FEASIBILITY OF SUSTAINABLE DEVELOPMENT BY CLOUD COMPUTING IN ASEAN REGION

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Abstract

One of the most vital societal challenges of the 21st century is sustainable development.The rapid development and application of information technology (IT) is a global trend with significant implications for sustainable development. According to the findings of global action plan, electronic devices such as computers, laptops, and mobile devices account for 2% of greenhouse gas emissions worldwide. This figure cannot be reduced without effortsfromcompanies that support the "green IT" concept. Long-lasting products with low-energy consumption can save energy. However, green IT products have no international label. Even thoughseveral companies have developed certain labels, monitoring their quality remains difficult, and a guideline for quality checking is needed. Cloud storage is one of the methodsthat can reduce energy consumption. The main goal of the ASEAN community is to leverage on sustainable development in the ASEAN region through enhancing cooperation among member states in different aspects of life. In doing so, the ASEAN attempts to facilitate information exchange among member states which would be facilitatedby cloud storage. Therefore, creating a policy guideline is necessary to enable member states to mandate the use of large computing centers for companies to ensuresustainable energy savings. Companies typically use old servers that consume a significant amount of energy inefficiently. Thus, they need to set up fewer servers with highly efficient output.The purpose of this study is to consider the relationship between cloud computing and sustainability within the ASEAN region and to formulate a suitable legal framework for promoting cloud computing it amongmember states. This paper also aims to examine how ASEAN can encourage member states to utilize the cloud computing technology through legal frameworks thatare intended to reduce power consumption in the information and communication technology departments of various organizations.

Keywords:*Sustainable development, Cloud computing, ASEAN member states, Legal Framework, Green IT.*

I. INTRODUCTION

Information plays a vital role in the business supply chains of society. It also assists government to deliver assistance to their citizens. In other words, data is the very foundation of our communications and everyday lives.[1]Cloud computing has the potential for creating a profound new sustainability and has a great positive contribution to it.[2]Cloud

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[1]   https://blogs.msdn.microsoft.com/govtech/2010/05/27/public-policy-and-cloud-computing-in-asia-new-opportunities-new-challenges-new-responsibilities/

[2] Ryan Schuchard, Former Associate Director, Climate Change, BSR. http://www.bsr.org/en/our-insights/blog-view/taking-ethics-to-the-cloud.

computing is a fast growing industry that assists economiesin moving forward. Adopting cloud computing in the ASEAN region may assist the region to move forward within a very short period of time. According to the ASEAN ICT Master Plan 2020 (AIM2020), a new stage of development is required to transform the ASEAN digital economy.[3]Data sharing between member state countries can be an important catalyst for economic growth and greater economic interdependence; however, it should be borne in mind that it can also cause tensions if managed poorly.[4]While earlier challenges facing ASEAN were the high cost of market entry, the next focus on development will be on widening its economic transformation. In order to speed up the adoption of cloud computing in the ASEAN region, legal and technical issues must be clarified.

The most significant feature of the cloud is that it does not rely on local servers which consume a great deal of energy. It also has an effect on contributions to sustainability by encouraging consumers to use clean-tech applications and virtual services. Global trade in the 21st century has propelled nations to spend more than $2trillion annually on information technology and related services such as cloud computing.[5]Much of the operational costs of cloud based applications are due to the considerable amounts of energy consumed[6]which take up almost 10% of datacenter operational expenses, and this is likely to rise by 50% in the next few years. Apart from such operational expenses, high power consumption produces heat which need to be addressed through cooling systemswhich have their own costs that range from $2 million to $5 million annually. Therefore, reduction of the above energy-related expenses is a major issue that has to be addressed in green cloud computing. It is not surprising why the management of

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[3] ASEAN TELMIN 15 adopts ICT Masterplan 2020, 28 November 2015 . http://english.vtv.vn/news/asean-telmin-15-adopts-ict-masterplan-2020-20151128113250067.htm

[4] The Cloud & Big Data, Policy Challenges for Asia, Keio International Center for the Internet & Society, The Cloud and Big Data - Policy Challenges for Asia, May 30-31, 2013 Conference Report, p 10.

