

Putting the “Account” into Cloud Accountability

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Abstract: Security concerns are often cited as the most prominent reason for not using cloud computing, but customers of cloud users, especially end-users, frequently do not understand the need to control access to personal information. On the other hand, some users might understand the risk, and yet have inadequate means to address it. In order to make the Cloud a viable alternative for all, accountability of the service providers is key, and with the advent of the EU General Data Protection Regulation (GDPR), ignoring accountability is something providers in the EU market will do at their peril. To be able to hold cloud service providers accountable for how they manage personal, sensitive and confidential information, there is a need for mechanisms that can mitigate risk, identify emerging risks, monitor policy violations, manage any incidents, and provide redress. We believe that being able to offer accountability as part of the service provision will represent a competitive edge for service providers catering to discerning cloud customers, also outside the GDPR sphere of influence. This paper will outline the fundamentals of accountability, and provide more details on what the actual “account” is all about.

1 INTRODUCTION

Security concerns are often cited as the most prominent reason for not using cloud computing (CIPL, 2009; Rong et al., 2013). At the same time, customers of cloud users, especially end-users, frequently do not understand the need to control access to personal information. This is particularly evident in the context of social media, where the users are not the customers, but the product (being sold to marketers). On the other hand, some users might understand the risk, and yet have inadequate means to address it (Cattaneo et al., 2012). In order to make the Cloud a viable alternative for all, accountability of the service providers is key.

To be able to hold cloud service providers accountable for how they manage personal, sensitive and confidential information, there is a need for an orchestrated set of mechanisms: preventive (mitigating risk), detective (monitoring and identifying risk and policy violation), and corrective (managing incidents and providing redress) (Jaatun et al., 2016).

Suppliers within the cloud eco-system need to be

able to differentiate themselves in what ultimately is a commodity market, and being able to offer accountability as part of the service provision will represent a competitive edge for service providers catering to discerning cloud customers (Prüfer, 2013).


2 ACCOUNTABILITY


In order to provide accountability (Pearson, 2017), providers must facilitate choice for users, and exercise control over handling of data. Such data practices must be transparent to the users, and the providers must also be compliant with applicable laws and regulations.

2.1 Requirements

The starting point is that an accountable organization must commit to responsible stewardship of other people’s data, requiring that it:

- defines what it does,
- monitors how it acts,
- remedies any discrepancies between the former two,

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- explains and justifies any action.

These elements can be elaborated as follows.

1. An accountable organization must demonstrate willingness and capacity to be responsible and answerable for its data practices.
2. An accountable organization must define policies regarding their data practices.
3. An accountable organization must monitor its data practices.
4. An accountable organization must correct policy violations.
5. An accountable organization must demonstrate policy compliance.

In addition to the above, there is a need for accountability across the cloud service provision and governance chains, and not just in isolation for organizational cloud consumers or cloud service providers. Hence there is a need for provision of evidence of satisfaction of obligations right along the service provision chain, as well as aspects such as checking that partners are accountable too and that there has been proper allocation of responsibilities along the service provision chain. These requirements need to be reflected within the processes for organizations described above, but in addition there are implications in terms of the way that the accountability governance chains will operate, the scope of risk assessment and the ways in which other stakeholders are able to hold this organization to account. In complex, dynamic or global situations there needs to be a practical solution for data subjects to obtain both requisite information about the service provision and remediation.

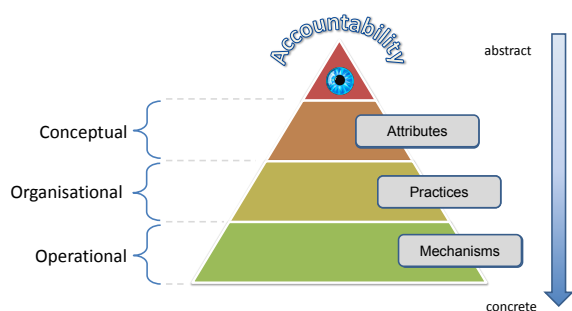


Figure 1: A Conceptual Framework for Accountability.

