Special Paper on Hybrid Cloud

Complement to ECIS[1] paper on Cloud Computing Standards, Compatibility and Interoperability:
Ensuring a thriving competitive market

EXECUTIVE SUMMARY

What is Hybrid Cloud and why is it important?

When the concept of cloud computing first emerged, it was closely associated with "public cloud" and tended to be viewed as an alternative to traditional "on-premises" computing resources. The emergence of the "born on the Internet" enterprises and new cloud based services further underlined this perception. However, public cloud is not suited to all use cases and new deployment models have developed which meet users' wider and varying needs.

The new emerging paradigm is Hybrid Cloud, which spans public clouds, private clouds – off or on-premises – and existing enterprise IT systems. For this new cloud paradigm to succeed in the enterprise, a variety of cloud systems are necessary. These systems also require integration with traditional IT systems since it is simply too costly and too risky to replace all existing systems. Further, the combination of traditional IT systems and cloud computing promises significant improvements in enterprises' agility to adapt to new business models.

For Hybrid Cloud, interoperability and open standards are imperative since there is a need to connect applications and services operating across many different environments – not only those dedicated to business capabilities, but also those necessary for operation, monitoring and management of the system as a whole. Policy makers have a key role to play in ensuring that open cloud interoperability standards are supported and promoted. Without sufficient promotion for such standards, cloud computing is at risk of regressing to a state very similar to previous client/server environments with customers locked into proprietary software and hardware configurations.

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[1] The European Committee for Interoperable Systems ("ECIS") is an international non-profit association founded in 1989, which endeavours to promote a favourable environment for interoperable ICT solutions. For more information on ECIS, please consult www.ecis.eu.

What is the role of Hybrid Cloud?

Cloud computing is about agility and choice; it enables enterprises to deploy, leverage and adapt software functionality in a manner that affords significant improvements in flexibility - while reducing the costs, skills and time involved. The downside of **public cloud** from a customer perspective is that it is a shared environment and control over the resources is largely in the hands of the cloud service provider. These factors can affect the customer's ability to configure solutions appropriately to meet security and regulatory requirements. An alternative approach is to employ **private cloud** deployments either on-premises or in a cloud service provider's data center.

The original focus of cloud computing was to increase flexibility and agility for deploying "new" software services and applications. Today, there is growing emphasis on integrating cloud applications with traditional IT resources which are already deployed within an enterprise – such as databases, authentication systems and software applications. Enterprises now want to optimize usage of existing resources they own while leveraging the "pay only for what you use" model offered by cloud services.

The combination of these factors has resulted in the practical realization that "one size does not fit all." Agility can only be achieved via a mix of existing and new infrastructure comprised of both in-house and "rented" resources, where each component can be individually located (and moved) wherever is most appropriate.

Cloud computing offers this capability via what is known as a "**Hybrid Cloud**".

Where did Hybrid Cloud come from?

At its core, cloud computing is as much about business and economic drivers as it is about moving the boundaries of research and providing technical solutions. One of the initial value propositions offered by cloud computing - driven by economics - was to offer enterprises the ability to pay for only the actual resources consumed in an "on demand" manner. Instead of having to specify, purchase, install and configure all the hardware and software that might someday be needed, cloud computing offers customers the ability to "rent" hardware and software and pay for only the time they use. Several cloud service providers offered "resources for hire" within their data centers that customers could rent rather than purchase - as needed. Since these resources are available to anyone and everyone, this model is known as "public cloud".

The advantage of public cloud is not simply that you only pay for the actual resources that you use during the time that you use them, but also that you can rapidly allocate additional resources "on demand" to manage large spikes in user demand.

Policy and Regulatory Implications of public clouds from a technical perspective

Disadvantages of public clouds are that the customer loses control over the physical resources involved, and since the resources are shared with other cloud service customers the potential for variable performance exists (*e.g.*, if the Internet network links are heavily loaded). Not every IT solution is suitable to operation using resources that are not directly controlled or managed by an enterprise. Regulations and policies can mandate specific levels of resource control, some solutions may require "local" resources that third-party vendors cannot or do not provide, and some data and resources are so critical that their security and control simply cannot be trusted to anyone outside the enterprise.

