



EOSC-hub

D12.2 Report on business model analysis for procuring services in the EOSC

Lead Partner:	GÉANT Association
Version:	
Status:	Draft for public consultation
Dissemination Level:	Public
Document Link:	https://documents.egi.eu/document/3627

Deliverable Abstract

Synopsis of the unique issues associated with acquiring digital services for research in the EOSC, drawing out issues (e.g. perceived incompatibility with legal and regulatory frameworks) alongside further investigation into whether ‘cloud coins’ or voucher access models can be used as a legitimate mechanism to providing a long-term solution to making services available free at the point of use, exploring sponsored use scenarios and suggesting terms of reference for future EOSC Central Purchasing Bodies or intermediary organisations acting as demand aggregators in the EOSC context.

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EOSC-HUB RECEIVES FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 777536.



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TERMINOLOGY

<https://wiki.eosc-hub.eu/display/EOSC/EOSC-hub+Glossary>

<i>Terminology/Acronym</i>	<i>Definition</i>
AAI	Authentication and Authorisation Infrastructure
AWS	Amazon Web Services
CA	Contracting Authority
CAPEX	Capital expenditure
CPB	Centralised Purchasing Body
EC	European Commission
EOSC	European Open Science Cloud
FAIR	Findable, Accessible, Interoperable and Reusable
GDPR	General Data Protection Regulation
GPA	Government Procurement Agreement
GPU	Graphical Processing Unit
IaaS	Infrastructure as a Service
IGO	Intergovernmental Organisation
IT	Information Technology
KPI	Key Performance Indicator
MCAA	Marie-Curie Alumni Association
MoU	Memorandum of Understanding
NREN	National Research and Education Network
OTC	Open Telekom Cloud
PCI	Payment Card Industry

PCP	Pre-Commercial Procurement
R&E	Research and Education
SLA	Service Level Agreement
SP	Service Provider
TNA	Trans-National Access
TRL	Technology Readiness Level
VA	Virtual Access
VAT	Value Added Tax
WTO	World Trade Organisation

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Executive Summary

The EC's ambition for an EOSC that enables 1.7 million European researchers and 70 million professionals to carry out data driven data science requires the application of procurement and business models that balance legal, financial, operational and technical considerations.

This study is produced following recommendations in earlier EOSC Hub deliverables [\[R3\]](#) by considering case studies from EOSC-related projects and user demand scenarios that represent how a high proportion of the 71.7 million users could access EOSC resources.

Commonly required services for data science is in the domain of storage and compute, and these are available in a global commercial market exceeding \$31 billion [\[R53\]](#) and through sharing of resources amongst public research organisations.

In the currently planned elements for EOSC, the EOSC Exchange should allow the access to these services, regardless of if they are from public or private providers. This study has considered a number of practices in accessing such services, and these are explained more fully within the report.

It is expected that this report will be used to inform the Working Groups of the EOSC programme to inform their plans for the construct and delivery of an EOSC Exchange as part of the operation of the EOSC legal entity.

The key messages proposed to be embraced by the EOSC governing body are:

- Aggregation of demand and the application of centralised procurement can provide access to markets, process efficiency, and value for users. The EC procurement directive has some elements that limit flexibility over the lifetime of an aggregated procurement regarding who can benefit. Changes to the policy or an option for the EOSC LE to commission resources/services could be considered.
- Obligations and liabilities of parties involved in the supply chain need to be carefully understood, be it the EOSC legal entity or another actor, for example, in the event of a GDPR breach or financial liability excess consumption of resources.
- The use of vouchers is to be considered to be valuable in driving the adoption of cloud services, however, the overhead required to do this may be disproportionate in manpower or the VAT peculiar to the treatment of vouchers.
- Virtual access as a mechanism for recovering costs in EC-funded projects is expected to be of benefit and could potentially further assist in enabling public-to-public collaborations.
- The absence of public-to-public case studies where the providing party wishes to seek remuneration for their service has constrained the recommendations, noting that such a construct can only exist in circumstances where the parties involved are subject to the EC procurement directive.

1 Introduction

This is a report on how different business models and procurement methodologies may be applied to make the services available that are required in the EOSC. It is produced from the perspective of the consumers from the EOSC, reflected in demand scenarios that are explored in this report.

After consultation with interested parties, most notably the EOSC Sustainability Working Group a revised version of this report, D12.3, will be produced.

This European Cloud Initiative for an EOSC was presented by the EC in its April 2016 Communication on the European Cloud Initiative. The objective of the EOSC is to give the Union a global lead in research data management and ensure that European scientists reap the full benefits of data-driven science, by offering *'1.7 million European researchers and 70 million professionals in science and technology a virtual environment with free at the point of use, open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines'* [R42].

Providing access to such products, resources and services depends on:

- determining how demand can be aggregated and procurement solutions implemented in a manner that delivers value to users at all times.
- ensuring compliance with a portfolio of compliance, funding and regulatory obligations.
- the ability to operate in accordance with the FAIR principles [R2].

This needs to be considered in the context of the markets that are relevant to EOSC, from the smaller scale of public/community-based solution provisions to that of multi-million international hyper-scale cloud services. This was recognised in the programme of work for EOSC Hub, and a specific objective to *"Simplify access to a broad portfolio of products, resources and services provided by the major pan-European and international organisations through an open and integrated service catalogue"* [R1].

This report also addresses the following recommendations from a preceding activity in the EOSC-hub project, Deliverable D12.1 *Procurement requirements and demand assessment* [R3], through a number of case studies:

- To analyse the 'Voucher Market-Driven Access Model' (sometimes also referred to as 'Cloud Coins') and proposed by some projects as an incentive to adopt cloud services or for use in introductory schemes [R4], into a potentially more long-term solution to enable free use of paid commercial services.
- To assess the 'Sponsored Use' Market-Driven Access institutional model further in the context that institutions often rely on services provided by publicly funded infrastructures, and that where services are used directly by the researcher (with access and payment arrangements having been done 'in the background' by institutional functions dedicated to making resources available for faculty use), there will be requirements for institutions at a departmental level and projects to procure services from service providers to the EOSC.

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- Both models must consider public-to-public, private-to-public and public-to-private scenarios and must consider the wider funding environment in order to identify opportunities for new ways of working.
 - To illustrate the process, working with an example/typical institution and a commercial cloud provider, in terms of issuing purchase orders and invoices.
 - To work in close collaboration with the OCRE and ARCHIVER projects, both projects having been initiated during the course of 2018 and commenced in 2019. These projects present ideal case studies that will identify the challenges that the EOSC business model will need to address.
 - To propose the terms of reference for future EOSC central purchasing bodies or intermediary organisations acting as demand aggregators, including the characteristics and criteria that any such group must meet in order to comply with EC directives and taxation regulations, and competition law, and the design of a process to establish such groups. Such recommendations could be made to the EOSC Executive Board Working Group on Sustainability that will consider suitable business models, governance structures and legal entity. Note this item is planned to be incorporated into the next iteration of this report (D12.3) following feedback.

D12.1 was published in June 2019 and used as input for the strawman report produced by the EOSC Sustainability Working Group in September 2019. A subsequent report was produced by the EOSC Sustainability Working Group in December 2019 [\[R41\]](#) and D12.2 has been issued in June 2020, with an anticipated delivery of D12.3 Q4, 2020.

A revision of the Description of Work in March 2020 for the EOSC-hub project, Task 12, under which deliverables 12.1-12.3 are described, amended the objectives of D12.2. Originally planned for the completion of two procurement exercises, it was recognised that activities underway in parallel EOSC projects, such as ARCHIVER and OCRE were addressing this for demands identified in D12.1

The revision amended D12.2 to consider case studies based on relevant procurements and business models that could be considered via the Sustainability Working Group in order to inform the Executive Board and Governance Board as to factors to be considered in implementing EOSC in order to realise its stated ambitions.

Section 2 of this deliverable describes the methodology that was applied to understand the nature of the challenges associated with the regulatory and financial factors for providing resources/services to researchers, institutions and demand aggregators, detailed in Section 3, against the experiences gained in different case studies, described in Section 4, in order to draw conclusions, in Section 5, that are valuable for the EOSC going forward.

2 Methodology

Deliverable D12.1 *Procurement requirements and demand assessment* [R3] provided an analysis of demand and business models for the EOSC. The conclusions of D12.1 relate to implementing practices and solutions that will assist in the adoption of services and solutions that support the realisation of the EOSC's broader ambition to exploit the "trusted pool of non-personal data" [R6] and to be an enabler of the European Data Strategy [R7].

To achieve this ambition, resources such as Infrastructure as a Service (IaaS), the most commonly cited example in D12.1, can be made available to EOSC users through a variety of business models.

The participants of this deliverable, GÉANT, EGI.eu, SURF and CERN, have recorded their experiences directly from participation in the described case studies or via interview with representatives from the case studies.

Approaches to procuring the resources (procurement) and making them available to users (business models) are explored through demand scenarios and case studies.

The demand scenarios described in Section 3 reflect the perspective of researchers, institutions and demand aggregators, which were chosen as the three most common demand-side user groups.

The demand scenarios are then used to position and contextualise the following case studies in Section 4 in order to understand how well the demand and procurement requirements of the different demand scenarios are met by the examples provided in the case studies:

- Case Study 1: Practical Experiences of Voucher Use - HNSciCloud and OCRE
- Case Study 2: Practical Experiences of the Virtual Access Mechanism for Public-to-Public Service Provision
- Case Study 3: Practical Experiences of Public-to-Public Service Provision with Cost-Recovery Mechanisms
- Case Study 4: Practical Experiences with Demand Aggregation: SURFnet and the GÉANT IaaS Framework

The case studies are evaluated based on the evaluation criteria detailed below.

2.1 Evaluation Criteria for the Case Studies

For each demand scenario the actions raised by D12.1 and the case studies are weighed relative to a range of criteria (see Table 1) that are likely to influence the future EOSC.

Before considering which criteria are relevant, it is important to understand the distinction between resources and data in the context of this deliverable and the EOSC, and that this deliverable concerns itself with resources only. Policies around data access and terms of use within EOSC are currently being developed by the Rules of Participation and FAIR Working Groups, building on the FAIR data principles and overlying EOSC vision and policies concerning open research and the objective of 'free at the point of access'. The EOSC's policies will influence the delivery of the EOSC itself but are unlikely to influence the commercial supply market, unless EOSC operates at a scale commensurate with that of the market. However, any legislative, policy and regulatory changes at

a European level to reinforce the Single Digital Market [R7] are likely to create opportunities for the EOSC, as indicated in the European data strategy [R43].

The evaluation criteria in Table 1 summarise demand-side factors that are informed by legal, financial and regulatory obligations that the EOSC must meet in its engagement with the users as summarised in D12.1 [R3]. For each case study the impact in respect to these criteria is analysed from the perspective of the demand scenarios detailed in Section 3.

It is proposed that these criteria act as a good proxy to represent the ambitions for EOSC, the recommendations from D12.1, and factors arising from demand scenarios or case studies. Optimising approaches to ensure compliance or optimisation with such criteria is expected to result in the optimal procurement and business models for the operation of EOSC.

Table 1 – Case study evaluation criteria

#	Criteria	Description
1	Ease of access	The main characteristic and benefit of cloud services is in the simplicity of their design, intended to optimise the access and provisioning process, and removing barriers . It is, therefore, important to the users that the fulfilment process, from ordering to contracting, to delivery, is efficient, and the solutions offered by the EOSC should assist end users in meeting their operational-level requirements efficiently.
2	Free at the point of use	It is a stated ambition that EOSC services should be free at the point of use. The funding mechanism employed in the case study to achieve this is crucial to realising such a goal for the user.
3	Compliance with EC Procurement Directive EC 2014/24/	Notwithstanding the concept of free at the point of use, at some stage in the supply chain there is a likelihood that a purchase/contract will be required. For many procurers making such a purchase must be completed in accordance with the EC procurement directive.
4	Compliance with financial standards	The flow of benefits and monies as a result of participation in the EOSC must ensure compliance with financial regulations such as VAT. The impact of this to participants should not be disproportionate so as to detract from the purpose of criteria 1, i.e. the financial reporting/processing necessitated from the consumption of EOSC resources should not detract from the consumption of services.
5	Compliance with H2020 rules	Until alternative funding sources are identified, this deliverable considers the conditions imposed by the H2020 Grant Agreement. This may be to identify specific options that are to be maintained or transferred to the future funding arrangements for the EOSC or to show how the current Grant Agreement could be revised to improve one of the other criteria. For service providers operating the Virtual Access model, there must be a mechanism to recover costs.