2.2 Conceptual Model

Our conceptual accountability model (see Figure 1) elaborates on our definition accountability (Jaatun et al., 2016) by means of a set of

- *Accountability Attributes*: conceptual elements of accountability applicable across different domains
- *Accountability Practices*: emergent behavior characterizing accountable organizations (that is, how organizations operationalize accountability or put accountability into practices)
- *Accountability Mechanisms*: diverse processes, non-technical mechanisms and tools that support accountability practices.

The core attributes of our accountability model are:

Transparency: the property of a system, organization or individual of providing visibility of its governing norms, behavior and compliance of behavior to the norms.

Responsiveness: the property of a system, organization or individual to take into account input from external stakeholders and respond to queries of these stakeholders.

Remediability: the property of a system, organization or individual to take corrective action and/or provide a remedy for any party harmed in case of failure to comply with its governing norms

Responsibility: the property of an organization or individual in relation to an object, process or system of being assigned to take action to be in compliance with the norms

Verifiability: the extent to which it is possible to assess norm compliance (i.e. a property of a system, service or process that its behavior can be checked against norms)

Appropriateness: the extent to which the technical and organizational measures used have the capability of contributing to accountability.

Effectiveness: the extent to which the technical and organizational measures used actually contribute to accountability.

To support and implement the main accountability attributes, we have developed a 'toolkit' (Jaatun et al., 2016) that forms the bottom layer in Figure 1 and from which organizations can select as appropriate.

3 THE ACCOUNT

Provision of accounts (Gittler et al., 2016) is an important part of the organisational lifecycle, and the means of demonstrating accountability. The form

and content of accounts are contextually dependent. In this section the varying properties of accounts are considered.

3.1 What is an Account?

An account is a report or description that may be written and/or oral, of an event or process. It serves to report what happened, what has happened, or what might happen. An account generally contains answers to the 'reporters' questions", i.e. who, what, where, when and why. It may also include measures taken to remedy prior failures. An account of the same event or process might be provided several times and vary in its format and information depending on the recipient.

An example where accounts are needed is data breach notification. In this case, the following information should be provided:

- To explain who committed the breach (or if unknown, how investigation to discover perpetrator)
- What the breach consisted of
- When the breach occurred (and was discovered if different dates)
- How and why it occurred, extent of breach
- What measures are being taken to prevent any further such breaches in future
- Contact information for a department or person to respond to further questions (and maybe link to web page for updates)

3.2 Forms of Account

There are two main forms of account: proactive or retrospective accounts.

Proactive accounts relate to reports before making services available. Provision of an account could be proactive, in the sense that the choice of accountability mechanisms and tools needs to be justified to external parties, and this could happen before any processing takes place (perhaps as part of a third party assurance review), when processing is particularly risky (e.g. before such processing, with documentation generated via Data Protection Impact Assessments), or using ongoing certification to provide flexibility (for example, as is the case with Binding Corporate Rules).

Retrospective accounts are reactive and can either describe a legitimate event - in which case they can be either periodic or produced upon request (e.g., triggered by a spot check by a regulator) – or an unexpected event, such as a data protection breach.

Furthermore, an interesting distinction can be made between what may be regarded as static accounts, as opposed to dynamic accounts. The former do not vary over time, whereas the latter take into account parameters that may change over time. For instance, an example of a dynamic account would be a CSA Open Certification Framework (OCF) level 3 account, which is an example of a dynamic certification. Indeed, it could be argued that yearly or monthly audits are irrelevant in an environment that changes completely on a daily or hourly basis, as is often the case with cloud computing. Continuous compliance monitoring is essential to securely delivering cloud services and ensuring compliance. Cloud services are inherently dynamic, because the dynamic provisioning and de-provisioning of resources is a key part of the cloud value proposition and business model. Hence, automation for operations and asset management are essential in this dynamic environment and verification of compliance with policy and legislation – such as the EU Data Protection Directive 1995 (Directive 95/46/EC), Gramm-Leach-Bliley Act (GLBA), US federal Health Insurance Portability and Accountability Act (HIPAA) 1996, and export compliance controls like the International Traffic in Arms Regulations (ITAR) – requires continuously running automation. Accounts can be also regarded as a process, for example a process of storytelling and explanation.