[5] Powering the Digital Conference Report A Trade Agenda to Drive Growth, Powering the Digital Economy, the software alliance. May 30-31, 2013.

[6] S. K. Son and K. M. Sim, "A price-and-time-slot-negotiation mechanismfor cloud service reservations," IEEE Transaction System., Man. (42) 3 (2012). pp. 713–728.

the applications in a cloud datacenter in an energy-efficient way is an urgent problem.

Renewable energy is one of the most efficient and viable solutions for addressing sustainable development challenges.[7]It transforms the disruptive aspects of technology to an inclusive and integrated digital society that could advance the ASEAN vision of having a single market. Renewable energy is used to deal with specific power production such as hydro, solar, wind, tidal, and biomass mostly in the rural areas of Asia and the Pacific. However, other new sources of technology and nature-oriented bios that imitate renewable technologies can strengthen sustainable development as well as enhance efficiency and applications. Cloud computing will facilitae connection among ASEAN citizens, and enable them to work together to bridge digital divides and build a common ASEAN identity based on low cost and energy-efficient technologies.

The vision for the AIM 2020 is to propel ASEAN towards a digitally-enabled economy that is secure, sustainable, and transformative; and to enable an innovative, inclusive and integrated ASEAN Community.[8]Bernie Trudel, Chair of the Asia Cloud Computing Association believes that success in Asia will critically depend on the promotion of smooth data flows between countries as it is the basis on which a new economy operates. As such, he believes that data policies in the region should aiw towards reducing regulatory uncertainty through, among others, providing a data classification nomenclature involving different security requirements for the various categories of data. The impact of this on regional trade could be immediate and profound.Asia could lead in this as it is well-placed and could immensely benefit from a seamless and clear set of standard policy and operational guidelines.[9]

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[7] The 12th International Conference "ASIAN Community Knowledge Networks for the Economy, Society, Culture, and Environmental Stability" 6 – 11 June 2016 Venue: Century Park Hotel & University of the Philippines, Diliman Campus. http://www.ku.edu.np/news/gallery/1/1373-2.%20%20Annoucement-Eng.pdf

[8] The ASEAN ICT Masterplan 2020, The Association of Southeast Asian Nations

[9] Simon Smith, President, Asia Pacific Carriers' Coalition president@asiapacificcarriers.org , Report on Cloud Data Regulations: A Contribution on How to Reduce the Compliancy Costs of Cross-Border Data Transfers, http://www.asiacloudcomputing.org/research/2014-cloud-data-regulations.

With the availability of such valuable resources, policy makers around the world are grappling with how to regulate data in an optimum manner. They attempt to protect data and information simultaneously while enabling the sharing of valuable information and collaboration among nations aimed at boosting social and economic development. There has been a marked increase in connectivity and mobility. Cloud computing advancement providesapplications and services to secure information ecosystems.

The aim of this essay is to envision a sustainable and equitable global community based on the role of cloud computing during the transition to such a society. Cloud computing will support and enhance the communication of ASEAN member state in a very effective manner.

II. CLOUD COMPUTING SERVICES

The National Institute of Standards and Technology define cloud computing, "as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.[10]Cloud computing give users more flexibility compared to the traditional hardware-based systems. It is becoming efficient and easily accessible by different devices while providing the opportunity for users to share data across multiple locations. Customers can access their data just on demand. It provides similar opportunities for different SMEs with different background and resources since all are leveraging on and through the same platform. Such a levelling of the playing field provides the edge in competition if used efficiently. Cloud computing technologies comprise public, private, and a hybrid of both. Private clouds are owned or leased by the enterprise, public cloud is sold to the public, while the hybrid is a combination of both. Cloud computing is deemed as the next generation of technological advancement and has become the basis for new business models and far-reaching business innovations. It not only reduces operational costs

