set prices for the subsequent regulatory period. The Authority anticipates that the RO Order would also specify a glide path, which could be based on a rule such as 'CPI – X.' The duration and shape of a glide path would be based on the Authority's analysis which will review Batelco's forecasts, as discussed in 10.3.
594. Alternatively, the Authority may employ a 'P₀ adjustment' which includes an initial price adjustment from one regulatory period to the next. 'P₀' refers to the level of cost reduction that the FSE would be anticipated to pass on to its wholesale customers at the beginning of each period. This could be combined with a glide path or phased approach to maintain the FSE's incentives to deliver efficiency savings.
595. In the case where anchor prices form part of the pricing framework, for non-anchor products, the approach taken in setting any restrictions on prices over the regulatory period would need to consider to what extent the FSE should retain the flexibility to change prices within regulatory periods, taking into account potential uncertainty in the market.
596. For example, if actual demand in future years is lower than forecasted by the FSE, the FSE may require flexibility to increase prices in order to reach the revenue requirement. Conversely, understated demand forecasts risk resulting in relatively high prices, which may adversely affect competition and end users.
597. Considering the scope for uncertainty in forecasting, it may be prudent to allow the FSE a degree of pricing flexibility over the regulatory period. At the same time, measures should

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be in place to allow the Authority to prevent potential abuses of pricing freedom. Such measures could include individual price caps, as discussed above.

598. The Authority may grant the FSE a degree of pricing flexibility over products not subject to price caps during the regulatory period. Any substantial price changes during a regulatory period may, however, still be subject to the Authority's review and may be adjusted through an RO Order, for example where price changes exceed a predetermined threshold.

Introduction of new services

599. The Authority anticipates that the FSE may introduce new services in the future in response to customer requests and technological progress. New services could be beneficial for wholesale customers and end users, and may help support NTP4 objectives. Therefore, the pricing framework should allow and facilitate the introduction of new services.

600. Visibility over the introduction of new services may be important both for OLOs and for an effective application of the pricing framework.

- a. For OLOs, visibility over new products may help with long-term planning. For example, Australia's NBN Co maintains a 'product roadmap' that details the expected timing and process for any new services that are planned to be launched in the future.¹²² Engaging OLOs in the process will promote the Purpose Statement objective that the FSE offers services that reflect its customers' reasonable requirements.
- b. The pricing framework relies on accurate forecasts of capex and opex. It will be important for the Authority to have a clear understanding of planned new service launches in order to appropriately consider the potential costs associated with these. Thus, advance information from the FSE about new services, including an indicative price range where possible, supports regulatory certainty in the application of the pricing framework.

601. The process of applying price controls to new services may depend on the nature of the services:

- a. If new services offer similar functionality as existing services – for example, this may apply to a new, faster version within an existing product basket – they may, where anchor pricing is used, be treated as unanchored products so that the FSE retains flexibility over their pricing, or contribute to the WAPC where this applies. In this respect, anchor pricing may incentivise the provision of superior new services whereas the use of a WAPC may limit the FSE's incentive to launch a new service if the WAPC is not adjusted accordingly.
- b. If new services deliver new types of functionality, there may be a case for considering these as part of a new and distinct basket. It may then be appropriate to designate new anchor products or determine a new WAPC, depending on the

¹²² NBN Co. (2017). *Integrated Product Roadmap as at April 2017*. Retrieved from <http://www.nbnco.com.au/content/dam/nbnco/documents/Integrated-Product-Roadmap.pdf>.

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extent to which existing anchor products in other baskets might constrain the pricing of the new services.

- c. Depending on the current regulatory objectives, the Authority may determine that new products should be subject to individual price controls.

602. Where changes are to be made in response to the introduction of new services, it may in general be appropriate for these changes to be made as part of the periodic regulatory reviews, rather than attempting mid-period adjustments that may increase the administrative burden and uncertainty. It may also be more feasible to assess the case for changes to price controls after it has been possible to observe the market impact of the introduction of new services.

Annex B: Summary of Key Activities and Tasks

603. The following table sets out the key documents, activities and tasks to be carried out as part of the future workstreams which are discussed in this report.

Table 4: Key documents and activities to be produced as part of the regulatory process

Document	Party responsible
Operator Business Requirements	Batelco, OLOs and the Authority
The Authority will collect responses of operators provided in a business requirements template document. The Authority will forward all of these requirements to Batelco. Batelco is to propose in the FSE draft RO the price and non-price terms for the FSE products and services that meet operators' business requirements. The Authority will review the FSE draft RO as it prepares the RO Order, addressing, amongst other things, whether the draft RO promotes service-based competition, enables the sustainability of the FSE business case and is efficient. The Authority will review operators' business requirements if FSE raises a dispute. Such a dispute will not stay automatically the product or service provision by the FSE.	
Separation Guidelines	Authority
The Authority will produce Separation Guidelines laying out requirements for Batelco to implement gradual separation and comply with all other relevant aspects of the Framework. This will cover amongst others: <ul style="list-style-type: none"> Requirements for Batelco's Separation Undertakings (see below). High-level requirements for the FSE's organisational structure and HR. Longer term requirements for Eol and EoO as relevant. 	
Monitoring Framework	Authority
The Authority will establish a regime for monitoring compliance with the Separation Guidelines and NBN deployment and performance targets, both during the transitional period and in the long term. This will also include requirements for Batelco internal monitoring obligations.	
Batelco Separation Undertakings	Batelco
Batelco will be required to submit Separation Undertakings for the Authority's review and approval, which will include amongst others: <ul style="list-style-type: none"> An asset allocation plan, setting out Batelco's proposal for which network assets should be under the control of the FSE or remain under control of the rest of Batelco. A systems separation plan and systems roadmap, setting out Batelco's proposal for establishing and separating systems and processes by the end of the transitional period, such that it is compliant with the requirements for Eol and EoO as relevant. A full list of the Authority's requirements on Batelco's Separation Undertakings will be presented as part of the Separation Guidelines.	
FSE Reference Offer	Batelco
Batelco will submit its FSE RO for the Authority's review and approval. As part of the FSE RO, Batelco will be required to address the reasonable business requirements raised by operators in establishing the FSE Product and Service Set. NBN-based wholesale products and services will be required to be supplied on an Eol-basis in the long term.	
FSE Reference Offer Order	Authority
Following the review of FSE's RO, the Authority will issue a Reference Offer ("RO") Order which sets out the price and non-price terms of the regulated wholesale products and services to be offered by the FSE in the long term.	
Amendments to Laws and Regulations	Authority
The Authority will identify any amendments to existing laws, regulation and licences necessary to give effect to the Framework.	

Source: the Authority