3.3 Attributes of the Account

Although the description of the event or process is an essential element, the account should also carry the following attributes:

- Recipient: This is the actor who receives the account. Depending on the recipient, the level of detail in the description of the event may change.
- Event/Process description
- Evidence: Relevant information to support explanation and justification about assertions
- Measures for remediation (if incident)
- Timestamp and signature: The accountable organisation is of course responsible for producing the account and therefore should sign the entire report including the date.

Accounts of legitimate events may be periodic and could sometimes be used as evidence for prior events whenever an incident happens in the future. A timestamp in the report hence becomes mandatory.

3.4 Interactions between Cloud Actors Related to Accounts

First we set out the general context in which accounts are produced, and then the process of generating and verifying an account.

As discussed further within the A4Cloud conceptual framework (Felici et al., 2014), a cloud actor (accountor) is accountable to certain other cloud actors (accountees) within a cloud ecosystem for:

- Norms: the obligations and permissions that define data practices; these can be expressed in policies and they derive from law, contracts and ethics.
- Behaviour: the actual data processing behaviour of an organisation.
- Compliance: entails the comparison of an organisation's actual behaviour with the norms.

For our purposes, the accountors are cloud actors that are organisations (or individuals with certain responsibilities within those) acting as a data steward (for other people's personal and/or confidential data). The accountees are other cloud actors, that may include private accountability agents, consumer organisations, the public at large and entities involved in governance.

Contracts express legal obligations and business considerations. Also, policies may express business considerations that do not end up in contracts. Enterprise policies are one way in which norms are expressed, and are influenced by the regulatory environment, stakeholder expectations and the business appetite for risk. By the accountor exposing the norms it subscribes to and the things it actually does, via an account, an external agent can check compliance.

3.5 Accounts Shown to Different Data Protection Roles

Generally speaking, the sort of information that an organisation needs to measure and demonstrate in such an account includes: policies; executive oversight; staffing and delegation; education and awareness; ongoing risk assessment and mitigation; program risk assessment oversight and validation; event management and compliance handling; internal enforcement; redress (Accountability Phase, 2010; ICO, 2012). Existing organisational documents can often be used to support this analysis (nymity, 2014). Measurement of the achievement needs to be done in conjunction with the organisation and the external agents that judge it, which is dependent upon the circumstances,

and to other entities that may need to be notified. Some examples of accounts that may be provided to cloud actors fulfilling certain data protection roles in a given context are shown in Table 1.

3.6 Verification of Accounts

It is not just a question of interaction between actors in the provision of accounts, but also in the verification of accounts. Verification methods may differ across the different forms of account in the cloud, as considered further below. As briefly mentioned in section 3, the company Nymity (nymity, 2014) has provided an example structure for evidence and associated scoring mechanism for accountability based on existing documentation that can form some of these types of accounts – but some organisations may want to take a different approach and so this should not be regarded as a standard. The Nymity accountability evidence framework is intended for collecting evidence in a single organisation and for demonstrating accountability that is structured around 13 privacy management processes (nymity, 2014).

There are different levels of verification for accountability, as proposed by Bennett (Bennett, 1995), which correspond to policies (the level at which most seals programmes operate), practices and operations. It is very weak to carry out verification just at the first of these levels – instead, mechanisms should be provided that allow verification across all levels. Most privacy seal programmes just analyse the wording in privacy policies without looking at the other levels, and thus provide verification only at this first level (of policies). The second level relates to internal mechanisms and procedures, and verification can be carried out about this to determine whether the key elements of a privacy management framework are in place within an organisation. Few organisations however currently subject themselves to a verification of practices, and thereby being able to prove whether or not the organisational policies really work and whether privacy is protected in the operational environment. To do this, it seems necessary to involve regular privacy auditing, which may need to be external and independent in some cases.