3 Demand Scenarios

The 1.7 million European researchers and 70 million professionals in science and technology described as the users of EOSC are expected to present in a variety of different ways when they consume/demand services from the EOSC. This section provides three commonly expected demand scenarios that describe different types of user groups.

3.1 Scenario 1: Researcher-Led Consumption

To understand the role of the individual researcher as a strategic (direct or indirect) decision maker, it is necessary to develop an abstract model that drives the decision making. EOSC-hub Deliverable D3.3 [\[R52\]](#) defined a common buyer persona to represent researchers and research communities from the point of view of a researcher's or research group's motivations to join the EOSC ecosystem.

While the analysis was made from a point of view that differed slightly from the scope of this document, it provided a model of the end-user constraints and motivations that drive all of the IaaS demand and procurement scenarios in this study. In the majority of cases, this demand of IaaS services is provided through local IT support structures that facilitate the in-house resources of the organisation, the services of the different e-infrastructures, and (currently in a minority of cases) use of commercial IaaS services to support the research processes. It is also recognised that there is considerable consumption of software, data and other scientific outputs sourced by the researcher independently, often referred to as the "grey" market, in that it is not usually formally associated with their host organisation (i.e. a University), having been procured via expenses, or by virtue of international collaborations with resources provided by another collaborating researcher.

The key characteristics of the Deliverable D3.3 "buyer persona" that are relevant to this study are related to goals (primarily competitive advantage: for example, publish research results faster) and challenges (limited financial resources as well as time and effort to integrate new tools and services to the research and collaboration processes). Therefore, processes that slow down access to additional resources or require non-trivial changes to researchers' working practices would need to be matched by considerable, proven benefits in terms of speed and impact of the research results provided.

Intuitively, many of the goals and challenges of an individual researcher could be addressed by calling off resources from a large pool of commercial resources on-demand (for example, speed and limited financial resources that the researcher controls directly). However, fulfilling some of the open access and expert support requirements may be more challenging unless there are complementary mechanisms to the mere provision of access to commercial resources.

While these drivers are shaping the procurement models and influencing their feasibility, the voucher model is the one where the impact of the individual motivations and constraints are the most pronounced and direct.

3.2 Scenario 2: Institution-Led Consumption

In this scenario a legal entity, e.g. a university procures resources or services on behalf of its users (staff, faculty, associates, researchers etc.), and manages access and payment as a back-office function. It may be that the institution pays for this resource using its departmental budgets or that, as in the researcher example, another entity pays for the resources. Such resources might be either supplied by large e-infrastructures or commercial organisations.

Of significance is the process of how the institution procures the resources, be it from a privately owned commercial entity or a public body. The institution may carry out procurements independently or by using frameworks or aggregated procurement solutions facilitated by Centralised Purchasing Bodies (CPBs), as defined in the EC directive on public procurement (2014/24 EC).

Defined as a business-to-business transaction, the institution as the customer typically requires a service-level-bound proposition with clear provisions regarding service definition, performance, intellectual property, and information management, and ownership. Value for money, ease of operation and a viable positive business case are important facets in the buying decision.

In terms of methods for charging for use of services, typically, supply-side organisations from the public sector provide services free-at-point-of-use or with indirect cost recovery, particularly in the case of e-Infrastructures using virtual or transnational access instruments. Where these mechanisms are unavailable, the demand-side organisations pay for the services, while any authorised user affiliated to the institution can access the service freely. In this scenario, there is a need to identify what would be required to ensure that institutions can buy or consume services via the EOSC. It may also be necessary to investigate potential Teckal implications, the various roles in EU procurement and their characteristics, and whether procurements via the EOSC would be compliant with EC directives.

Referred to as the 'Sponsored Use' Model in Deliverable 12.1, in this scenario, the Institution as a purchasing function takes on a number of characteristics:

- It prefers to contract with the resource supplier (via a bilateral relationship that would set out terms around payment, quality, service levels, security, liabilities, etc.).
- It would like to provide these resources to its staff free at the point of use.
- Resources are intended to be scalable to operate at a level commensurate with demand.
- Resources are to be procured in aggregate and disseminated to individual departments or teams (i.e., unlike the Researcher scenario, there is a one-to-many relationship between resources and users).

There is a need to investigate and analyse the end-to-end process and the agreements, etc., that would need to be provided in order to facilitate the process. However, given the heterogeneous nature of process, only the institutional buyers at a high-level interaction with the service can be described as follows:

- The institutional buyer (demand-side) finds the service.
- The institutional buyer contacts the service provider (SP).

- A contractual relationship is negotiated, specific to the requirements of the buyer, which may or may not result in a commitment for the buyer to pay for the service.
- A bilateral contract is created between the SP and the buyer.
- The buyer contracts with the SP and advertises the availability of the service to its internal users.
- Service utilisation is monitored by the SP and the buyer as part of their ongoing contractual obligations to each other.
- The user is able to go about their business unimpeded, accessing the service as required.
- Usage is paid for centrally and does not depend on individuals calling off 'lots' of allocated usage. That is, this consumption model is likely to be based on an 'all-you-can-eat' consumption model.
- The supply-side organisation or SP recovers the cost of the service from the demand-side organisation or institution, mostly likely by issuing an invoice to the institution using systems they have agreed between them.
- There are no third-party rights expressly agreed or implied, as the relationship is strictly between the buyer and the SP.

3.3 Scenario 3: Demand Aggregator-Facilitated Consumption

While many research services require a significant degree of specialisation to meet the needs of researchers, there are also generalist services that are used by many institutes in essentially the same way (not unlike a commodity service). For such 'commodity-style' services, there are clear benefits to the aggregation of demand, and the bundling of buying power. Benefits of such demand aggregation naturally include cost savings due to the ability to negotiate better prices with vendors and to cut down on overhead costs, but can also extend to safeguarding service continuity or to ensuring compliance with desired standards or specifications, e.g., with existing authentication and authorisation systems.

Demand aggregation requires a central party (or parties) to mobilise their network to agree on service definition, specification, terms and conditions, process etc. - and to provide a commitment to purchase a defined volume if the necessary conditions are met. The legal status of the central party can take several forms, ranging from essentially a matchmaker that operates in the background to a formal purchaser of services in bulk. These typically come with different levels of risk for the demand aggregator, where higher risk is usually associated with a stronger position and greater influence.

In case study 4, presented in the Section 4.4, GÉANT and associated National Research and Education Networks (NRENs) act as the central parties that mobilise their constituencies, typically universities and other organisations performing research within the remit of the NREN. In such a scenario the model employs a national tiering as an organising principle. However, demand aggregation could also be achieved across other dimensions (than national boundaries), such as research discipline, presuming a central entity can be found that is capable of mobilising its stakeholders in a way similar to the NREN in the case study.

A word of caution is appropriate, as the terms ‘demand aggregation’ and ‘brokering’ are often used in similar ways and without a precise definition, and there are variations in respect to the depth of the aggregation role an entity undertaking such an arrangement may employ. This may give rise to confusion as the terms are not interchangeable and, in fact, both terms may refer to a variety of roles in terms of responsibilities and obligations. For example, it has been suggested that EOSC could act as ‘a broker of services’, and there are various documents and designs which propose that the EOSC hub would act as a broker [\[R8\]](#). The implications of assuming such a role, however, depend greatly on what is exactly meant with the term ‘broker’ in such a context: Creating an online portal in which to advertise services and facilitate the coming together of a buyer and seller would broker relationships with limited risk. However, should such a portal act as an intermediary between buyers and service providers, the entity behind the portal would assume commercial and financial risk (possibly by proactively buying services to then resell). This can also be defined as a brokerage role, but it has significantly different implications and obligations to the former.

Appendix II provides more detail on which elements need to be taken into account for brokering services if the EOSC-hub procures using specifically assigned funding resources to be re-sold inside the EOSC portal to researchers and end users (it could require a multi-million Euro investment to commit to resources and the associated contractual and financial liabilities), and explains the typical activities that are expected to be performed in exchange for charging a brokerage fee.

4 Case Studies

To assess the benefits of using cloud coins or vouchers (as defined in Deliverable D12.1 [\[R3\]](#) as a long-term mechanism for users to access paid services and resources free at the point of use, the following case studies describe the experiences of users and observations of the primary stakeholders involved.

The case studies are intended to illustrate a scenario where individual researchers or small research groups:

- access a paid service (without having to pay themselves to use it) that cannot be accessed using virtual access [\[R39\]](#) or Trans-National Access (TNA) [\[R40\]](#).
- need limited-scale access to commercial services on an ad hoc basis.
- expect free-at-the-point of use services (where an institution may not already have a direct relationship with the vendor of those services).
- would like to access pre-paid, ring-fenced or discounted resources.
- require a low barrier to adoption.
- stipulate ease of use as a priority.

4.1 Case Study 1: Practical Experiences of Voucher Use - HNSciCloud and OCRE

The results of the analysis carried out in Deliverable D12.1 [\[R3\]](#) recommended that the following voucher-related schemes used under the EOSC-related projects (HNSciCloud, EOSC Hub and OCRE) could provide evidence and offer insights how, or even if, vouchers could be practically used as a long-term solution to distributing free-at-the-point-of-use services to end users:

- The voucher scheme for providing access to commercial cloud services for public sector researchers developed, tested and documented by the HNSciCloud project.
- The voucher scheme piloted by the EOSC-Hub Digital Innovation Hub for providing access to publicly funded services for industry/SMEs.
- The voucher scheme proposed as one of several procurement channels within the OCRE project.

In theory, the use of vouchers to access cloud resources would seem to have beneficial application in servicing the demands of the Researcher, as described in Section 3.1 .

The approach should also have additional advantages compared to the use of credit cards, as analysed in the comparison table in Appendix III which, in absence of a more appropriate mechanism, become the de facto method for spot buying in this context. Additional, flexible resources drawn from a large pool could produce publishable results faster than, for example, running the data processing tasks in a sequential manner, using locally available resources. However, it is also possible to identify potential limitations of the voucher model in supporting large-scale or long-term collaborations, especially in the context of support for open science and FAIR data assets. At least in the short to medium term, it has to be assumed that each cloud provider will use vendor-specific enhancements and optimisations as a method of differentiating their services

from others, which can limit the re-usability and interoperability of the cloud-based components - especially if they are developed by small, independent research groups (which might be overrepresented among the voucher recipients).

For the above reasons, it is proposed that the voucher model would be well positioned as an EOSC-sponsored replacement of accessing commercial cloud resources on the more piecemeal basis of currently employed methods such as using spot buying methods, and credit card (whether an institutional one or personal). The table in Appendix III compares the cost factors of the two approaches from the researcher's point of view:

In the absence of strong policy guidance constraining the choices available to researchers, the perceived cost/benefit ratio from the researcher's point will play an important role in shaping the demand. This includes both perceived, and actual cost and benefit (perceived complexity and associated risks and costs in terms of effort), as well as intangible aspects (trust, familiarity, branding and so on), as factors that influence the level of interest in the shared, common e-infrastructure services. This applies to services provided in house (or through federating services provided in house by research IT collaborations), procured from external sources and distributed as vouchers, or integrated to the overall e-infrastructure service offering in ways where the end user experience differs based on the provider class (commercial/academic).

The terms 'Cloud Coin' or Voucher Access Model were used in Deliverable 12.1, and a generic, non-prescriptive collaboration model for the voucher acquisition, distribution and activation is illustrated in [Fig.1](#) below.