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[10] Peter Mell& Timothy Grance, The Nist Definition of Cloud Computing , SP 800-145, 2011.

but allows for major improvements over the traditional business and resource applications. This has led to tremendous productivity growth, enhanced accessibility and flexibility, and more seamless operations.[11]

The global value of cloud computing is expected to reach $270 billion in 2020.[12]Cloud computing may assist ASEAN countries to achieve stronger economic development through enabling an interconnected and interoperable digital economy. The primary focus of the ASEAN economic communityis to move beyond trade liberalization and to build an integrated economy based on four interrelated pillars as outlined in the AEC blueprint. Shared cloud computing started in early 2011, continuing to grow at compound annual rates and assisting the industry in generating millions of new and creative jobs globally. Economic growth cannot be reached without the 4 pillars of ASEAN economic integration and supporting the pillars require collaboration among member states. Cloud computing empowers enterprises and consumers located across borders. It provides the conditions for users and consumers to have their data in multiple locations and countries and this will assist ASEAN member states to generate and use data at low costs and in a timely manner.[13]

The IT revolution has benefited human tremendously. Cloud computing empowers human beings to have access to vast amounts of data and collapses distances in a way that has never occurred before. It allows companies to operate seamlessly in the global market using lower levels of energy consumption while governments seek applications of the information ecosystem at national and international levels. They understand how cloud computing can deliver benefits to their economies.

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[11] Red Akrim, The Growth of Cloud Computing in Emerging Asian Market, https://www.cloudswave.com/blog/the-growth-of-cloud-computing-in-emerging-asian-market/

[12] Red Akrim, The Growth of Cloud Computing in Emerging Asian Market, https://www.cloudswave.com/blog/the-growth-of-cloud-computing-in-emerging-asian-market/

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III. GREEN TECHNOLOGIES FOR ENVIRONMENTAL PROTECTION AND SUSTAINABLE DEVELOPMENT (GREEN CLOUD COMPUTING)

Energy consumption arising from the use of information and communication technology equipment has been the focus of much attention in recent years with much emphasis placed on managing it across the entire process and sectors. Cloud computing encourages the application of cleantech such as smart grids. It also encourages the substitution of resource-heavy physical products with virtual services. Cloud computing utilizes enormous amounts of energy and forms much of the total operational costs of users that is estimated at up to 10% and forecast to rise by 50% over the next few years. Such high power usage generates heat which require cooling systemswhich costs between $2 million to $5 million annually. Green cloud computing can reduce such energy related expenses. Data centers use nearly 1.5 percent of global electricity and this has climbed steadily despite the recent economic slowdown and is expected to continue to grow substantially. Cloud computing will involve an increase in the size and capacity of data centers and of networksbut, if properly managed, can potentially lead to overall energy savings. Currently, power consumption in data centers is managed which has led to substantial progress in energy efficiency. Cloud computing infrastructure has benefited vastly when located in data centers. Several new techniques improve the energy efficiency of cloud computing indata centers, such as sleep scheduling and virtualization of computing resources. Further, the required enery to transport data to and from the end users and the energy consumed by the end-user interface is very important and cannot be ignored.[14]

Resource utilization and energy efficiency should be considered in data centers as having an impact on the climate. Some scholars believe that the cloud is a key feature of environmental sustainability since it addresses two pivotal elements of a green IT approach namely energy efficiency and resource efficiency.[15] The three considerations in carbon

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[14] J Baliga, RWA Ayre, K Hinton, Green cloud computing: Balancing energy in processing, storage, and transport, Proceedings of the IEEE, 2011 , p 150. http://ieeexplore.ieee.org.

