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IMPLEMENTATION OF IAAS IN CLOUD USING MONOLITHIC MODEL

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Abstract— **In a large Infrastructure-as-a-Service (IaaS) cloud, component failures are quite common. Such failures may lead to occasional system downtime and eventual violation of Service Level Agreements (SLAs) on the cloud service availability. The availability analysis of the underlying infrastructure is useful to the service provider to design a system capable of providing a defined SLA, as well as to evaluate the capabilities of an existing one. This project presents A Monolithic Model to quantify the availability of a large-scale IaaS cloud, where failures are typically dealt with through migration of physical machines among three pools: hot (running), warm (turned on, but not ready), and cold (turned off). The Physical Machines will be Migrated Based on Guard conditions..**

Index terms- **Analytic-numeric solution, availability, downtime, cloud computing, simulation, stochastic reward nets.**

I. INTRODUCTION

Cloud computing is the phrase used to describe different scenarios in which computing resource is delivered as a service over a network connection (usually, this is the internet). Cloud computing is therefore a type of computing that relies on sharing a pool of physical and/or virtual resources, rather than deploying local or personal hardware and software. It is somewhat synonymous with the term 'utility computing' as users are able to tap into a supply of computing resource rather than manage the equipment needed to generate it themselves; much in the same way as a consumer tapping into the national electricity supply, instead of running their own generator. One of the key characteristics of cloud computing is the flexibility that it offers and one of the ways that flexibility is offered is through scalability. This refers to the ability of a system to adapt and scale to changes in workload. Cloud technology allows for the automatic provision and deprovision of resource as and when it is necessary, thus ensuring that the level of resource available is as closely matched to current demand as possible. This is a defining characteristic that differentiates it from other computing models where resource is delivered in blocks (e.g., individual servers, downloaded software applications), usually with fixed capacities and upfront costs. With cloud computing, the end user usually pays only for the resource they use and so avoids the inefficiencies and expense of any unused capacity. However, the advantages of cloud computing are not limited to flexibility. Enterprise can also benefit (in varying degrees) from the economies of scale created by setting up services en masse with the same computing environments, and the reliability of physically hosting services across multiple servers where individual system failures do not affect the continuity of the service.

A. Private Cloud

Operate a private cloud in which only the specified client is a unique and secure cloud-based environment to a specific model of cloud computing. Like the other models in the cloud, private clouds on an underlying pool of physical computing resources as a service using the computing power provides a virtualized environment. However, under the private cloud model, cloud (the source of the pool) company that provides more control and privacy that is only available through one company.

To provide a variety of services that can be categorized as private cloud services and technology practices that significantly and so it is difficult to define what constitutes a private cloud from a technical aspect. Instead, such services are generally classified by the features they offer to their client. Private clouds characterize the traits of a company and for the sole use of higher levels of network security are ring-fencing of a cloud. They draw their source from the same group all the networks, servers and multiple clients that have access to virtualized services is defined in contrast to a public cloud. Private cloud services, physical computers distinct their resource pool to draw from, but they can be hosted internally or externally can be accessed through private leased lines or encrypted secure connections via public networks.

Ring-fenced private cloud model provides additional security for storing and processing data, or any organization, including the organization needs to carry out delicate tasks, is ideal for. For example, a private cloud service to store sensitive data internally and still be in demand, such as resource allocation, their business will want to profit from some of the advantages of cloud computing infrastructure necessary for the rule can be utilized in a financial institution.

But the added benefits of virtualization by Enterprise private cloud model used in the past for individual local access network (LAN s) will be closer to the more traditional model. Features and benefits of private clouds are therefore:

- High security and privacy;
- More control; A private cloud is accessible only by a single company, and configure the company to achieve a tailored network solution will have the ability to manage their requirements. However, this level of control eliminates the centralized

management of hardware economies of scale generated by the some of the public clouds

- The cost and energy efficiency; The implementation of a private cloud model, the individual divisions / business functions and easy access to resources directly respond to their demand by ensuring that an organization can improve resource allocation. This will not only provide a cost-saving, but it can reduce a company's carbon footprint more
- Improved reliability; Resources (servers, networks, etc.) within the host where the physical infrastructure is also virtualized operating environments across the network is meant to be more resilient to the personal failures. Virtual partitions, for example, the resource can pull them from the rest of the servers are unaffected. In addition to the name of a third party to host the cloud, the company still spent on infrastructure and physical security of the data centers can benefit from the host
- cloud bursting; Some of the providers in the context of the spikes in demand, within a private cloud offering, offer the opportunity to appoint cloud bursting. The service provider is sensitive functions that require more space in the private cloud to a public cloud allows you to switch some non-sensitive functions. Private clouds offer the capabilities of the non-sensitive functions are always assigned to the public cloud, public cloud services can be integrated hybrid clouds to form.

B. Public Cloud

Many users of cloud computing, cloud services are the most recognized model of a public network such as the Internet, provided a virtualized environment is stored in the shared physical resources, and which are available to the public cloud model is. They also have access to a single company to create a unique cloud platform, which is defined in contrast to the ring to the underlying computing resources pool of private clouds. Public clouds, however, using the same shared infrastructure provides services to multiple clients.