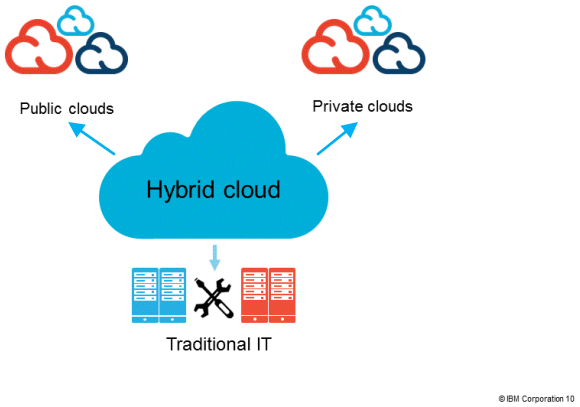
For these reasons, enterprises will always require some level of "private" resources to meet their needs. However, the architectural model offered by cloud computing can still provide value, hence the emergence of the "private cloud" model within an enterprise. The term "private" describes the simple fact that the resources within the cloud are only available to a single customer and are not shared. Advantages of a private cloud include a greater level of control over the resources, data and functionality provided while still being able to optimize their usage. Disadvantages include higher costs associated with purchasing, configuring and managing all the resources, and being limited to only the resources that are currently available.

In addition, enterprises often have significant investments in existing resources such as databases, identity (*e.g.*, "user login") services and software systems.

If the true value of cloud computing is to be achieved, the ability to mix and match existing resources, new private resources and public resources must be supported. This model of flexibility and agility in connecting an extremely broad spectrum of resources into a unified, cohesive solution is a hybrid of many different items, and exemplifies the "Hybrid Cloud" model.

Public + Private + vendor independence = Hybrid

Using the hybrid cloud model, enterprises gain flexibility not only from quickly connecting "public" and "private" resources, but also from being able to change or move resources as demands change. For example, an enterprise may want to enter a new geographical market, but local regulations may mandate that data reside in "local" data centres. Not every cloud vendor has resources in every geography so an enterprise will partner with new vendors or build their own private infrastructure thereby creating a hybrid model.



The “hybrid cloud” model offers great flexibility in adapting IT resources and investments to meet the needs of an enterprise in a highly dynamic manner, which allows the business to quickly address changing market and customer demands.

Another example an enterprise may face is when an existing cloud service provider makes changes to their offerings so they become sub-optimal such as pricing, performance changes or even worse – a provider may go out of business or be acquired by their customers' competitor. Finally, there is a need to move *software* components around dynamically to avoid moving huge amounts of *data*; with the explosion of interest in “Big Data” and extremely large data sets, the economics of constantly moving gigantic datasets around to wherever the software runs have quickly become prohibitive.

Hybrid clouds are built from infrastructure composed of two or more distinct cloud infrastructures that remain unique entities, *i.e.*, public or private, but are bound together by technology that enables data and application portability. Unfortunately the IT market has numerous definitions for the term “hybrid” and cloud computing, and not all of them agree. For the purposes of this paper we will use the simple definition as described above. Although the concept of hybrid cloud represents a mix of the “best of both private and public cloud”, *a hybrid cloud is implemented using various software environments, and often involves proprietary technologies.* Being able to make changes to components of already-deployed cloud services – for any reason and without affecting users – is a hallmark of an optimal hybrid cloud platform.

Cloud Service Model and Cloud Deployment Model

The "cloud service model," which we covered in the previous ECIS paper, describes how a given piece of software is designed, created and consumed while the "cloud deployment model" (see Table 1 below) shows who owns the resources that are being used to implement the service *at this moment*, and where they exist.

	Description	Defined by	Key definitions
Cloud Service Model *(Focus of previous ECIS Cloud Computing White Paper)*	What parts of the software stack are automatically managed? How is cloud software created and consumed?	**Answers the "What" and "How" of IT solutions**	*IaaS, PaaS, SaaS*
Cloud Deployment Model *(Focus of this paper)*	Where does the service run? Which server/datacenter? Who owns/manages the physical resources being used?	**Answers the "Who" and "Where" of IT solutions**	*Public cloud, Private cloud,* ***Hybrid cloud***