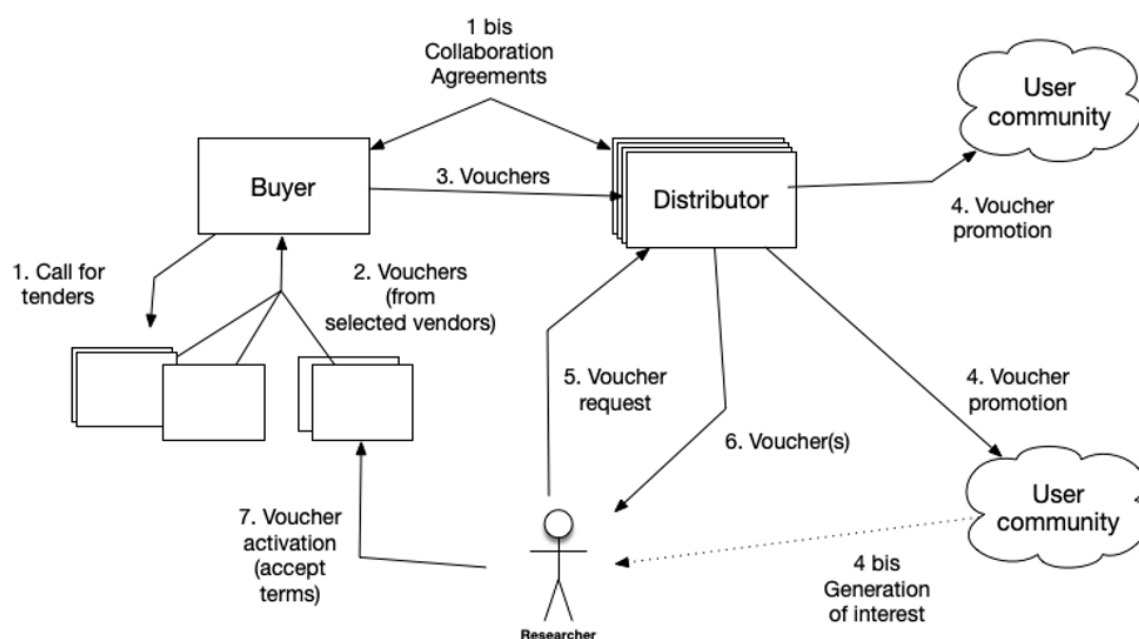


Fig.1 - Conceptual model of voucher acquisition, distribution and activation

The voucher scenario explores the use of vouchers in more detail, as trialled in the context of different incentivisation or introductory schemes. However, the analysis is now expanded to also

establish whether vouchers can be used as a long-term solution for providing free-at-the-point-of-use access to commercial services.

The use of cloud coins or vouchers to provide access to IaaS resources to researchers in Europe has recently been investigated in two Horizon 2020 EU projects: HNSciCloud [R9] and OCRE [R10]. The two approaches for the acquisition and distribution of the vouchers are detailed below in the form of use cases.

4.1.1 HNSciCloud Vouchers Use Case

4.1.1.1 Procurement

During the HNSciCloud project's pilot phase, the buyers group [R11] had access to large-scale services jointly procured from Exoscale (a consortium led by RHEA) and Open Telekom Cloud (OTC) (a consortium led by T-Systems). Out of a total procurement budget of €5.3 million, €417,000 were made available in the form of vouchers to be distributed to end users identified by the members of the buyers group and external long-tail of-science users. The procurement was performed as part of the pilot phase call-off in the context of the framework agreement established as a result of the initial tender [R12]. The voucher scheme had a defined associated Service Level Agreement (SLA) and an acceptable usage policy was included in the contract. Suppliers were required to integrate their compute and data management services into the evolving EOSC catalogue and the experiences gained during the process were documented and published [R13].

4.1.1.2 Legal & Contractual

The contractual relationship was between the company leading the consortia and CERN, as the lead buyer. The consortia were responsible for stopping the running VM instances launched by the end users once the credit was exhausted and preventing them from creating new ones. The SLA defined the period during which the data was kept by the cloud provider after a user had exhausted the allocated credit. Defining such a period provided a basic exit plan from a given cloud provider to the end users on-premise infrastructure or another provider. In the broader context of the EOSC, it is advisable that the beneficiaries of vouchers sign a declaration of proper conduct while using vouchers.

4.1.1.3 Process

Once the schemes were put in place by the consortia, members of the buyers group tested them using a small number of vouchers made available for free by Exoscale and OTC. Functionality such as account creation, registration and redeeming process, usage monitoring and account closure were reviewed. Contractors revised the schemes based on the feedback provided by the testers. The buyers group then distributed vouchers to researchers previously selected by the European Council for Doctoral Candidates and Junior Researchers (Eurodoc) [R14] based on their knowledge of cloud computing and ensuring a distribution across research disciplines and member states. Five selected researchers were invited to access the resources free-at-the-point-of-use, up to the voucher's face value, under the condition that they provide feedback on the usability and usefulness of the scheme for their research. Two declined after reviewing the guidelines, due to a lack of time and concerns that they could not exploit the services without local IT assistance. Exoscale vouchers

were distributed to two Eurodoc researchers, who were very satisfied with the scheme. The results of the feedback as well as additional details on the process are available in a published report [\[R15\]](#).

4.1.1.4 Financial and Regulatory

The procurement was co-funded by the members of the buyers group and the EC via a grant using the H2020 Pre-Commercial Procurement (PCP) financial instrument which is exempted from the WTO Government Procurement Agreement (GPA), the EU public procurement directives and the national laws that implement them.

The service capacity (compute and storage) allocated to each member of the buyers' group was proportional to their contribution to the procurement budget.

As an international organisation, CERN is exempted from Value Added Tax (VAT) in its host states [\[R16\]](#). Therefore, VAT did not apply to the HNSciCloud procurement and vouchers.

4.1.1.5 Scalability

The management and tracking of end users and the vouchers they were allocated was managed by CERN using a simple spreadsheet to record voucher status, codes and to whom they had been allocated. This approach was adequate for this limited scale use case.

4.1.1.6 Results and Recommendations

HNSciCloud adopted a voucher scheme to lower the entry barriers to cloud services for new users. The scheme enabled community managers of the early adopter teams to distribute voucher codes to users, so that they could more easily access cloud resources. With a limited quota and duration associated with each voucher, users could easily deploy cloud resources, associated to a community or customer account, and the procurers had an oversight of the usage of the services they funded.

The voucher scheme was particularly effective in increasing the number of individual users that accessed the cloud services and the range of use cases deployed. This included the long-tail-of-science users engaged via Eurodoc and users from the members of the buyers group with applications that were not foreseen during the project planning and execution. The users were required to briefly describe in writing their use case before receiving a voucher and to complete an online survey on the experiences afterwards. Linking the distribution of vouchers to a requirement to describe the targeted use case beforehand, and providing feedback after usage did not deter users from using the voucher scheme. The voucher scheme was also successfully used by some users to pilot the deployment of existing workloads on new architectures, such as high-end GPUs and software frameworks such as TensorFlow, that were not available via their institutional in-house IT resources.

Vouchers were also successfully used by service providers as a means of compensating procurers when the terms of an SLA were breached. This usage of vouchers was also successfully tested during the pilot phase of the HNSciCloud project as a result of an agreement with one of the supplier consortia where a service was unavailable for a longer period than the down-time specified in the SLA.

HNSciCloud found vouchers to be an “effective mechanism to encourage new procurers to make use of cloud service” and “for procurement organisations of any size to support, test and development activities involving cutting-edge architectures and services without impacting their production environments”. HNSciCloud found that “vouchers are probably not the most appropriate mechanism for well-planned, continuous or large-scale usage (or) for use cases with demanding storage and network requirements”. [R50]

Table 2 – Case study evaluation

	Researcher	Institution	Demand Aggregator
Ease of access	The ease of use of the voucher mechanism depends on how providers organise the access (activation process).	Typically, very easy: receive voucher codes via email with instructions for follow-up actions (typically URLs to support material and questionnaires to send out as part of the distribution process).	A potential definition of the aggregator / lead buyer role is that of an organisation identifying a specific demand and developing a project proposal in a suitable call and bringing in the relevant service providers.
Free at point of use	Yes	N/A	N/A
Compliance with EC Procurement Directive EC 2014/24	N/A	Compliance needs to be built into the acquisition and distribution agreements and processes. The buyer of the vouchers needs to ensure compliance with national laws.	
Compliance with financial standards	N/A	Compliance needs to be built into the acquisition and distribution agreements and processes. Compliance with the VAT regulations requires that the cloud providers determine the place of supply (based on the country where the voucher is activated). See Council Directive (EU) 2016/1065.	
Compliance with H2020 rules	N/A	Rules governing subcontracting and/or “other direct cost” categories.	Obligations may be defined as part of the distribution arrangements (e.g. if an institute is part of the consortium, reporting obligations, potential audits, etc.).

4.1.2 OCRE Vouchers Use Case

4.1.2.1 Procurement

In the context of the OCRE project, GÉANT, as procurer, invited suppliers already contracted via the pre-existing GÉANT IaaS framework [R17] and licensed to sell in the Netherlands, to provide

vouchers for IaaS commodity cloud for a total of € 500,000 excluding VAT. Three providers were selected: a Microsoft reseller, an AWS reseller and an independent service provider. The suppliers had to comply with a set of service requirements described in the call-off, examples of these requirements include the voucher amount, the duration, the expiration date and the service termination procedure. The service itself is delivered in accordance with service levels and descriptions recorded in the GÉANT IaaS framework.

4.1.2.2 Distribution

The OCRE vouchers were distributed through several distribution channels, including CERN, EURODOC and the EOSC-hub project (represented by the project coordinator EGI.eu). EOSC-hub (represented by the coordinator, EGI.eu) agreed with OCRE (represented by the coordinator, GÉANT) via a Memorandum of Understanding (MoU) to be a voucher distributor. EOSC-hub initially received 75 vouchers for distribution to a targeted group of Earth observation researchers in the early adopter programme. Distributing the vouchers through the EOSC marketplace (which would necessitate the analysis of potentially complex distribution networks and integration with an existing user support and service management framework) was not tested in this use of vouchers.

4.1.2.3 Legal & Contractual

GÉANT and the selected suppliers signed call-off agreements defining the clauses and provisions for the procurement of vouchers. The vouchers then established direct contract privity between the users and the respective supplier. The call-off agreement foresaw that the suppliers report every month on the consumption of the vouchers. Specific conditions for researchers using OCRE vouchers were defined. Each researcher had to agree to these when redeeming a voucher on the supplier's website. Each supplier was to incorporate these conditions in their own sign-up and activation system, and send GÉANT a copy of the file in which the researcher agrees to these conditions.

The role of the distributor was to facilitate the distribution of vouchers called off by GÉANT to users who met eligibility criteria. MoUs between the contracting authority and the organisations participating in the distribution of vouchers are not considered legally binding.

The construct of these arrangements as shown in [Fig. 1](#) was to ensure the obligations and benefits of each party involved in the value chain was clearly defined and had set out the inter-relationship with the other parties involved. For example, GÉANT did not wish to be liable for costs incurred above the value of the voucher, so the supplier was contractually bound to provide a soft landing as the voucher value consumption reached its limit. Further if there were to be a breach of GDPR by the end user, then the liability for this would sit with either the user or provider, not GÉANT or the distributor. The GDPR role types were therefore defined in such arrangements.

4.1.2.4 Process

CERN prepared a questionnaire [\[R18\]](#) with input from Eurodoc and the Marie-Curie Alumni Association (MCAA) [\[R19\]](#) to collect applications for vouchers from individual researchers. The questionnaire was distributed to a network of Eurodoc ambassadors who advertised the programme among the Eurodoc community. It was also promoted within the MCAA network.

MCAA and Eurodoc representatives selected candidates based on the completeness of their applications, their affiliations and the location of the research (i.e. in European or associated member states). During the selection process, attention was paid to gender balance and diversity in the fields of research. Successful candidates were asked to select the cloud provider of their choice. In September 2019, a total of 81 valid applications from researchers were received. The requirements outlined in the applications were analysed and published as a report. [\[R20\]](#)

A first set of nine vouchers was distributed to MCAA researchers. The distribution process of vouchers from two of the suppliers was then stopped by the OCRE management team in January 2020 as these suppliers were unable to process the related VAT at the point of consumption.

EOSC-hub focused on incorporating the voucher resources into the EOSC marketplace. In parallel to this integration task, EOSC-hub distributed a set of seven vouchers to Earth observation researchers, and is in the process of onboarding another set of vouchers to the EOSC portal. The EOSC-hub helpdesk intends to increase its scope to support voucher-based resources.

The distribution of vouchers from the third supplier to MCAA and Eurodoc researchers is ongoing. So far, one supplier has provided one consumption report as foreseen in the call-off agreement which remains to be analysed.

The providers then provide training and support to the researcher to assist in the consumption of resources/services to the value of the voucher.