[15] Ryan Schuchard, Former Associate Director, Climate Change, BSR. http://www.bsr.org/en/our-insights/blog-view/taking-ethics-to-the-cloud

emissions are the number of servers being used, the energy consumption of each server, and the carbon intensity of energy sources utilized in powering them.[16]

1) Energy-efficient cloud computing

The increased usage of cloud computing has led to higher energy consumption of networks and computing resources needed resulting in the emission of enormous quantities of CO_2. It is thus important for cloud resource providers to reduce such consumption to achieve operational cost savings and to improve system reliability.[17]This has led to new "low-carbon" cloudcomputing solutions, and renewable energy sources promise to be major players in the effort to drastically reduce CO_2 emissions and cope with the growing power requirements of data centers.

Although numerous academic and commercial endeavors have been made to reduce power costs and carbon footprints by applying better energy-proportional computing technologies and more efficient power delivery and cooling systems, energy efficiency alone will slow down the growth of the IT carbon footprint. Microsoft conducted research with Accenture, a leading technology, consulting, and outsourcing company, to compare energy use and the carbon footprint of Microsoft-facilitated business applications with corresponding on-premise deployments.[18] The study focused on three Microssoft's mainstream business applicationsnamely, Microsoft Exchange®, Microsoft SharePoint®, and Microsoft Dynamics® CRM. Each application was available both in the on-premise and cloud-based versions and their environmental impact of IT delivery peruser were compared. The study found that enery usage and carbon emissions could be reduced by more than 30% by using microsoft cloud and that shared cloud services can reduce energy use and emissions by more than 90%. This was attributable to factors such as dynamic provisioning, multi-tenancy, server utilization, and data center efficiency. As such, ASEAN member states can take

[16] https://aws.amazon.com/about-aws/sustainability/
[17] YunNi Xia, Member, IEEE, MengChu Zhou, Fellow, IEEE, Xin Luo, ShanChen Pang, and QingSheng Zhu, IEEE Transactions on Systems, Man, and Cybernetics: Systems, (2015) 45 (1). P 73.
[18] Cloud Computing &Sustainability: The Environmental Benefits of Moving to the Cloud, Accenture. WSP. p3.

advantage of highly efficient cloud infrastructures by having their own data centers and using cloud services to reduce the environmental impact of IT services. Besides cost savings and easy-accessibility advantages, cloud computing can reduce the carbon footprint of business applications which is important for ASEAN member states as carbon emissions have been rising fast in the region due to rapid economic growth, and as a means to improve the collective capacity to address climate change. Although some member states have started taking adaptive actions to address climate change, cloud computing services can be a significant solution to achieve the mitigation targets adopted by them. For instance, Indonesia plans to reduce emissionsby 26% from business-as-usual (BAU) by 2020, Malaysia seeks to reduce her energy intensity of GDP by 40% by 2020 compared to 2005 levels, the Philippines aims to deviate by 20% from BAU of their emission growth path, and Singapore has targeted emission reductions of 16% below BAU by 2020. This can also reinforce the goals of the ASEAN Socio-Cultural Community (ASCC) Blueprint of enhancing regional and international cooperation to address the issue of climate change. [19]

Currently, IT companies prefer to choose renewable energy resources to power their rapidly expanding datacenter infrastructures and maintain safe levels of global greenhouse gases. As such, many governments have instituted measures and standards such as incentives for green power generation and consumption. According to the international environmental organization Greenpeace, "Green IT = Energy Efficiency + Renewable Energy".[20] Besides the pressures of reducing huge energy consumptionand carbon emission, applying green energy providesmany unique opportunities to cloud datacenters. The first impotant opportunity is that cloud service providers will own geographically distributed datacenters which can distribute workloads among geo-dispersed datacenters, while supporting a wide host of IT workloads, including both delay-sensitive non-flexible applications such as web browsing and delay-tolerant flexible applications such as scientific computational jobs. They mitigate the risk against the future

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[19] ASEAN Cooperation on Climate Change. http://environment.asean.org/asean-working-group-on-climate-change/
[20] G. Cook, How Clean is Your Cloud?, Greenpeace International Tech. Rep., Apr. 2012.