In terms of the verification process, there are various different options about how this may be achieved. There could for example be a push model in terms of the account being produced by organisations or else a pull model from the regulatory side; the production of accounts could be continuous, periodic or triggered by events such as breaches. In general, there should be spot checking by enforcement agencies (properly resourced and with the appropriate au-

Table 1: Accounts provided by whom to whom and in what circumstances.

Type of Account	Data Protection Roles	Example Cloud Actor producing the Account
Account for self-certification/ verification	Data Controller (DC), for Data Protection Authorities (DPAs) and their customers	Organisational Cloud Customer
Periodic internal reviews (to check that mechanisms are operating as needed and update if required)	DC or Data Processor (DP), for themselves or auditors	Organisational Cloud Customer, Cloud Provider
Evidence provided by risk analysis, PIAs and DPIAs (including assessment along the CSP chain and how this was acted upon)	DC, for DPAs and their customers	Organisational Cloud Customer
External certification e.g. BCRs, CBPRs, CSA OCF level 3, privacy seals, accountability certifications, security certifications	DC or DP, for certification bodies (evidence for certification) or for customers (evidence of certification)	Organisational Cloud Customer, Cloud Provider
External audit (ongoing)	DC or DP, for auditors (evidence) or customers (audit output)	Organisational Cloud Customer, Cloud Provider
Verification by accountability agents	DC to agent, output to DPA	Organisational Cloud Customer
Evidence about fault if data breach	DC to Data Subject (DS), DC to DPA, DP to DC, DP to DP	Organisational Cloud Customer, Cloud Provider

thority) that comprehensive programmes are in place in an organisation to meet the objectives of data protection. There could in some cases be certification based on verification, to allow organisations to have greater flexibility in meeting their goals.

It is often regarded as underpinning an accountability-based approach that organisations should be allowed greater control over the practical aspects of compliance with data protection obligations in return for an additional obligation to prove that they have put privacy principles into effect (see for example (Weitzner et al., 2008)). Hence, that whole approach relies on the accuracy of the demonstration itself. If that is weakened into a mere tick box exercise, weak self-certification and/or connivance with an accountability agent that is not properly checking what the organisation is actually doing, then the overall effect could in some cases be very harmful in terms of privacy protection. As Bennett points out ((Bennett, 2012) p. 45), due to resource issues regulators will need to rely upon surrogates, including private sector agents, to be agents of accountability, and it is important within this process

that they are able to have a strong influence over the acceptability of different third party accountability mechanisms.

In particular, it is important that the verification is carried out by a trusted body that does not collude with the accountant, and that it is given sufficient resources to carry out the checking, as well as there being enough business incentive (for example, via large fines) that organisations wish to provide appropriate evidence to this body and indeed implement the right mechanisms in the first place.

The overall process around verification of an account is summarised within Figure 2.

First of all, there is a certain context in which the 'start' – labelled (1) within Figure 2 - would apply, in other words the context in which an organisation might need to give an account, or might wish to do this voluntarily. Broadly speaking, these situations requiring or involving production of an account may be characterised as follows:

- Regulatory obligation: The most typical situation where there is a legal obligation to produce an account is where governmental bodies or regulatory