4.1.2.5 Financial and Regulatory

There were two learning points in this implementation of voucher use:

1. **VAT.** In the course of consumption of the vouchers the three suppliers presented different interpretations of the VAT treatment in relation to the use of vouchers. This has resulted in only one of the three providers being able to meet the requirements to ensure compliance with VAT legislation. GÉANT's opinion, informed by external professional tax advisors is that Council Directive (EU) 2016/1065 should be applied, requiring the VAT to be accounted for in the location where the researcher consumes the service. This has frustrated the project in that it has limited the number of suppliers capable of handling this transactional complexity.
2. **EC Funding Cost Eligibility Criteria.** Due to the VAT being associated with the end user GÉANT is unable to recover it, thus will seek EC funding to cover these costs. Furthermore, the general principle is that costs under H2020 can only be claimed for benefits received by GÉANT/other project beneficiaries. In this scenario the researcher/user is not a beneficiary. Discussions with the EC Project Officer have been held to address this matter but an appropriate mechanism to ensure objective allocation of the vouchers has been agreed with the EC Project Officer.

In principle, the financial aspects of the voucher access are dealt with during the initial procurement by the contracting authority. However, at that time and before the activation of the vouchers, it was not possible to determine accurately which countries would consume what volume of resources. Therefore, it is important to ensure that the issuer of the vouchers takes the responsibility for determining the place of supply in the VAT sense.

The VAT implications on vouchers are being investigated further by GÉANT with the EC before additional vouchers can be offered by OCRE. Appendix I provides further information on VAT.

4.1.2.6 Scalability

The management and tracking of end users and the vouchers they are allocated requires dedicated manpower effort when operated at a large-scale. CERN is exploring the small-scale use of the Voucherify tool [R22] in order to automate the tracking process and simplify the task. A larger-scale use of the tool is anticipated in the OCRE project.

In the EOSC-hub context, the marketplace-based approach could reduce the service discovery (for the user), distribution (for EOSC) and user support (both users and EOSC) overhead by leveraging the marketplace tools. There is also scope to integrate the voucher-based resources to the overall EOSC Service Management System, for example, to inform cloud providers of EOSC-wide issues that might influence them or the voucher users.

4.1.2.7 Results and Recommendations

OCRE and EOSC-Hub voucher activities are still ongoing, therefore, project results and documented feedback from researchers are not available.

The most effective way to engage with the users for the collection of experiences needs to be determined (e.g. by collecting and comparing results of different approaches) as part of the voucher service onboarding process. For example, distributing questionnaires at the same time as the vouchers might lead to low response rate and considerable selection bias in the responses received.

Implications of using vouchers as a mechanism to offer free-at-the-point-of-use access to services for EOSC:

- Fits with EOSC's mission and policy:

A voucher scheme has proven to be an effective way of providing resources free-at-the-point-of-use in the context of the EOSC, based on the limited-scale pilots carried out within the cited projects to date. It is in line with the EOSC vision and adheres to the draft Rules of Participation [R23]: Ground Rule 2 (vouchers can be registered in a catalogue) and Service S1 (vouchers are free-at-the-point-of-use).

- Benefit realisation:

Vouchers are particularly useful for small-scale limited usage by individual users. In particular, vouchers are suitable for the long-tail scientists who frequently do not have a structure through which they can access such IT services. In this way, vouchers are very good at engaging new users who have not used EOSC services before. In addition, vouchers offer a flexible way to explore innovative architectures (e.g. GPUs, FPGAs etc.) and software libraries (e.g. TensorFlow) before adopting them in production at larger scales.

- Funding:

One can imagine EOSC vouchers being funded as part of EC research grants or procured by research communities to test state-of-the-art solutions.

4.1.2.8 Review Table

The below table analyses this case study against the evaluation criteria introduced in Section 1, and further predicts how vouchers could also be deployed in the other two Demand Scenarios described in this document.

Table 3 – Case study evaluation

	Researcher	Institution	Demand Aggregator
Ease of access	Simple. Typically, the user enters a unique voucher code via the supplier's interface to enable access to the services.	The institute executes the normal procurement process and requests to have a voucher model supported by suppliers as part of the requirements for the tender/call-off.	The demand aggregator needs to verify that the candidate suppliers can support a voucher model for access to the services.
Free at the point of use	Yes, once a voucher has been redeemed, the researcher has a credit available on their supplier account.	The institute distributes vouchers to researchers according to their policy.	Voucher tracking requires support if a voucher scheme is deployed at scale.
Compliance with the EC Procurement Directive EC 2014/24	N/A	Yes	May raise the issue of state aid if the voucher recipient is from the private sector.
Compliance with financial standards	N/A	Yes	Issues may arise if the recipient of the voucher is not a member of the personnel of the demand aggregator or is working in another country.
Compliance with H2020 rules	N/A	Yes	yes

4.2 Case Study 2: Practical Experiences of Public-to-Public Service Provision supported by the H2020 Virtual Access mechanism

The following case study describes public-to-public service provision via the H2020 virtual access mechanism which is ideal for the institutional procurement of services for research to be offered free at point of use. The intention is to offer insight how the EOSC can cater for procurement requirements of this nature.

4.2.1 Virtual Access in the Horizon 2020 Framework Program

Virtual Access (VA) refers to a specific financial instrument defined in the “European Research Infrastructures (including e-Infrastructures)” work programme, which is part of the Horizon 2020 framework program. The goal of this instrument is to reimburse service providers the cost of provisioning services to researchers.

This mechanism complements the Trans-National Access (TNA) defined in the same programme and addresses the general need of facilitating access to services from research and e-infrastructures. While TNA foresees user selection via peer review, user identification, and remote or physical access, VA was originally developed for open and free access to services through communication networks to resources needed for research, without choosing which researchers are given access [R24].

The contractual terms are collected in the H2020 grant agreement between the project and the EC (see Article 16 [R25]). Project beneficiaries in charge of virtual access are called “access providers” and provide access to research infrastructures or installation services (note that an installation is a part or a service of a research infrastructure that could be used independently from the rest; a research infrastructure can consist of one or more installations). An eligible access provider is any organisation that can be the beneficiary or linked third party of an H2020 project, if their services have a Technology Readiness Level (TRL) of 8 or 9.

Access must be free of charge through communication networks and for the purpose of research performed in public institutions or the private sector [R26]. Articles 16.2 and 16.3 define the eligibility of the costs. It should be noted that under the rules valid for the call that funded EOSC-hub, capital investment (i.e. costs of renting, leasing, purchasing depreciable equipment, infrastructure or other assets) could not be reimbursed. This constraint has been changed afterwards.

The services need to be reviewed periodically by a board of international experts (half of whom should be independent from the beneficiaries, unless otherwise specified). To be eligible for funding, access providers need to provide evidence of the international access to installations offered by the project.

Both VA and TNA can only be used in specific calls for projects in the context of H2020 if they are explicitly mentioned.

4.2.2 Procurement of Services for EOSC via TNA or VA

With the development of EOSC, the EC aimed to explore how the TNA and VA mechanisms could be used to reimburse the cost of accessing digital services provided by e-infrastructures. Therefore, this option was included in the EINFRA-12-2017 call, that funded the EOSC hub and OpenAIRE-Advance projects. The call specifically stated that “the operation of e-infrastructure services will be funded by supporting the trans-national and virtual access activities provided to researchers” [R27]. The goal was to stimulate the stakeholders to use these mechanisms and collect experience for evolving them further in the next Framework Program.

During the preparation phase of the EOSC-hub consortium, TNA and VA were evaluated:

- TNA supports unit costs and is more suitable for rival resources, however, it adds a considerable management overhead as it requires that users are chosen via a peer-review mechanism that is normally lengthy and expensive. This is typically used for scarce and expensive resources such as high-end HPC systems, however, it did not seem a reasonable choice for cloud-like services
- VA is more lightweight in terms of management, however, it only reimburses the operational part of marginal costs incurred to increase access to services (no CAPEX). It focuses on facilitating open and free access to services with no user selection, therefore, it is not well suited to support cost recovery of rival resources.

Given these considerations, it was clear that neither TNA nor VA were suitable in the context of the EOSC-hub project. Nevertheless, following the invitation of the policy makers, it was decided to use them to gain practical experience. Since the community is new to both mechanisms, VA was chosen as simpler to implement although it entails limitations on the cost items to be recovered.

On 24 May 2018, the EC organised a consultation workshop on the Access Costs Model for the EOSC. The EOSC-hub project provided initial feedback based on the preparation phase of the project and the initial setup. Of the specific issues raised by the project representatives, it is relevant to mention that:

- EOSC needs internal services that enable a multi-supplier federated environment. These services are not directly exposed to users and their cost cannot easily be measured indirectly by the use of the front-facing services that build on them.
- The VA mechanism would benefit from the unit cost approach that also envisions the recovery of CAPEX.

Following this consultation, the EC further evolved the rules for VA by defining a new provision [\[R28\]](#) for the INFRAEOSC-07-2020 and INFRAEOSC-03-2020 calls, which added the possibility to use unit costs in the VA mechanism. This can be considered as a key result achieved thanks to the EOSC-hub experience shared with the policy makers.

This case study reports on the experience of using the VA mechanism in the EOSC-hub project and also on the planning experience for a project proposal in the context of the INFRAEOSC-07-2020 call part A1.

The legal and contractual implications of VA are the same as being a beneficiary in an H2020 project. These aspects are regulated in the H2020 model grant agreement (especially Article 16 as defined above) where virtual access introduces a new direct cost category rather than establishing a new contractual model.

4.2.3 Using VA in EOSC-hub

The EOSC-hub project adopted the VA mechanism to provision access to the following service categories:

- **Common services** include high-throughput computing, cloud compute, storage and data management, among others.

- **Thematic services** include research data, advanced data brokering, and analysis capabilities provided by and for research communities.
- **Collaborative services** are platforms for sharing of research digital objects like scientific applications, pipelines, and virtual appliances.
- **Federation services** enable seamless operation, management and monitoring of distributed services across institutional borders.

During the preparation phase of the project, providers were selected either by direct invitation (mainly for federation-enabling services) or by open call (for the research-enabling services). Applicants had to declare their approach to cost claiming, their budget and their intended targets for expanding usage.

Following the guidelines for project preparation, a separated work package was created for the monitoring and reporting of service usage to be reimbursed via the VA mechanism (see EOSC-hub Work Package 13 “Access Provisioning”).

During the first phase of the EOSC-hub project, the research-enabling services were onboarded to the EOSC marketplace, thus offering a promotion and engagement channel for reaching new researchers.

Within the EOSC-hub project, 42 partners are involved in WP13 (Virtual Access) delivering 38 installations comprising: 16 Federation Services, 2 Collaboration Services, 10 Common Services and 10 Thematic Services. The total budget for VA is 4.4M€ (eligible costs) where 3.8M€ is funded by EC and the difference is funded by the EGI Foundation and partners. In the first 18 months of the project EOSC-hub services operated with the VA were accessed by more than 14.000 new users from 107 countries. The increase of users has been significant for all the service categories with around 5000 new users of thematic services (+283%), 5000 new users of federation and collaboration services (+37%), and 3500 new users of common services (+104%) [\[R29\]](#).

As required by the VA rules, providers need to define and collect key metrics to justify the amount of access and timely share. The following figure presents the metrics the EOSC-hub defines for each category of service, and the value at month 18 with the related increment from the previous measurement.

Number of users M1→M18	
Thematic service	5,060 (+283%)
Federation service	5,679 (+37%)
Common service	3,464 (+104%)

Integration of service providers M9→M18	
Federation services	1046→1384 (+32%)

Satisfaction (1 to 5) M9→M18	
Thematic service	4.2→4.62 (+9%)
Federation service	3.9→4.5 (+15%)

Average of reached countries M9→M18	
Thematic service	32.4→70 (+116%)
Federation service	45→48 (+7%)
Common service	19→25 (+24%)

Website/marketplace visits	M9 (only web-site)	M18 (web-site + MP)	Increase M9→M18
Thematic service	405	1916	1511 (+373%)
Common service	493	2232	1739 (+452%)

Fig.2 – VA Metrics defined in the EOSC-hub and related values at Month 18 (June 2019)

4.2.4 Financial and Regulatory

From a financial point of view, virtual access in the INFRAEOSC-03/07 projects deals with reimbursing the costs (based on unit cost, actual cost or a mix of both). Actual cost reimbursement is quite well understood, as it is the basis of the H2020 financial model (costs that can be directly attributed to the action are eligible). This model was used successfully in the EOSC-hub, despite the limitations discussed above.