rise in power prices by connecting to grids at different jurisdictions with time-varying electricity prices. They are alsousuallyequipped with uninterrupted power supply (UPS) to avoid interruptions caused by power outages. Since UPS battery is usually over-provisioned, energy can be stored during periods of generation and supply it when the renewable energy is inadequate. Cloud computing in ASEAN needs to utilize datacenters to provide common cloud computing services or data centers for member state to facilitate their communication. The utilisation of renewable energy is most commonly achieved by deploying on-site generation equipment at the datacenter facility.[21]

Guidelines and reference for using shared cloud computing in ASEAN must be established as soon as possible. For this purpose certain criterias are significant and must be developed and endorsed by the ASEAN environment ministers. They must serve as a reference point for regional standardsbased on environmentally friendly model countries in the region in order to assist them to achieve sustainable economic growth through shared cloud computing services. This can contribute to the implementation of ASEAN Socio-Cultural Community Blueprin and ASEAN ICT Masterplan 2020.

IV. ADOPTING CLOUD COMPUTING IN ASEAN

Many countries tend to adopt policies that would restrict the flow of data across their borders or require data servers to be located in their jurisdiction if they serve the local market. However, havinga free trade agreement and an ASEAN Economic Community (AEC) for promoting a single market and enhancing competitiveness and attractiveness of the region for foreign direct investment will require strongand effective collaboration among ASEAN member states.

The aim of the ICT masterplan 2020 is to promote digital transformation. This can help connect individuals and communities regardless of their location by facilitating faster access to services and create new technology for improved methods of doing business. Akey objective of AIM 2020 is to enable the transformation to the digital

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[21] Wei Deng, Fangming Liu, and Hai Jin. Harnessing renewable energy in cloud data-centers: opportunities and challenges. IEEE Network .2014, pp 48-50.

economy and facilitating the emergence of a single integrated market to make it attractive for investment and to motivate human capacity to participate and build a digital environment which is safe and trusted. Shared cloud computing in ASEAN is a tool to equip its citizens with the latest technology and application services for a trusted ICT environment by enhancing confidence in online transaction via a robust infrastructure.

The main aspect of adopting cloud computing in the ASEAN region is the legal framework.As ASEAN ICT seeks to reinforce regional connectivity through sustainable and green ICT use, it is crucialto adopt cloud initiative under its ICT masterplan. There is an urgent need for the ASEAN community to launch an ASEAN Cloud Computing Initiative with the aim of build trust and confidence in cloud computing in the region as shown by the European Union example.[22]Achieving a single digital market which is the first goal of ASEAN will not be possible without such an initiative. A study conducted by the European Commission indicated that from 2015 to 2020, cloud computing could add €449billion to the EU28 GDP (incl. the public sector), of which €103billion would be in 2020 alone, a share of 0.71% of total EU GDP which is more that 3 times that in 2013. It also noted that almost 303,000 new businesses would be created between 2015 and 2020, and 1.6 million jobs would be created until 2020, almost 1 million of which would be in the five years up to 2020. The study examined various baseline to worst-case scenarios and found that expenditures on cloud would replace that on other IT systems and services.

Data will be transferred internationally, and the first issue of consequence would be the protection of the data. Securing it appears to be one of the most common restrictions in various jurisdictions. It is obvious that by adopting cloud computing within the ASEAN region companies can gain fast access to the best-of-breed business applications and increase their infrastructure with reasonable cost. There are many obstacles and barriers that hindercloud adoption in these countries and even in the region, and these challenges need to be addressed and overcome. It is necessary for countries in the ASEAN

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[22] Digital Single Market, European Commission, https://ec.europa.eu/digital-single-market/en/digital-single-market.

region to have a single cloud market to assist them to collaborate in more effective and efficient ways. Cloud computing has a significant impact on economies and provide major employment opportunities. In other words, sustainable economic growth is a prerequisite for the ASEAN region to tackle poverty and environmental problems. A shared cloud computing platform allows companies to have unparalleled levels of connectivity between suppliers, employees, and customers.