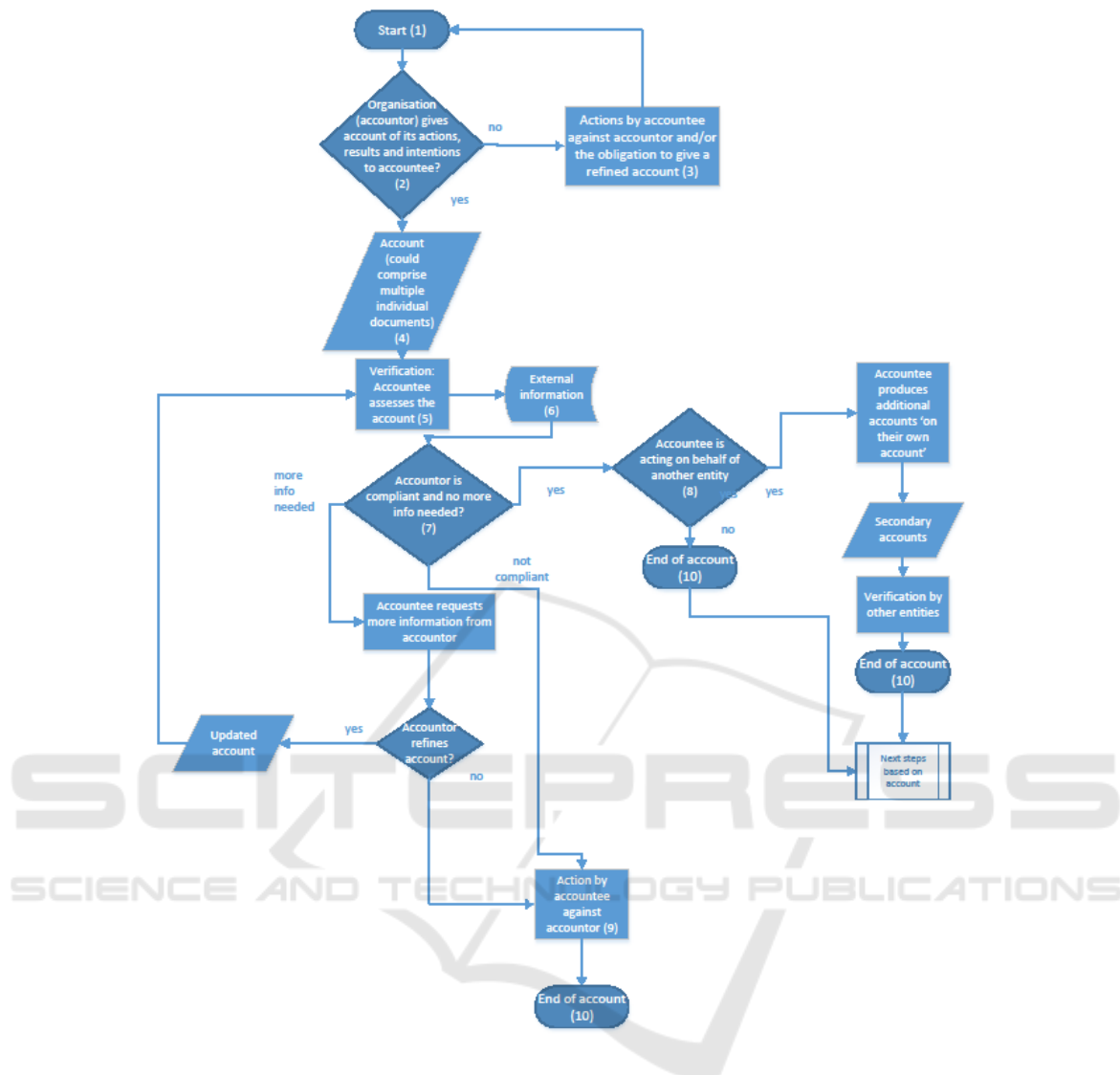


Figure 2: High-level view of the provision and verification of an account.

agencies enforce rights or obligations, by means of an investigation, a request for information or a spot check by a Data Protection Authority (DPA).

- Contractual undertaking: A legal obligation could instead come from the organisation itself, for instance from a contractual obligation to give an account. The cloud service provider may have given a contractual obligation in its terms of service or in a SLA that it would provide an account (for example, a data breach notification procedure) or that it would demonstrate compliance in some way. Another situation may be that the Cloud Service Provider (CSP) has undertaken to get third party certification for compliance or for some process and so is required by the third party

to give an account of certain processes in order to get certification.

- Voluntary undertaking to give an account: The CSP may just state (in a policy published on its website for example) that it would provide an account in certain circumstances or make ‘best efforts’ to do so. Many policies published in this way are not legally binding or may not be incorporated into the contract between the CSP or the customer, so the CSP can refuse to give the account or may claim that it cannot do so and has made a ‘best effort’.

Next, supposing this context is in place, the organisation (as accountor) is supposed to give account of not only its actions, but also its results and intentions

to the accountee cf. (2) in Figure 2. Exactly what must be provided will vary according to the context; for example, specific information will be expected in the case of the accountor wishing to be certified.