Unit cost calculation is supported by a specific template provided by the EC [R30] that offers a framework for calculating the overall costs of the installation and the estimated proportion of the use of the installation in the project. As the calculation is primarily based on historical data (last closed financial year), the unit cost calculation produces values that are typically slightly higher than the actual costs of the service provision (as the price/performance ratio of IT equipment typically improves over time). The reimbursement model does not force the retirement of the equipment at the end of the depreciation period (the unit cost remains the same, independent of the equipment used). Thus, it is possible to continue using hardware until the end of its useful life, even if this exceeds the depreciation period used for accounting purposes.

From a regulatory point of view, the services fulfil the free-at-the-point-of-use objective. Compliance with procurement and VAT rules seems relatively straightforward: each of the installations that the access provider provides access to will comply with the local rules and, due to lack of payment by the user, the transactions involving the end users do not incur VAT (and do not require the place of supply to be determined).

The enforcement of the rules will follow the usual H2020 approach (primarily this means that non-compliance may result in costs being considered ineligible).

4.2.5 Funding

Currently, virtual access is a specific mechanism for a subset of H2020 calls. It, therefore, provides a model for using the related EC grants (awarded based on a competitive process) to partners in a

way that directly matches the actual cost of service provision, rather than a standard procurement approach,.

4.2.6 Reporting of VA

4.2.7 Scalability

Virtual access mechanism imposes limitations mainly on the degree to which the model can be scaled down and be applied to novel, emerging electronic services. The calculations that are needed to establish a unit cost require non-trivial effort and historical data (e.g. cost information from a financial period that has already been closed). Nevertheless, it is possible to use the actual cost model for the services that lack historical cost information.

4.2.8 Benefits

The experience of using the VA mechanism in EOSC-hub demonstrated the following benefits:

- Although the financial instrument was limited in terms of types of costs that could be recovered, it stimulated providers committed to the EOSC mission to take the initiative in participating, even if with an in-kind contribution. Some of these services helped to implement the first iteration of the EOSC Federating Core (the Hub Portfolio), while other services were directly used by researchers [\[R51\]](#).
- The community acquired expertise in using the mechanism, identifying the Key Performance Indicators (KPIs), and reporting usage.
- The collected experience reported to the EC helped to improve the mechanism for future calls (e.g. introduction of the unit cost, applicability to authenticated users, policy restrictions).

Throughout this experience, the following learnings were collected:

- Many providers did not find the mechanism compatible with their national mandate or policies; i.e., they needed the possibility to recover the full marginal cost and also needed to be able to limit the user base to specific communities. Understanding the growth of users for some services is difficult, especially as the VA was designed for open services with anonymous access.
- Two providers dropped out from the use of VA during the course of the project for the following reasons:
 - One provider intended to use VA for a service that is normally offered under a paid scheme. Organising a second channel for offering the service for free was too complicated to organise.
 - One provider had delays in the development of the service and did not manage to reach the minimum maturity required (TRL 8).
- The project office overhead for managing the installations and providing support to providers was much higher than anticipated.
- Automatic collection of data is not easy to be organised as organisations are new to this type of reporting.

- The guidelines and expectations regarding reporting were not clear enough. The approach to how the final evaluation would be conducted in relation to the success criteria also lacked clarity.

4.2.9 Results and Recommendations

Virtual Access is a good concept in view of the overall EOSC goals: services are open (at least to the community specified), they are free at the point of use, and the funding is explicitly targeted at pushing services beyond the existing user communities.

Following the revision of VA based on the EC decision in February 2019 [R31], the mechanism overcomes some of the limitations identified by the EOSC-hub project, and opens the way to a second round of piloting of the mechanism with projects from calls INFRAEOSC-07 and INFRAEOSC-03. Providers will acquire more experience in defining and measuring unit costs for their services, and this will further support the capability to define financial incentives to open up national infrastructures.

It should be noted that the adoption of unit cost requires the availability of historical cost data. Therefore, this seems more appropriate for recovering additional costs when opening up existing service, rather than for the development of new services for which other instruments are better suited.

Based on the current experience, the EC is working on improving the mechanism in the next framework programme, Horizon Europe. It is recommended to maintain the mechanism in the future framework program while keeping an open dialogue with the provider community to understand how this can be further refined.

4.2.10 Review Table

The below table analyses this case study against the evaluation criteria introduced in Section 1, and further predicts how vouchers could also be deployed in the other two Demand Scenarios described in this document

Table 4 – Case study evaluation

	Researcher	Institute	Demand Aggregator
Ease of access	The VA mechanism does not impose particular requirements on the users. How easy it is to obtain access provision depends on how providers organise the access.	The service provider must be a beneficiary in an H2020 project where the VA mechanism is available.	A potential definition of the aggregator / lead buyer role is that of an organisation identifying a specific demand and developing a project proposal in a suitable call and bringing in the relevant service providers
Free at the point of use	VA mandates that services need to be offered free at point of	n/a	n/a

	use and with no user selection.		
Compliance with the EC Procurement Directive EC 2014/24	n/a	VA is a type of cost in H2020 grants. Providers participate in project calls and, if selected by the EC, they can access the funding	n/a
Compliance with financial standards	The service is offered free at point of use so there are no financial implications for the users.	Only non-deductible VAT on the eligible costs can be recovered.	There is no specific provision for this role.
Compliance with H2020 rules	The activity must be research and the goal must be to expand usage.	The rules are defined by Article 16 in the H2020 model grant agreement.	There is no specific provision for this role.

4.3 Case Study 3: Public-to-Public Cooperation with Cost-Recovery Mechanisms

This case study considers public-to-public service provision with a cost-recovery mechanism, in the form of cooperation between two or more public-sector bodies. In particular, it relates to situations where one public-sector entity, e.g. a university, a public-funded research infrastructure or a research institution, procures digital services from another public-sector body, for its own benefit or for the benefit of its users (staff, faculty, associates, researchers etc.).

This particular case study is inspired by a simulated negotiation organised by the EOSC-hub project where a representative from the ELIXIR research infrastructure discussed needs and collaboration opportunities with four publicly funded national e-infrastructures: INFN (Italy), SURF (Netherlands), CESNET (Czech Republic) and CSC (Finland).

The ELIXIR community curates and makes available large-scale public datasets that are useful for research (in the order of Petabytes). Small research groups are interested in accessing and analysing those data in combination with private data from their activities. The typical analysis may range three to six months, and could potentially use thousands of CPUs with very high I/O requirements on the data. Fast networking, high-end computing facilities with shared file systems and secure data management are essential. E-infrastructures have the mission to serve research with high-end digital services.

At the time of writing the simulation is still in progress, however, one of the options being discussed is a cost recovery mechanism whereby the ELIXIR research infrastructure reimburses the costs of one or more of the publicly funded national e-infrastructures in return for the provision of digital services. This situation can be a typical example where public-to-public cooperation could be considered between two or more research facilities to make the services available that are required in the EOSC. This method of cooperation may provide access to such products, resources and

services without the need to engage regulated procurement procedures (which otherwise may be the case), and thereby facilitate resource sharing.

4.3.1 Legal & Procurement

This sort of public-public cooperation, involving the provision of digital services against a cost-recovery mechanism, may raise regulated procurement issues if it involves a public-sector entity as a ‘purchaser’. EU Directive 2014/24/EU on public procurement [R44] applies to contracts for pecuniary interest concluded in writing between one or more economic operators and a contracting authority, and having as their object the execution of works, the supply of products or the provision of services. The term ‘contracting authority’ include entities such as the state, regional or local authorities and ‘bodies governed by public law’, which are in essence entities influenced or financed by another public body or by the state [R45]. Most publicly funded universities, research infrastructures and research facilities are caught by the definition of a ‘body governed by public law’, and, therefore, will be considered as ‘contracting authorities’ and be subject to the rules set out in Directive 2014/24/EU on public procurement.¹

It is important to note that, in contrast to private-sector commercial entities that offer their (digital) services on the market, and are guided by commercial interest, public-sector research entities will usually:

- operate on a not-for-profit basis and be guided by considerations relating to the public interest.
- not provide (digital) services on the open market in competition with private providers.
- rarely participate as tenderers in open tender procedures.
- have limits on the level of commercial activities that they may carry out.

Public-sector research entities would usually find themselves in the position of a service provider, as part of a larger cooperation arrangement that they set up with another university, research facility or a public-sector body, and which has broader objectives than the mere provision of services.

Nevertheless, in the context of EU Directive 2014/24/EU, the fact that both parties to a contract (the purchaser and the service provider) are themselves public-sector entities, does not rule out the application of the procurement rules [R46]. This may mean that when two or more public-sector entities, such as universities, research infrastructures or research facilities, collaborate and one entity provides (digital) services against remuneration to the other entity, even if merely on the basis of a cost-recovery mechanism, then this arrangement may be caught by the provisions of Directive 2014/24/EU on procurement, if the ‘purchasing’ entity is a ‘contracting authority’. In such cases, a competitive tender process may need to be followed before the conclusion of the agreement, and the results of such procurement process cannot be determined in advance.

¹ Unless they are exempt by virtue of their legal status, such as an ERIC or an international organisation. Indeed, the ELIXIR research infrastructure is part of EMBL, which is an international organisation and therefore is not subject to EU Directive 2014/24/EU. A case-by-case analysis will be required to determine whether a particular entity is caught by Directive 2014/24/EU or not.

Therefore, there is a risk that due to regulated procurement constraints, the intended public-to-public cooperation may not be feasible for the original parties it was intended for.

4.3.1.1 Possible Exemptions from the Directive 2014/24/EU

However, Directive 2014/24/EU also provides a number of exemptions from the application of the rules on competitive tendering to certain arrangements, or to contracts below a certain value. It is possible that a certain arrangement, which would otherwise be considered as a 'public contract' within the meaning of Directive 2014/24/EU, will be excluded from the requirement to conduct a competitive tender, and that the parties to such an arrangement could contract directly.

Examples of such exemptions include situations of sole-source provider, lack of competition, extreme urgency circumstances, contracts awarded on the basis of an exclusive right, low-value contracts and other specific exclusions [R47]. This case study focuses on the particular exemption granted to public-to-public cooperation.

4.3.1.2 Exemption for Public-to-Public Cooperation

Directive 2014/24/EU specifically acknowledges that the application of the public procurement rules should not interfere with the freedom of public-sector entities to perform the public service tasks conferred on them by using their own resources, which includes the possibility of cooperation with other public-sector entities [R49].

Article 12 of the Directive 2014/24/EU allows two or more public-sector bodies to enter into an arrangement involving the provision of services against remuneration without following the procurement rules if:

- (1) the agreement establishes or implements a cooperation between the participating entities with the aim of ensuring that public services they have to perform are provided with a view to achieving objectives they have in common
- (2) the implementation of that cooperation is governed solely by considerations relating to the public interest; and
- (3) the participating entities perform on the open market less than 20% of the activities concerned by the cooperation.²

Such public-to-public service provision could be provided jointly through cooperation without having to use any particular legal form, and it may cover all types of activities related to the performance of services and responsibilities assigned to or assumed by the participating entities; both mandatory or voluntary tasks or services conferred upon such entities by public law.

A recent case law by the Court of Justice of the European Union illustrates the importance of the concept of 'cooperation' at the very heart of the public-public exemption, which is very relevant for this case study [R49]. This court case introduces some limitations on what could be considered

² The 20% relates to the activities included in the cooperation. Article 12(5) of the directive provides specific guidance for the way it should be calculated.

public-to-public cooperation, which would justify an exemption from the requirement for a competitive tender.

In essence, the joint cooperation of all entities involved must be essential to guaranteeing that the public services they must provide are carried out. To meet this condition, it is not enough that the arrangement is limited to a reimbursement of costs. The court observed that if such reimbursement of costs alone was sufficient to characterise 'cooperation' (within the meaning of condition (1) above), then no distinction could be made between a 'cooperation' and a normal 'public contract' which requires a tender.

Therefore, in order to be exempt from the application of the procurement directives, the public-to-public cooperation agreement requires the parties to jointly define their needs, and the solutions to be provided. The agreement should also be based on a strategy that is common to the public entities of this cooperation, and it requires that the entities join their efforts to provide the services. In other words, the cooperation between the two entities must be broader than a mere provision of services, even if it is based on a cost-recovery mechanism and is not-for-profit.

4.3.2 Process

The process for the public-public cooperation could be described as follows:

Within the merit of its public-service mission, the public research institution identifies a specialised need for additional capacity to support the services that it provides to its users, which cannot be met internally. For this purpose, it looks for a cooperation with other public institutions with the aim of ensuring that the services they have to perform are provided with a view to achieving objectives they have in common.