The rate of cloud adaptation is growing at a remarkable pace in Asia although the degree varies across countries. Some countries such as Singapore, Taiwan, and Australia have comparatively higher rates of adaptation compared to China, India, Indonesia, the Philippines, Thailand, and Vietnam. The factors driving the adoption of cloud solutions in Asia include the mobile revolution which requires consumers to have access to corporate services from anywhere in the globe. The Asia Assocation of Cloud Computing studied the attractiveness of cloud computing in 14 of its member countries countries. It evaluated cloud computing attractiveness in terms of the potential market size of SMEs, and their readiness and awareness capacity for accessing it. The parameters included addressable market, adoption suitability, demand drivers and affordability, and financial support from governments. Only some of the ASEAN member states, namely Singapore, the Philippines, Malaysia, Thailand, Vietnam, and Indonesia ranked 4,8,9,10,12, and 13 respectively had those parameters.The main issuesto be considered in adopting cloud computing in ASEAN include:confidentiality, privacy, and data protection; regulatory compliance; and intellectual property.

It is worth noting that based on the 2016 index released by Asia Cloud Computing Assocation,Asian economies lead the world in cloud readiness. The survey compared 14 markets in the Asia-Pacific including a sample of six non-Asian markets. The CRIused ten parameters to measure the preparedness of countries in adopting and rolling out cloud computing. It compared countries in relation to each other rather than using absolute scores. Four parameters measured "hard infrastructure" capacity, i.e., international connectivity; broadband quality; power grid, green policy and sustainability; and data centre risk, and six parameters measured the "soft infrastructure" i.e., cyber security, privacy, government regulatory environment and usage; intellectual property

(IP) protection; business sophistication; and freedom of information. Bernie Trudel, Chairman of the ACCA stated that, "The results put Asia in a very strong position to lead the next wave of global innovation and technology."She also added that, "the Asia Pacific is poised to outperform as they lead the world into the digital age, driven by cloud computing technologies."[23] Thus, ASEAN must initiate a strategy on cloud computing to promote the use of off-site data storage in order to reduce information technology costs and create new jobs. Establishing a harmonized set of regulation like what the European Union did is a basic requirement.

Regardless of the cloud computing used by an installer many challenges exist, and the area of risk analysis in deploying shared cloud computing within ASEAN must be considered. In other words, it is necessary to analyse the legal issues impacting the cloud environment. In fact, as cloud computing grows substantially, so would the number of legal issues in its environment.

A. CONFLICT OF LAW AMONG COUNTRIES PERSONAL INFORMATION AND THE CLOUD

Privacy laws that impact the flow of data varies among different legal jurisdictions. The level of security required by users is different based on the sensitivity of their data. It is not possible for users to make providers undertake additional security measures, although major institutions such as banks, should and do. Most providers refuse to follow the user's security policies, and even if they do, the changes would be minor. If users demand extra security, providers feel that they are simply not ready to move to the cloud. Countries follow different laws regulating the location of different types of data storage. Thus, it is necessary that such restrictions and regulations are handled by an overriding organization.

The lack of harmony among legal and political regimes makes it difficult to apply standard legal frameworks relating to the cloud as it involves various data locations and unclear divisions of

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[23] Asia Cloud Computing Association (ACCA), 2016 Cloud Readiness Index http://www.asiacloudcomputing.org/research/cri2016?utm_content=buffer0e418&utm_medium=social&utm_source=linkedin.com&utm_campaign=buffer