If an organisation gives no account in the first place, there should be repercussions about this that might include the obligation to give a refined account, defined according to the accountees' or assessors' needs, cf. (3) in Figure 2. For example, in the case of regulatory requests, the consequences could be fines. In the case of contractual undertakings, failure to produce an account would be a breach of contract that entitles the customer to damages, or service credits (for breach of SLA) or gives a right to the customer to terminate the contract without notice. Failure to produce an account needed for a third party certification of compliance would mean that the CSP could not obtain the certification. This may have direct legal consequences for the relationship between the CSP and its customer (depending on whether this was a condition of the contract) because the customer may decide to terminate or not to renew the contract. In the case of a voluntary undertaking, although there would be no legal redress for the customers, the consequences of refusal to give an account may involve damage to its reputation by disgruntled customers.

If the organisation does provide an account, this can result in one or more documents being provided, or information being captured by other means, as the account provided by the organisation could be written or oral, cf. (4) in Figure 2. For further information, see for example (Vranaki, 2016) which expands upon real life cases in which multiple accounts can be created by a Data Controller for presentation to a regulator.

The accountee then assesses the account (5), potentially making reference to additional information (6). The level of satisfaction with the account is gauged (7), in the sense that the account may be judged to show that the organisation is compliant (if appropriate), or else may be judged to provide a satisfactory explanation about a data breach event. On the other hand, the accountee may judge the organisation to not be compliant (and hence for example, not issue a certificate of compliance) (9), or wish to have additional information about the event. Especially in the case of a data protection report, the accountee probably requires more than just information, in other words clarification, explanation, updating and also most probably corrective action. Hence, even if the account process is complete in the sense that the accountee may accept the account is accurate and may be satisfied with it, it could be that they are not satisfied in the sense that the account shows that some

action/omission has caused and is causing harm and needs additional action. For this reason, the 'End of account' (10) may only be the start of another process, even if the accountee is satisfied with the account. 'Next steps based on account' reflects that this process may follow; it could include for example remediation, actions based on the account, further investigation, etc. After all, an account of a breach should contain something about ongoing corrective action.

Accountability agents or other third parties could be used to provide verification of accounts, and serve as an intermediary to the ultimate accountees, some of whom may impose sanctions (8). If, as considered within D:C-2.1 (Felici et al., 2014), there is a good trust relationship between such an agent and the accountee, then the agent's account is likely to be directly accepted by the other accountees.

The account process is taken to finish (10) if either an account has been provided that is found to be satisfactory by the accountee or an agent acting on its behalf, or the account is not found to be adequate and appropriate actions are taken by the accountee against the accountor. However, this notion of 'finishing' is too coarse-grained, as discussed above. Furthermore, accountability is not a binary state, but has a certain level of maturity. Correspondingly, accounts have a certain effectiveness and appropriateness. Depending on the maturity an accountee may be satisfied or not, and the threshold of this maturity might differ depending on the accountees or the event about which one is asked to give an account. Hence, more mature account might be provided, or different ones for different accountees, events, etc., so this is another reason why 'End of account' is not necessarily an end state, but the process might be repeated from the start with a different degree of maturity or threshold.

Sanctions might be applied at several points, notably if the organisation does not provide an account in the first place (3), if it fails to respond adequately to the dialogue with the assessor, or if the assessor is not satisfied in respect to the accounts produced (9). In fact, the use of the word 'sanction', here meaning a consequence of an inadequate or non-provision of an account, is avoided when listing accountability artefacts (Gittler et al., 2016), because in legal terms 'sanction' refers to a punishment imposed by a legal or regulatory authority, for example fine, imprisonment or penalties for disobedience, whereas we also want to include non-regulatory actions imposed by the accountee, which is perhaps the customer, and this could for example mean contract termination or perhaps a contractual penalty for failure to produce a report. Such consequences or repercussions are therefore represented quite broadly in Figure 2 as actions

by the accountee against the accountant.