The research institution then reaches out to potential cooperating entities and starts a negotiation with those interested. The negotiation must be based on genuine cooperation for achieving objectives they have in common, and not merely limited to a simple reimbursement of costs.

If complementarities in the cooperation are identified and common objectives identified, then the cooperation may be crystallised. The cooperation can take any legal form –it does not need to be a contract or a joint venture. It should be based on a cooperative concept and not require all parties to assume the performance of main contractual obligations, but to commit to contribute to the cooperative performance of the common objectives.

4.3.3 Policy

As discussed above, EU procurement law provides for an exemption from the need to carry out a regulated competitive tender process in order to identify the relevant service providers partners to a public-to-public service provision with a cost-recovery mechanism. It is important however to confirm on a case-by-case basis, taking expert legal advice where relevant, that the conditions for this exemption, as identified above, are fully met.

It is interesting to note, as a general remark, that the conditions for the exemption discussed above are broadly coherent with the requirements and constraints that publicly-funded research

institutions will normally have if they were to assume the role of a service-provider under a public-public cooperation agreement.

In the specific ELIXIR collaboration case study with INFN, SURF, CESNET and CSC referred to above, the four potential service providers expressed their internal constraints due to their by-laws or internal policies. For example, some research institutions may only be allowed to carry out limited economic activities of up to 20% of their overall activity. This seems coherent with the requirement that the participating entities in the public-to-public cooperation perform on the open market less than 20% of the activities concerned by the cooperation.

Moreover, they communicated that they usually avoid competing with private entities in tender procedures for the provision of services, and that there would be formal or informal policies that could prohibit them from preparing and submitting bids in public tenders. Such research facilities will only be taking upon themselves the role of a 'service provider' if this is done as part of broader obligations under a cooperation arrangement that is in line with their normal missions and objectives as a public-sector entity. This, once again, seems to fit well with the conditions for the exemption from a regulated tender procedure (conditions (1) and (2) above), that the implementation of the cooperation should be governed solely by considerations relating to the public interest and that it aims at ensuring that public services they have to perform are provided with a view to achieving objectives they have in common.

4.3.4 Financial

The public institution benefiting from the services would usually pay against invoices. This is normally subject to VAT unless there are specific exemptions that apply. The payment is likely to be limited to reimbursement of costs.

4.3.5 Benefits

If all conditions are met, public-to-public cooperation allows research facilities that are subject to EU Directive 2014/24/EU to avoid running a competitive tender if they wish to rely on the capacities of other research facilities for digital services. If all conditions are met, they are able to benefit from the exemption without the burden of organising a public tender while using the cost reimbursement mechanism.

4.3.6 Results and Recommendations

- Public-to-public cooperation is a useful exemption from the application of Directive 2014/24/EU on public procurement, which can be used by collaborating research institutions to provide services. It is mostly relevant for research facilities that fall under the definition of a 'contracting authority' within the meaning of Directive 2014/24/EU, as it allows them to enter into such an arrangement without the need to incur the additional administrative burden and costs associated with the conduct of a competitive tender process.
- EOSC governance should develop guidelines and promote this scheme as one of the available options to maximise cross-border interoperability with cost reimbursement among public institutions.

- EOSC governance could develop contractual templates for this kind of public-to-public cooperation between research facilities.
- The EOSC portal could allow public institutions to find opportunities for public-to-public cooperation.

4.3.7 Review Table

The below table analyses this case study against the evaluation criteria introduced in Section 1, and further predicts how vouchers could also be deployed in the other two Demand Scenarios described in this document

Table 5 – Case study analysis

	Researcher	Institute	Demand Aggregator
Ease of access	No implications for researchers	If conditions are met, the complexity is similar to organising a direct contract.	This role is not explicitly foreseen, however, a public entity could potentially participate in a public-public cooperation as demand aggregator.
Free at the point of use	No implications for researchers	No constraints are posed by the mechanism.	
Compliance with the EC Procurement Directive EC 2014/24	n/a	An exemption is explicitly foreseen by the directive.	
Compliance with financial standards	n/a	VAT would apply on the cost reimbursement unless specific exemptions exist.	
Compliance with H2020 rules	n/a	n/a	n/a

4.4 Case Study 4: Practical Experiences with Demand Aggregation: SURFnet and the GÉANT IaaS Framework

This case study demonstrates how demand for common services from research and education users across Europe can be aggregated in order to get the best deal from suppliers in the market whilst complying with procurement regulations. More specifically, it considers the pan-European Infrastructure-as-a-Service (IaaS) tender which GÉANT launched in 2016. In this tender, demand aggregation and procurement were coordinated between GÉANT and NRENs. The NRENs acted as the central parties that mobilised their constituencies (typically universities and other organisations

performing research), and coordinated the national provision and adoption of the procured services.

The process, as detailed below, builds on the GÉANT IaaS framework. This framework provides a set of policies and processes which enable research organisations from different European countries to undertake joint, cross-border procurement - thereby overcoming barriers for such collective activities posed by the diversity in national legislation, rules and regulations. The GÉANT IaaS framework functions as a layer between research institutes subject to national legislation and service suppliers operating in the international marketplace and helps to ensure compliance with procurement regulations that stem from the European Council Directive 2014/24/EU of 26 February 2014.

This case study describes pertinent aspects of the GÉANT IaaS Framework and its implementation in more detail, focusing, where applicable, on the perspective of SURFnet (the NREN in The Netherlands).

4.4.1 Procurement

In the 2016 IaaS tender, GÉANT acted as a Centralised Purchasing Body (CPB) to put in place a number of framework agreements that could be used by Research and Education (R&E) entities across Europe. This demand aggregation channelled through a central body is advantageous to the participating entities, as it allows them to benefit from more favourable conditions of use (including volume discounts and data egress waivers), and a greater influence in negotiating preferred standards and interoperability requirements (such as federated identity management or single sign-on). In addition, it reduces the amount of procurement activity required by R&E entities wishing to consume IaaS through the framework.

The framework agreements incorporate model contracts which will govern the consumption of IaaS by institutions. These contracts can be amended to accommodate any national legislative obligations, thus giving assurance to institutions that key obligations such as data security provisions are clearly established and further reducing burden or overhead for institutions in the procurement process.

Employing this IaaS framework, GÉANT launched a pan-European IaaS tender in 2016. Aggregated sales through the framework at time of writing have totalled in excess of €26.5 million via 385 institutions and organisations, and 18 NRENS.

The first service agreements were available in January 2017. Current agreements will expire at the end of 2020, after which the tender and associated agreements will be superseded by the results of the tender being prepared by the OCRE project.

4.4.2 Process

The end-to-end process that was followed from preparations to service provisioning can be summarised with the following steps:

1. Preparing, organising, and, most notably, gathering a number of organisations (R&E Contracting Authority (CA) institutions, and NRENS across Europe) who can be named in

the OJEU procurement procedure by one CA acting as a Centralised Purchasing Body (CPB) on behalf of the others. In this instance GÉANT was the CPB and co-ordinated a set of procurement documentation setting out a consensus on common requirements and boundary conditions for the desired services.

2. Running a formal tender procedure on a European level, managed by the CPB. When successful, this step ends with the CPB and service provider signing a framework agreement. For the GÉANT IaaS framework this resulted in the award of multiple framework agreements per country, recognising that the common needs identified by the community are often met by national IaaS providers.
3. Signing a service commencement form between the NREN and the service provider, which gives the green light to commence direct interaction between a service provider and an institution in a national territory. This was incorporated to ensure the NREN in each nation was engaged to help ensure the successful adoption and deployment of IaaS as described in Section 4.4.3.
4. Institutions (including NRENS) call off, on a local, institutional level, a specific type and volume of service, either as a direct award to a service provider of choice (in case the requirements fit exactly within the framework agreement) or as a mini-competition (in case of additional requirements in terms of functionality or non-functional demands including specific rules and regulations).
5. Selected service providers and institutions work together to provision the service so that end users at the organisation can start using it.

4.4.3 The NREN's Role in the IaaS Supply Chain

Throughout the process, the NREN fulfils several critical functions:

- The NREN helps assure that the framework agreement is compliant with national legislation, rules and regulations.
- The NREN mobilises its community to align on specifications and requirements, and form a buyer group (together with their counterparts across Europe).
- The NREN signs the service commencement form, authorising direct contact between service providers and the research organisations which they represent.
- The NREN champions the adoption of services through activities such as promotion, education, training, etc.

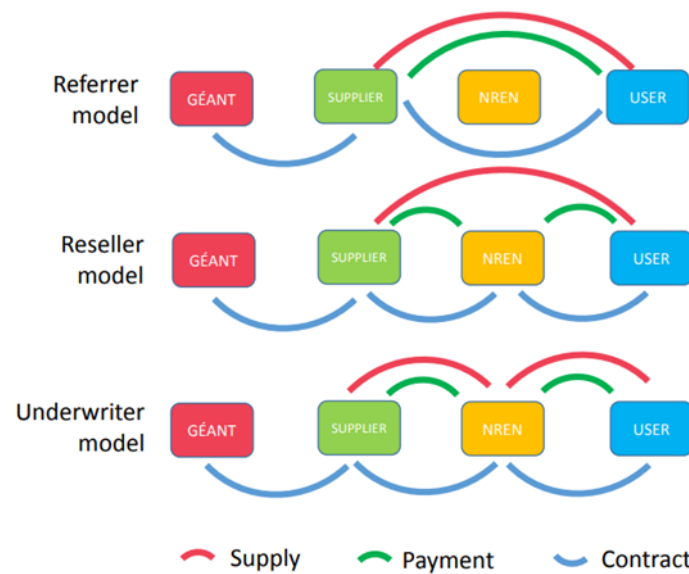


Fig.3 - The different roles that an NREN can assume in the demand aggregation and service delivery process.

The framework includes a mechanism which, on a national basis, requires the NREN to indicate which role they wish to play in the process under the framework agreements:

- Referrer

As a referrer, the NREN is mostly a facilitator, acting as an intermediary by making the providers who hold framework agreements in this country and the institutions purchase services directly from the service provider.

- Reseller

The reseller role expands on the referrer role, including involvement in the contracting and billing of (some of) its institutions' service orders.

- Underwriter

As an underwriter, the NREN makes purchases from service providers (on behalf of its connected institutions) and distributes the acquired resources across its community (institutions and end users) so that research organisations can purchase services directly from their local NREN, and the NREN may provide additional services to their community.

The NREN has a more active role and is more exposed to commercial risk, which may be compensated by a margin on top of the service provider's price (note, however, that not all parties allow for such a margin). In this scenario the NREN effectively acts as the service provider towards their member organisation.

This case study focuses on the experiences of SURFnet who selected the role of GÉANT IaaS underwriter. SURFnet's underwriter role was made possible by a firm purchasing commitment from SURFnet members (which also strengthened the position to negotiate favourable criteria with service providers). To help their members make optimal use of the IaaS services, SURFnet developed an online portal called SURFcumulus. To offset costs for the portal and administrative overhead in

the tender process, SURFnet added a margin on top of the price as negotiated with service providers. This service fee was discussed and approved beforehand by the SURFnet member institutions.

4.4.4 Policy

The law allows a fair degree of freedom for the central purchasing body and the NRENs to decide who may join the tender process on the consumer side (all parties included in the tender become contracting authorities). In the 2016 tender process, SURFnet's policy was to include all its members but no other parties in the Netherlands that might have been interested (e.g. primary education).

On the service provider side, any party may apply to tender. While this includes in principle both public and private organisations, in practice only private parties were selected for the GÉANT IaaS tender – largely because of a greater level of maturity in business operations (such as having a clear pricing structure and SLAs).

4.4.5 Legal & Contractual

As explained above, the GÉANT IaaS framework comprises a number of different steps that result in a number of legally binding documents:

1. The tendering process, formalised through the procurement process advertised in the Official Journal of the European Union. This process is subject to the legislation of the country in which the tender is organised (which builds on the EU Council Directive 2014/24/EU, though details of how this is implemented vary between countries).
2. Creation of the framework agreement, which is subject to the legislation of the country in which the framework is drafted.
3. Utilisation of the framework agreement for call-off contracts between the service provider and the consuming research organisation. This is subject to the legislation of the country in which the research organisation resides.

In principle, these could be three different countries and, therefore, three different sets of legislation, rules and regulations. For the 2016 GÉANT IaaS tender, the tender was carried out in accordance with the UK Public Contracts Regulations, the framework agreement governed by the laws of England and Wales. In the case of SURF, call-off contracts are governed by the laws of the Netherlands.