responsibilities among stakeholders.[24]Among others, differences in international privacylegislation can be a trade barrier and prevent innovation.[25]Depending on their level of development, countries experience significant differences in legislative and enforcement issues involving the personal data protection. Cloud providers are required to contacttheir users in the event of a data security.The Euroepan Union Data Protection directive has similar rules to protect users' personal data throughout the European Union.[26] New regulations of the European Union in data protection or the EU Directive enables its citizens to not just sue companies that hold their personal data, but also organisations that process it on their behalf. The experience of the European Union indicates that having a directive is not a practical solution, since it is interpreted based on a state's own laws which has led to wide variations in interpretation and enforcement, while regulations make member states apply them directly without any change. ASEAN member states are required to harmonize data protection across ASEAN in order to establish a unified market in digital services. Such harmonization across ten countries will indeed contribute to economic growth.The experience of the EU as mentioned above proves that this method works perfectly well, since it gives member states a single point of contact to contribute and collaborate. Initially, ASEAN must establish an ASEAN Sales Law to deal with divergent national sales laws by providing contracting parties with a uniform set of rules.

Conflicting data protection legislation exists even among developed countries and is a barrier for personal data transfers across borders. An example would be developed countries which apply restricted provisions of cloud services to local companies within the country.

B. PRIVACY AND SECURITY

According to Russ McRee, a security researcher and manager of incident response at Microsoft Online Services, an entity that shifts a legacy application into a cloud computing environment loses control over the networking infrastructure, including servers, access to logs,

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[24] ITU-T Technology Watch Report March 2011, Privacy in Cloud Computing, p11.
[25] www.economist.com/node/21543489
[26] Robert B. Mitchell, Legal Issues Surrounding Cloud Computing, 2012 Refereed Proceedings, Association of Business Information Systems, New Orleans, Louisiana.

incident response and patch management. Despite the widespread penetration and adoption of cloud computing, many challenges remain regarding privacy and security. Two main concerns in this area are loss of control over data and dependence on the cloud computing provider since data protection laws require the provider to take appropriate measures to protect personal data. These two issues may lead to a number of legal challenges such as identity management, access control, risk management, and regulatory and legislative compliance.[27] According to 2011 report, most providers did not prioritize security in their contracts as well as had problems with audit rights. This is of much concern to financial service users who need to retain comprehensive audit rights for themselves, their auditors, and regulators[28] as providers usually do not want to cede their audit rights. Generally, such rights are an issue with shared services. Some users ask for audit rights due to their own lack of knowledge while providers only offer application software running on the user's own infrastructure.

C. LOCATION OF DATA

The primary location of the data and any backup sites are crucial since it reflects the law and regulationsof the jurisdiction. Such locations need to be established. Amazon.com Inc., for example, has large datacenters in the United States and Ireland, which could be an issue if used as backup centers for certain types of data. The data protection laws of the European Union member states and of other regions, are extremely complex and insist on having in place certain definitive requirements where the movement of personal data outside these regions need to follow strict protocols. For instance, the EU requires that individuals must be informed by the data controller if their data is moved to a region outside the EU. The data controller and end processor must also have contracts approved by the Data Protection Authority, and this can be problematical as it depends on the region where the data is processed. The United States and EU have a reciprocal agreement, and a recipient in the former only has to self-certify its data procedures by

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[27] Cloud Computing Security and Privacy Issues, Council of European Professional Informatics Societies, http://www.cepis.org/index.jsp?p=641&n=825&a=4758

[28] Financial Services Authority, Senior Management Arrangements, Systems and Controls, 2009, 8.1.8 (U.K.).https://www.handbook.fca.org.uk/handbook/SYSC.pdf

registering with the U.S. Department of Commerce. As such, providers must be sure about the regulations of other jurisdictions where they may host their data, have primary and backup locations, and intermediate locations if data is being transferred between jurisdictions. Since, their data is deposited with a third party, they need to ensure there is adequate security and meet allregulatory and legal requirements as well as comply with procedures and local laws where the server is located. For instance, if the provider's company is in the United States but they host their data on a server in the EU, it is likely that the users have to abide by EU laws if the data is to be transferred into and out of the system. This procedure may be more onerous for regions where local governments allow unlimited access to the data regardless of its sensitivity, such as China, where the provider may have limited scope for encrypting data if the local authority does not permit it.