The process of providing an account could be quite complex, and this is just a generic overview of that process. There could be multiple documents that in the form described here provide an account, but each of which may be viewed as an individual account, and perhaps even have a slightly different process flow. For example, multiple accounts provided by different parties within an organisation could be aggregated by a senior officer, who acts as a communication interface with the accountee (in this case, the regulator); this officer would interact further if needed with the various internal teams that produced the accounts if further information is required.

The element of responsiveness is not necessarily in the account itself, yet in the interaction between what the account should be about (and how it should be refined if deemed inappropriate) and in the establishment of the account objects, i.e. the norms that need to be compared with actual behaviour (compliance). Part of the norms to which actual (system) behaviour is compared should be defined in a two-way communication (dialogue) between cloud providers and external stakeholders, which includes cloud users, regulators and the public at large.

The process of generating and verifying accounts for certification could be more specialised than the flow shown in Figure 2 (for example, it could involve assessment by multiple parties) and would need to be adapted as the purpose of verification of the account and possible outcomes would differ, i.e. result in a certain level certification, or no certification being given.

This flow shown in Figure 2 is a generic flow that could apply in range of contexts and is not cloud-specific. With regard to cloud contexts, as with other service provision delivery contexts involving a chain of providers, provision of an account might involve chaining of accounts. For example, an account provided by an organisation using the cloud that is acting in the capacity of a data controller, to a data protection authority might be constructed using accounts that had previously been provided to it from the cloud service providers that it was using.

4 DISCUSSION

Accountability is a difficult concept to define, and many European languages even lack a word for it. Numerous definitions of accountability exist in different domains (such as public policy, financial sector or enterprise operations), and each focuses on slightly different, context specific, aspects. Hence there is

no consensus on a single definition. The EU General Data Protection Regulation (GDPR) (EU, 2016) defines accountability as being “responsible for, and be[ing] able to demonstrate compliance with [principles relating to processing of personal data]” (Article 5), and details many accountability elements including (in Article 22) a list of a Data Controller’s accountability instruments:

- Policies
- Documenting processing operations
- Implementing security requirements
- Data Protection Impact Assessments
- Prior authorisation/consultation by Data Protection Authorities (DPAs)
- Data Protection Officer
- If proportional, independent internal or external audits

Ten years ago, Lampson (Lampson, 2004) listed accountability as one of the three core objectives of having a security policy, alongside usage control and availability. It is thus surprising that accountability has had such a little impact on the Cloud services that are currently on offer.

The big Cloud providers that currently dominate the international market have such economic power that they effectively could ignore any European attempts at forcing them to run their business the way the European Union (EU) thinks they should. However, the GDPR (EU, 2016), with its significantly higher economic penalties, is poised to change that.

What we have presented is only part of the puzzle for modern services. The kind of tools that we have outlined (Jaatun et al., 2016) will need to be complemented by other security tools to make security and privacy stronger, for instance by enforcing confidentiality and anonymity where desired.

5 CONCLUSION

In this paper we have presented fundamental requirements that we believe must be met by Cloud providers wishing to be accountable stewards of their customers’ data.

The kinds of tools we have outlined (Jaatun et al., 2016) all contribute to an accountability-based approach, increasing transparency for Cloud users, and enabling Cloud providers to “do the right thing” with respect to accountability along the provider chain. We believe that providers soon will be required to justify their practices and mechanisms for handling

customers' data to external parties (Pearson, 2013), and that a certification scheme inevitably will emerge, much like we see for the Payment Card Industry Data Security Standard (PCI-DSS, 2013).

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APPENDIX

Abbreviations

- BCR:** Binding Corporate Rules
- CBPR:** Cross-Border Privacy Rules
- CSA:** Cloud Security Alliance
- CSP:** Cloud Service Provider
- DC:** Data Controller
- DP:** Data Processor
- DPA:** Data Protection Authority

DPIA: Data Protection Impact Assessment

DS: Data Subject

OCF: Open Certification Framework

PIA: Privacy Impact Assessment

PCI-DSS: Payment Card Industry Data Security
Standard