Whilst not tested in every member states public procurement legislation, it is pragmatic to assume that the obligation for GÉANT or any other entity establishing a framework on behalf of others needs to identify the entities that intend to use the framework. This process requires considerable interaction with multiple entities to secure their approval to be named in the OJEU notice and those not listed are not able to use the framework across its lifespan, typically 4 years.

4.4.6 Financial & Regulatory

The framework is fully compliant with VAT regulations, more specifically the VAT regulations that apply in the home country of the research organisation consuming the service. Thanks to arrangements between the service provider and the research organisations, the service is free at

the point of use by the researcher. It is usually the central IT department who signs the contract with the service provider, offers the services internally, and manages the spending. Usually, service consumption is monitored and aggregated, where mapping consumption at the individual level to the organisational level is made possible by federated access and identity management, and central or aggregated administration, and billing tools offered by the service provider.

As the framework and call-offs are implemented in accordance with the EU directive on procurement, expenditure placed through them will meet many funding and legislative obligations on contracting authorities

While the financial responsibilities of the NREN vary as a function of the role that it chooses in the process (referrer, reseller or underwriter), funding is ultimately provided by a combination of funds with the research institutes and centrally allocated funds. This balance differs within the various European countries, ranging from decentralised situations, where the research institutes exert most control, to more centralised models, where the national government or NREN plays a more prominent role.

4.4.7 Benefits

While detailed numbers on reduced overhead costs and more favourable conditions with vendors are not publicly available at this time, cost savings of up to 25% (The Netherlands) or 33% (Ireland) have been previously reported. Multiplying this with the total spent on IaaS cloud services throughout Europe clearly shows a significant opportunity, when applied at scale and in a consistent way.

In addition, common standards, in particular in the area of access & identity management, and value-adding services such as cloud portals improved the user experience for end users.

4.4.8 Results and Recommendations

To assess the applicability of the framework for EOSC at large, it is imperative to review some of the lessons learned from the 2016 tender process:

- The process works well for services that are essentially a commodity, i.e. where the overlap of user needs and requirements is high. This is a necessary condition for a sizable aggregation of demand.
- Benefits realised, especially in terms of costs saved, are greatest when the partaking research organisations are prepared to commit a sizable proportion of their budget to reach true economies of scale and bargaining power. The stronger the commitment that research institutes can give to their NREN, the more powerful the NREN can operate.
- The obligation to identify beneficiaries during the tendering process is a considerable overhead that limits flexibility over the life of the framework.

The core strength of the framework lies in providing a common interface between the international marketplace and a variety of national laws. Successful operationalising of this model requires strong national bodies that can organise the process and mobilise members at the national level. Equally, the model is not developed for non-national intermediaries such as international research

organisations that cut along disciplinary instead of national lines. Using the model for such scenarios might be worthwhile but will require further development and elaboration.

By aggregating demand process savings are available to all users and R&E institutions are able to access preferential deals from hyper-scale providers, previously unavailable to them when procuring independently.

4.4.9 Review Table

The below table analyses this case study against the evaluation criteria introduced in Section 1 , and further predicts how vouchers could also be deployed in the other two Demand Scenarios described in this document

Table 6 – Case study analysis

	Researcher	Institute	Demand Aggregator
Ease of access	Once procurement and service provisioning are completed, researchers can in principle easily access services as required. Access is further facilitated by a portal (developed in this case by SURF) and by the adoption of Authentication and Authorisation Infrastructure (AAI) standards that enable single sign-on.	Substantial effort is required from institutes to engage in the procurement and service provisioning process for their researchers. Once service provisioning is complete, little ongoing effort is required.	The central purchasing body and NRENs put significant effort into organising and coordinating the demand aggregation and procurement process. After this is done, depending on the role the NREN selects, ongoing effort may be required to help researchers make optimal use of the service.
Free at the point of use	Yes, services are free to use for the researcher through their affiliation with a host institute that is part of the buying group.	The institute pays for consumed resources, either the NREN or the service provider directly. The NREN may charge a fee to cover its expenses and/or value-add services.	
Compliance with the EC Procurement Directive EC 2014/24	n/a	Compliance with this directive is built into the framework agreement and process. The NREN has a role to safeguard compliance with national laws.	
Compliance with financial standards	n/a	Compliance with applicable financial regulations is built into the framework agreement and process. In particular, VAT regulations for the home country of the research organisation consuming the service apply.	
Compliance with H2020 rules	n/a		Demand aggregator may not be eligible for cost recovery funds as they

			are not receiving the benefit (which will be with the institutions).
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5 Conclusions

The business models and procurement methodologies required to provide ‘1.7 million European researchers and 70 million professionals in science and technology a virtual environment with free at the point of use, open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines’ [\[R42\]](#) are not diverse and multiple.

This study has considered case studies for services for three scenarios that are believed to be a proxy for a large proportion of this user community of researchers and professionals.

As the EOSC legal entity evolves and the proposition it brings is implemented, this study has identified a number of conditions, either through previous application or early indication from work done to date, that must be considered in the construct of activities in its operation.

These conditions may require the implementation of certain operational practices, be it procedural or by way of commensurate resources, to realise an effective service. It may also be that continued refinement of funding agreement rules, or indeed EC legislation, may benefit the operation of the EOSC.

The four case studies included, to the greatest extent possible looked at lessons from other EOSC-related projects and the application of this in at least one of the demand scenarios. Key observations resulting from this are set out below.

- **Cloud Coins / Voucher Use**

This mechanism was recognised as having good potential to help drive initial uptake of cloud services. It is probably not the most appropriate mechanism for well planned, continuous or large-scale use. Whilst the case studies did not test this mechanism at scale, extrapolation of the findings can help provide possible implications.

Regardless of scale, the VAT considerations from the use of vouchers by distributed researcher users across Europe creates an administrative burden that may be so onerous that it thwarts the effective deployment, as there is a disproportionate overhead required in administration.

The funding arrangement facilitating the procurement of the resources to be consumed through vouchers needs to recognise the benefit may be realised by a third party to the project, and ensure this is within the definition of eligibility on the funding agreement.

Finally, the supply chain needs careful planning in order to set out the responsibilities and liabilities of all those involved, for example, in the GDPR or costs incurred beyond the voucher values. Consideration of who has privity to which agreement in the supply chain needs to be mapped and interdependencies incorporated in each relevant agreement to ensure end to end effectiveness.

- **Virtual Access**

Virtual Access is a good concept in view of the overall EOSC goals: services are open (at least to the community specified), they are free at the point of use, and the funding is explicitly targeted at pushing services beyond the existing user communities.

Following the revision of VA based on the EC decision in February 2019 [\[R31\]](#), the mechanism overcomes some of the limitations identified by the EOSC-hub project, and opens the way to a second round of piloting of the mechanism with projects from calls INFRAEOSC-07 and INFRAEOSC-03. Providers will acquire more experience in defining and measuring unit costs for their services, and this will further support the capability to define financial incentives to open up national infrastructures.

It should be noted that the adoption of unit cost requires the availability of historical cost data. Therefore, this seems more appropriate for recovering additional costs when opening up existing service, rather than for the development of new services for which other instruments are better suited.

It is noted that the EC is working on improving the mechanism in the next framework programme, Horizon Europe.

- **Public-to-Public Cooperation**

Public-to-public cooperation is a useful exemption from the application of Directive 2014/24/EU on public procurement, which can be used by collaborating research institutions to provide services. It is mostly relevant for research facilities that fall under the definition of a ‘contracting authority’ within the meaning of Directive 2014/24/EU, as it allows them to enter into such an arrangement without the need to incur the additional administrative burden and costs associated with the conduct of a competitive tender process.

EOSC governance should develop guidelines and promote this scheme as one of the available options to maximise cross-border interoperability with cost reimbursement among public institutions.

EOSC governance could develop contractual templates for this kind of public-to-public cooperation between research facilities.

The EOSC portal could allow public institutions to find opportunities for public-to-public cooperation.

It may also be possible that with the application of Virtual Access Funding, there would be no contract between public entities, so, as well as templates to facilitate this practice, different funding regimes could also increase the likelihood of such public-to-public collaborations.

- **Demand Aggregation and Centralised Procurement**

The case study produces three main conclusions:

- The process works well for services that are essentially a commodity, i.e. where the overlap of user needs and requirements is high. This is a necessary condition for a sizable aggregation of demand.
- Benefits realised, especially in terms of costs saved, are greatest when the partaking research organisations are prepared to commit a sizable proportion of their budget to reach true economies of scale and bargaining power. The stronger the commitment that research institutes can give to their NREN, the more powerfully the NREN can operate.
- The obligation to identify beneficiaries during the tendering process is a considerable overhead that limits flexibility over the life of the framework.

The core strength of the framework lies in providing a common interface between the international marketplace and a variety of national laws. Successful operationalising of this model requires strong national bodies that can organise the process and mobilise members at the national level. Equally, the model is not developed for non-national intermediaries such as international research organisations that cut along disciplinary instead of national lines. Using the model for such scenarios might be worthwhile but will require further development and elaboration.

By aggregating demand process savings are available to all users, and R&E institutions are able to access preferential deals from hyper-scale providers, previously unavailable to them when procuring independently.

The implications from the case studies are considered to be particularly pertinent if the concepts for an EOSC Exchange activity are to be implemented in the EOSC, and through consultation with interested parties, most notably the EOSC Sustainability Working Group, a revised version of this report, D12.3, will be produced, that is hoped will inform and guide the future implementation of the EOSC.

It is recognised that this study is not exhaustive and that to ensure success there are other criteria that may need to be considered, for example:

- The scalability of any approach.
- State Aid infringement concerns.
- Considerations for the motivations and requirements of suppliers to EOSC.
- Maturity of markets, practices, technology and supply chains to ensure achievability, be it to work in a standardised way or at scale across Europe.

6 References

No	Description/Link
R1	https://www.eosc-hub.eu/about-us
R2	https://www.fairsfair.eu/
R3	https://documents.egi.eu/public/RetrieveFile?docid=3466&version=1&filename=EOSC-hub%20D12.1%20FINAL.pdf
R4	Voucher Schemes for Accessing Commercial Cloud Services in the Research Environment
R5	https://ec.europa.eu/commission/presscorner/detail/en/speech_20_102
R6	https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy
R7	A Digital Single Market Strategy for Europe, COM(2015) 192 final
R8	Two example references to EOSC-hub acting as a broker: https://confluence.egi.eu/display/EOSC/Service+Portfolio+Management+-+SPM https://confluence.egi.eu/display/EOSC/Communications+Toolkit?preview=%2F18973612%2F26417066%2F00+EOSC-hub+service+portfolio+v2.pptx
R9	https://www.hnscicloud.eu/
R10	https://www.ocre-project.eu/
R11	The Buyers Group includes the following organisations: CERN, CNRS, DESY, EMBL, ESRF, INFN, KIT, STFC, SurfSARA, see https://www.hnscicloud.eu/partner-type/buyers
R12	Christophe Veys, & Bob Jones. (2017). D2.2 Tender Material Publication. Zenodo, https://doi.org/10.5281/zenodo.253998
R13	Integrating commercial cloud services into the European Open Science Cloud, March 19, 2019, https://doi.org/10.5281/zenodo.2598039
R14	http://www.eurodoc.net/
R15	Bob Jones, Joao Fernandes, & Marion Devouassoux. (2019). Voucher Schemes for Accessing Commercial Cloud Services in the Research Environment. https://doi.org/10.5281/zenodo.2615456
R16	https://fap-dep.web.cern.ch/node/318
R17	https://clouds.geant.org/geant-cloud-catalogue/geant-cloud-catalogue-iaas/
R18	https://forms.gle/T7AFXJvD2uLgHaBV6
R19	https://www.mariecuriealumni.eu/
R20	Marion Devouassoux, Bob Jones, & João Fernandes. (2019, October 24). Long-Tail-of-Science's Requirements for Commodity Cloud Services in Europe. Zenodo. http://doi.org/10.5281/zenodo.3564668