Table 1

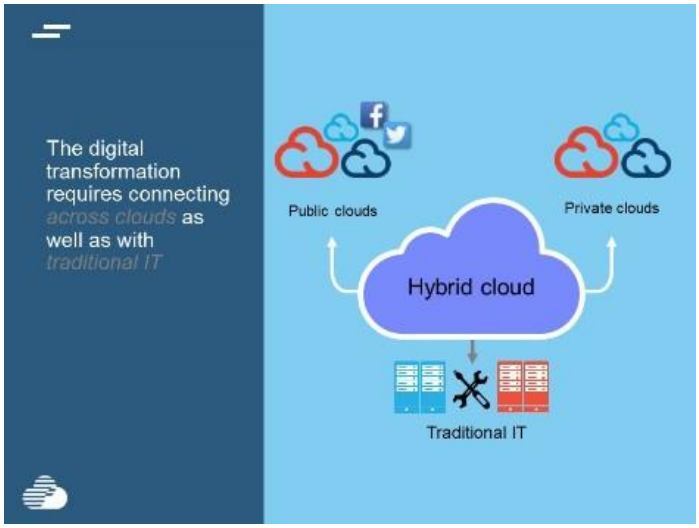
One of the main advantages of cloud computing is the ability to add, remove or change the resources being used by a given application dynamically; this ability is defined by – and constrained by – the "cloud deployment model". Governments – and enterprises – face many demands, and solutions designed for each of these demands may have a variety of different considerations. The Hybrid Cloud enables unprecedented flexibility and efficiency in meeting the overall demands of an enterprise while offering the flexibility to address specific regulatory and economic requirements for a variety of specific needs.

Cloud Deployment Model	Benefits	Issues/Concerns
Public Cloud	Handle unpredictable spikes in workload Quickly deploy new services without major hardware purchases Optimize costs; "pay only for what you use"	Security/data control issues Laws/Regulations regarding data protection Network latency/performance issues Unpredictable response time ("Real time" needs)
Private Cloud	Control access to sensitive data Optimize expensive resource usage Enable "self-service" model to offload administrative overhead Enable fine-grained inter-department billing Manage resource growth demands "Do more with less"	Must purchase, configure, install and manage hardware Limited by available resources Limited support for "mobile" clients/users Disaster recovery- requires a second (unused) datacenter?
Hybrid Cloud	Resolves issues with "private" and "public" clouds Manage control over sensitive data as needs change Comply with government regulations (*e.g.*, "data sovereignty") Manage an appropriate data "lifecycle", archive relevant data Adapt to changes in vendor prices, contracts, acquisitions, failures, *etc.*	*Open standards and interoperability required*

Table 2

Summary: Implications for the public sector and initial policy recommendations

Today cloud computing is at the heart of a new wave of Digital Transformation. It can scale up computing resources to cope with unpredictable peaks in demand, provide a platform for rapidly developing and deploying new applications, and it is a delivery channel for "Software as a Service (SaaS)". For this new cloud paradigm to work in the enterprise a variety of cloud systems are necessary and they need to connect with the traditional IT systems. This is called Hybrid Cloud, spanning public clouds, private clouds – off or on-premises – and connecting with traditional IT.



"*The model of flexibility, choice, and agility in connecting a broad spectrum of resources into a unified, cohesive solution is known as a 'Hybrid Cloud'*"

From a government perspective, the adoption of Cloud Computing has been an attractive policy option for a number of reasons:

- It drives down the cost of IT, particularly in the public sector and improves the relationship between government and citizens through far more customized and easily available services.
- It acts as a catalyst for innovation and change in the private sector, driving down IT costs and freeing up investment.

The unique value of cloud computing has already resulted in the creation of the US Government's **Cloud First** strategy in 2010, and the European Commission's "**Unleashing the Potential of Cloud Computing in Europe**" in 2012.

Governments may also wish to change certain parameters or thresholds for cloud deployment – for instance with regard to security or data privacy.

- The security and data privacy offered within a cloud service may become

inadequate or unable to meet local standards or legal requirements

- Government entities may choose to apply some across the board certification process whereby cloud providers are prequalified to do business (*e.g.*, with government agencies) based on some pre-defined criteria

Hybrid cloud offers distinct advantages to governments over pure public cloud since it allows the mixing and matching of resources to meet local requirements, whether these are based on regulation or customer choice. Examples of this could be the use of public cloud for certain services, but the choice of private cloud for other services that involve sensitive data. The Hybrid Cloud allows integration across these disparate resources in a manner which allows optimal flexibility and control in meeting the needs of today- and tomorrow.

For Hybrid Cloud to function, however, interoperability and open standards are crucial. Lack of open standards for cloud solutions directly impedes the ability to implement Hybrid Cloud solutions. Policy makers have a key role to play in ensuring that open cloud interoperability standards are supported and promoted. Without sufficient promotion for such standards, cloud computing is at risk of regressing to a state very similar to previous client/server environments with customers locked into proprietary software and hardware configurations.