Due to the expansion of the cloud computing market, some companies subcontract to others in another region especially those providers who offer large-scale applications. However, it is obligatory for them to comply with the laws and regulations of referred region. If the cloud provider go bankrupt or cease operating and data where located in another region's jurisdiction, the data would be subject to completely different access rules.[29] Generally, in IT sourcing, the supplier will provide a commitment as a warranty or undertaking to comply with applicable laws. It is normal for users to enquire about the performance of the provider and its obligations under the agreement. Users in cloud computing services must carefully check whether the providerwarrants that its services comply with applicable law. Further, such warranty must not only be limited to the provisions but must also cover the receipt of the service. They need notmeet the user's requirement if the provider only complies with the laws where the servers are based and from where the service is provided but must comply with applicable laws in the area where the services are actually accessed and used. [30]

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[29] Cloud Computing: Data Privacy in the Cloud, Vic (J.R.) Winkler, TechNet Magazine > Home > Issues > 2012 > August >, https://technet.microsoft.com/en-us/magazine/jj554305.aspx (17 Feb 2016).

[30] Andrew Joint, Edwin Baker, Knowing the past to understand the presentissues in thecontracting for cloud based services, Computer Law & Security Review, 2 7 (2011) 4 0 7 -4 1 5.

D. COLLECTING AND ANALYZING

Data stored in the cloud environment is subject to less stringent legal standards in terms of search and seizure when an offence occurs. The very first step is to determine whether it is possible to collect volatile data and, if so, the investigator gathers the content of physical memory. In case of non-volatile data which are obtainable, the investigators gather data from the internet history, log files, files, and directories. The data collected from PCs and smartphones are analyzed to establish whether traces of a cloud storage service exist in the collected data. The ID and password of the user's cloud spacecannot be used until the search and seizure warrant is issued because it is a private storage and data collected without a warrant would not be valid. One of the main steps is to geta search and seizure warrant associated with the use of data stored in the cloud. If the warrant is not securedonly the remaining artifacts in the PCs and smartphones can likely be analysed. The investigator can access the suspect's cloud storage without the suspect's ID and password by using config.db which contains important information. The investigator can find the suspect's dropbox_path by collecting config.db from the suspect's PC. The investigator installs Dropbox on their PC, copies config.db to that PC, and then places config.db in the same path as the suspect's dropbox_path. Through this process the investigator is able to access the suspect's cloud storage.[31]

V. CONCLUSION

The long history of ASEAN's role in trade and economic integration in the region are strong indications that the same can be done for free trade in information offered through cloud computing. Various surveys conducted by the ACCA, ICT Master plan and...indicate that carbon emissions can be reduced to 90% by switching to cloud computing. Having centralized cloud computing ruleswill lead to more integrated economies. A recent survey by ACCA shows that Asian countries are in a very strong position to lead the next wave of global innovation and

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[31] Hyunji Chung a, Jungheum Park a, Sangjin Lee a, Cheulhoon Kang b, Digital forensic investigation of cloud storage services, Digital Investigation, (2012) 9. Pp 81–95.

technology. Cloud computing will have major implications in emerging the economies of Asia. Digital transformation can connect ASEAN citizens regardless of their location. It facilitates their access to services and creates new methods of doing business. However, countries need to have secure and reliable data flows across borders. They must place cloud computing as an integral part of their national ICT plans in order to have secure and long-term access to cloud services which can lead them to continued sustainable growth in an era of increasingly digitized economies. In fact, data privacy restrictions inhibit the development and efficient use of cloud services although they have been enacted to enhance national security. Cloud users will use the facility if they are confident that the security and privacy of their data will not fall into the hands of unauthorized parties. Therefore, effective privacy regulations and enforcement are among the most significant aspects of cloud computing readiness which must be adopted by ASEAN member states through directives or harmonized regulations. Progress in various other ASEAN sectors such as the ASEAN Australia Development Cooperation Program on harmonising e-commerce legal frameworks and the APEC Privacy Framework provides a solid platform for further development in enhancing initiatives related to policies on such technology.

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