R21	https://ec.europa.eu/taxation_customs/sites/taxation/files/information_microbusiness_es_euvat_2015_en.pdf
R22	https://www.voucherify.io/
R23	Rules of Participation, Version 0.2 (29 January 2020)
R24	See Annex 4 of the Horizon 2020 Work Programme 2018-2020 “4. European research infrastructures (including elnfastructures)”, Chapter “Specific Features for Research Infrastructure”, Section D https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-infrastructures_en.pdf
R25	https://ec.europa.eu/research/participants/data/ref/h2020/mga/gga/h2020-mga-gga-multi_en.pdf
R26	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/faq;keywords=/601
R27	EINFRA-12-2017 call https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/einfra-12-2017
R28	https://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf
R29	See EOSC-hub D13.2 Periodical assessment of the services https://documents.egi.eu/document/3501
R30	https://ec.europa.eu/research/participants/data/ref/h2020/other/call_ptef/pt/h2020-call-ct-infraeosc-07-2020-ria_en.xls
R31	https://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf
R32	https://zenodo.org/record/2615456 ‘Best Practices’ section
R33	https://ec.europa.eu/taxation_customs/individuals/buying-goods-services-online-personal-use/buying-services/electronically-supplied-services_en
R34	An example of an approach is the recent German government scheme to support German digital game industry with 200M€ grant scheme https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_55186
R35	https://ec.europa.eu/competition/international/multilateral/
R36	The EU-Boeing dispute is an example of a WTO dispute where similar issues were raised. In the summary of findings, payments and access to government facilities was noted several times. While any R&D collaboration with industry might raise the issue of “access to facilities”, the voucher scheme can also be interpreted as a payment. https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds353_e.htm
R37	https://www.gartner.com/en/newsroom/press-releases/2019-07-29-gartner-says-worldwide-iaas-public-cloud-services-market-grew-31point3-percent-in-2018

R38	A broker is a person or firm who arranges transactions between a buyer and a seller for a commission when the deal is executed. A broker who also acts as a seller or as a buyer becomes a principal party to the deal. Neither role should be confused with that of an agent—one who acts on behalf of a principal party in a deal. https://en.wikipedia.org/wiki/Broker
R39	Virtual Access - Article 16.2 of H2020 Grant Agreement https://webgate.ec.europa.eu/funding-tenders/opportunities/content/article-162-%E2%80%94rules-providing-virtual-access-research-infrastructure-article-163-%E2%80%94en See also Section Work Programme 2018-2020 “European research infrastructures (including eInfrastructures)”, Chapter “Specific Features for Research Infrastructure”, Section D https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/h2020-infra-2018-2020_09_25_2017.pdf
R40	https://webgate.ec.europa.eu/funding-tenders/opportunities/content/article-161-%E2%80%94rules-providing-trans-national-access-research-infrastructure_en
R41	https://www.eoscsecretariat.eu/working-groups/sustainability-working-group
R42	https://op.europa.eu/en/publication-detail/-/publication/5253a1af-ee10-11e8-b690-01aa75ed71a1
R43	https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf
R44	Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement, OJ L 94, 28.3.2014, p. 65–242
R45	For the exact definition of a ‘contracting authority’ see Article 2(1)(1) and 2(1)(4) of Directive 2014/24/EU
R46	Recital 31 of Directive 2014/24/EU
R47	Articles 7-17 and 32 of Directive 2014/24/EU
R48	Recital 31 of Directive 2014/24/EU
R49	Case C-429/19, Remondis GmbH v Abfallzweckverband Rhein-Mosel-Eifel, ECLI:EU:C:2020:436
R50	https://doi.org/10.5281/zenodo.2615456
R51	Briefing Paper on the EOSC Federating Core: https://www.eosc-hub.eu/sites/default/files/EOSC-hub%20Briefing%20Paper%20v2.0%20-%20EOSC%20Federating%20Core%20v0.3%20%28consultation%20comments%20and%20responses%29%20%282%29.pdf EOSC-hub Supporting Services: https://www.eosc-hub.eu/support-services

R52	https://www.eosc-hub.eu/deliverable/d33-interim-report-dissemination-and-exploitation-project-results
R53	https://www.gartner.com/en/newsroom/press-releases/2019-07-29-gartner-says-worldwide-iaas-public-cloud-services-market-grew-31point3-percent-in-2018#:~:text=The%20worldwide%20infrastructure%20as%20a,%2C%20according%20to%20Gartner%2C%20Inc.&text=In%202018%2C%20the%20top%20five,less%20than%2073%25%20in%202017.

Appendix I. VAT

Relevant VAT legislation:

- For a VAT-registered business to recover VAT charged as input VAT, it must relate to a supply made to them in connection with any goods or services to be used for the purpose of any business activity carried out by that business, i.e. a business cannot recover VAT incurred on supplies received by another party.
- Under the OCRE project, where the cloud services are being consumed by the end user and service is provided by a third-party supplier, the VAT charged by the supplier is to the end user. Even if GÉANT does pay for the services on behalf of the user, the supply (and therefore the VAT charged) is made to the user. As a result, this VAT on the user is not recoverable by GÉANT. So, although there is VAT due as part of the cost of supply, GÉANT has no right to recover this VAT as it is only a third-party payer. The cost of VAT is therefore neither recoverable nor irrecoverable by GÉANT as it isn't VAT incurred by GÉANT.
- As a further but material complication, under EU VAT legislation, for this type of transaction, the place of supply is where the user resides and the supplier must account for the VAT due, at the applicable rate, in the country of the user. The implication, therefore, is that each supplier should know where each user is based, and what the applicable VAT rate is in order to account for the appropriate amount of VAT. For multinational suppliers this is a complex but normal business process. For smaller enterprises the requirement to have access to international VAT expertise is a potentially significant barrier to entry. Note that this was experienced in OCRE where the end user was identified, contrary to HNSciCloud where an end user was not identified, solely the VAT exempt organisation, CERN.

H2020 Cost Eligibility Criteria:

- It is clear that unless the project partner is also a user of the service, the VAT does not belong to them, so it is neither recoverable nor irrecoverable. The logical extension of this would be for every user to become a partner and, therefore, claim the costs they incur (without VAT included in the claim if they have recoverable VAT or with VAT if their VAT is irrecoverable). This may be logical but is impractical for 100's or 1000's of partners to become partners in such a project.
- It is interesting to note that these concepts/issues have been faced by other EU initiatives, in particular WiFi4EU and the voucher system it operates. Here the voucher granted has a nominal but VAT-inclusive value that a supplier can claim from the EC. The understanding of the T12.2 sub-task is that it is accepted that:
 - VAT is an unavoidable cost to the project.
 - invoicing by the suppliers must comply with the national rules in each country.
- Applying the same VAT-inclusive cost approach to OCRE, this effectively means that for a voucher of nominal value will have included within that value the VAT that is due to the supplier calculated on that specific user. Similarly, if a partner such as GÉANT is

to pay a supplier directly for services that it does not consume itself but gives to a user on some defined allocation basis, then the same VAT calculation based on the user's own VAT jurisdiction and place of supply will hold true and the VAT does not become 'GÉANT's VAT' just by the act of GÉANT paying for the supply.

Appendix II. What it means to be a broker of commercial services

EOSC-hub acting as a broker as defined in the commercial sense [\[R38\]](#) would require the following dimensions to be taken into account in the design of the functionality of the EOSC marketplace and associated policies, terms of use, and frameworks for liabilities and indemnifications:

- Service providers would need to actively agree that EOSC-hub is requested to operate as a broker for services that are advertised on the EOSC portal.
- It may be intended to charge a brokerage fee to the buyer or the service provider to account for the overhead and risk taken in arranging the contracting and payment for the service, and becoming the principal party to the deal.
- The EOSC-hub legal entity would inherit specific legal and financial obligations as third-party rights are implied: it would be necessary to create related agreements with service providers and buyers in order to be indemnified against any breach of contract by either service providers or buyer/users.
- EOSC-Hub might be required to:
 - Perform sales ledger activities, i.e., translate monitored usage into an invoice, issue the invoice, collect payment, perform credit control, and forward revenue to the relevant SP; or
 - Hand off usage monitoring reports to the service provider for them to perform sales ledger activities; or
 - Hand off all usage monitoring and sales ledger activities to the service provider; and/or
 - Invoice the User and return the relating fees to the service provider.

In addition to the above, financial, legal and regulatory obligations associated with brokerage include:

- If payment is collected from the user and channelled towards the service provider via the broker, significant liabilities and organisational responsibilities are created:
 - VAT and corporation tax implications arise.
 - Payment terms would have to be carefully thought out and negotiated to avoid creating a liability for the broker where payment must be made to the service provider before it is received from the user.
 - Credit control operations would need to be included in the hub's resource planning to ensure that payment is received from the user before it becomes due to the service provider.
 - Insurance or other suitable provision would need to be made to protect against bad debt.
- Where payment is allowed via credit card, the seller is mandated to be Payment Card Industry (PCI) compliant, and often transaction fees in the region of 1.5-3% of each transaction are charged to the seller by credit card payment gateways that cannot be passed on to the user.

- Contractual warranties must take into account the need for both the buyer and the user to indemnify the broker against:
 - Misuse (wilful or negligent).
 - Non-performance of buyer/service provider obligations.
 - Copyright infringement.
 - GDPR breach.
- Key commercial concerns:
 - Any 'commission' levied on the service by the broker towards the service provider must capture not only the cost recovery of the added-value services it performs in its brokerage role from an enabling perspective, but it must also recover the costs incurred of making the relevant legal and financial arrangements commensurate with a true broker role.
 - Whether performing a financial brokerage role would be perceived as a valuable service to either providers or users.

Appendix III. Comparison of Buying Routes

The table below lists risks that the use of credit cards and spot buying methods to access resources entail for open research.

Table 7 – Risks

Factor	Voucher	Credit card (institutional)	Credit card (personal, reimbursed via expenses)
Strategic funding opportunities	High: allows access to results of pre-funded aggregated procurement activities.	Low: requires correlation between piecemeal procured resources against resources available via frameworks or aggregated procurements.	Low: requires correlation between piecemeal procured resources against resources available via frameworks or aggregated procurements.
Mitigation of risk of procurement directive breach	High: ensures that resources have been procured in a compliant manner.	Low: spot buying risks breaching procurement thresholds when total expenditure is calculated.	Low: spot buying risks breaching procurement thresholds when total expenditure is calculated.
Speed	Medium: distribution can be rapid, but activation might introduce delays unless the model is designed carefully.	Varies/Slow - instigation of a new card typically requires approval in advance.	Fast - instantaneous access.
Complexity/effort	Medium to high: voucher access would include validation and approval steps, non-standard terms and conditions.	Simple	Fairly simple to medium: small-scale use (in the normal out-of-pocket expense reimbursement) easy, growing use increases administrative scrutiny and overhead.
Risk perception (from the user perspective)	Low (perception that the cloud provider will have an interest in limiting the resource use to the value of the voucher).	High - risks overspend against the approved credit limit and risks breaking procurement rules internally.	Medium - organisation may refuse reimbursement and exposes the user to personal financial risks.
Uncertainty (period after selection of approach and before starting the resource use)	Low - the distributor of the vouchers would be required to play a role of an intermediary between issuer and user (in case of a	High - credit limits would have to address the open-ended nature of cloud usage, and the fact that rather than being a call off against	Low to medium - technically purchase of standard commodity service; requires balancing the amount of personal risk the

	dispute), documented activation process.	an allocated total, the notion of credit means an upfront commitment and guarantee to pay for something, and it is not certain that there would be institutional approval to meet a commitment that exceeds thresholds.	researcher is willing to take and the risk of disruption of the research process due to running out of credit.
Contract privity	The buyer in this context is the distributor of the voucher or whoever committed to meet the cost of the service. Provided that the user is authorised/entitled to use the voucher, any default in provision of service would be dealt with based on the term set out as part of the procurement process. Due to the large financial value of the contract, these terms can be more generous than an individual institute or researcher can negotiate	The buyer in this context is the institution, therefore the parties to the agreement are the institution as buyer, and the service provider as seller. This is a simple construct.	This introduces the buyer as a consumer and creates complex contract privity. The contract in this case is between the user as a consumer and the service provider. Should the Institution have cause to raise an issue with the service provider, it cannot do so as it is not party to the contract. This is sub optimal.

The above analysis uses the 'buyer persona' model. Therefore, in theory, the value of the voucher mechanisms is, in its ability to reduce perceived risk and uncertainty in outsourcing data, processing tasks that are ideally one-off in nature ('Cloud bursting' tests), and in resolving the various risks and issues concerned with credit card utilisation, particularly in terms of contract privity. From the point of view of the EOSC, cloud vouchers can increase the perceived value of the overall EOSC offering, both for the established EOSC users and new contacts whose initial interest in the EOSC might have been based on the opportunity to access commodity cloud resources free of charge.