They are the most prominent examples of cloud computing, by definition, are publicly available, will be placed in the public cloud model. Cloud storage and online office applications such as software as a service (SaaS) offerings for cloud-based web hosting and development environments, perhaps including the Service (PaaS) offerings, as a service (IaaS) and Platform as the most familiar, but the infrastructure is widely available (all with private clouds But there are inside), as well as the model to follow. Infrastructure and private clouds, public clouds are less likely to offer the required level of security is used extensively in private offerings. However, the company still non-sensitive content, online document collaboration and storage of webmail, for example, to make their activities more effectively to significantly utilize public clouds.

The public model offers the following features and benefits:

- Ultimate scalability; To respond to fluctuations in the operation of applications that run on them smoothly, so that the resources of the resource group Public clouds' are available on demand from the vast pools
- Cost effective; And so the scale of the resource to bring together dozens of public clouds can benefit from the largest economy. Centralized operation and management of the resources of the underlying components such as servers all shared cloud services the next time you need a low bespoke configuration. Some of the proposals in the mass market advertising based on their income, the client is free.
- the cost of utility-style; Public cloud services are often required to employ a pay-as-you-go user, and then they are only used in paying wages, will be able to access the resources they need, which means that the charging model; Thus avoiding wasted capacity
- reliability; Servers and networks involved in the creation of a public cloud and a physical component redundancy configurations fail, the remaining parts of the cloud service is still running on the meaning unaffected. Clouds resource to draw from multiple data centers, in some cases, an entire data center and private cloud services to go offline receives no ill effect. In other words, no single point of failure, there is no harm in a public cloud service, which will be
- Flexibility; There are a myriad of IaaS public cloud model to follow and that it PaaS and SaaS services available in the market from any Internet-enabled device is ready to be accessed as a service. These services are private and Enterprise customers alike the most computing needs and provide their benefits. Businesses can also create hybrid clouds, private clouds, where sensitive business functions needed to manage, can integrate their public cloud services
- Location independence; The accessibility of public cloud services through the Internet connection to the client determines where the services are available. This from multiple locations (including emergency) IT infrastructure, remote access or online document collaboration company offers invaluable opportunities.

C. Hybrid Cloud

A hybrid cloud to perform distinct functions in the same organization, a comprehensive cloud service using private and public clouds. Some of the capabilities of the cloud computing services should offer a variety of degrees, but public cloud services, private clouds are likely to be more cost efficient and scalable. Therefore, the company is relying on a private cloud where they need it and ensuring their platforms, all seamlessly integrated, for all non-sensitive operations can increase their abilities by implementing public cloud services.

Hybrid cloud models can be implemented in a number of ways:

- Separate up of private and public cloud providers to provide services to an integrated service team
- Individual cloud providers to offer full hybrid package
- integrate their private clouds in a public group of companies to sign up themselves and their infrastructure

In practice, the name of a company with a secure and scalable private cloud, hybrid cloud hosting within their e-commerce website host could run, but their brochure where it is cost effective as a public cloud, the site (and the security is less of a concern). Alternatively, an infrastructure as a service (IaaS) offering, for example, to follow the model of the hybrid cloud and a private cloud storage for data with client to provide a financial business, but with the cooperation of the public cloud, allowing the project planning documents - a convenient place where they have access to multiple users from can.

A hybrid cloud configuration, such as hybrid hosting, the following features for its users:

- spread; Private clouds (whether they are hosted internally or externally, for example), depending on their configuration to provide a certain level of scalability is pulled from the resource because of the cloud, a public cloud service, provides the scalability limits.

1) Purpose:

Infrastructure as a service (IaaS) Software as a Service (SaaS) Platform as a Service (PaaS) are the three primary service models. As with all cloud computing services to a public connection, typically over the internet, in a virtualized environment, "cloud" computing to provide access to the resource. In the case of IaaS computing infrastructure provided by the computing resource, in other words, is exclusively the virtualized hardware. Definition of the virtual server space, network connections, bandwidth, IP addresses and include offerings such as load balancers. Physically, the cloud provider is responsible for maintaining all of the hardware resource of the pool, many data centers are usually drawn from a multitude of distributed servers and networks. The client, on the other hand, will be given access to their own platforms to build a virtualized components.

Cloud hosting in conjunction with the other two forms, IaaS price and the underlying hardware complexities and costs of managing outsourced to cloud providers to create the easily scalable IT solutions that can be utilized by enterprise customers. The level of customer switching operations of a business, or if they are looking to expand, they can tap into cloud resource and they need it, rather than buy, install and integrate the hardware themselves.

How to use IaaS Enterprise Notable examples are as follows:

- Enterprise infrastructure; Some businesses need to manage the growing businesses to store and protect the transfer of sensitive data (only accessible by the business itself) can scale their infrastructure to meet their growth in private clouds.
- Cloud Hosting; Was founded on pooled resources from the underlying physical servers, virtual servers hosting websites. A website hosted in the cloud, for example, be placed on the Web site to deal with unexpected demands and demand scalability provided by a vast network of physical servers can benefit from redundancy.
- Virtual Data Centers (VDC); Improved cloud hosting capabilities, the company that provides IT infrastructure or implement either a private or public cloud, which can be used to integrate all of these operations within the virtualized network of interconnected virtual servers.

As a service that provides a common infrastructure that can deliver the following features and benefits:

- spread; When the resource is available and the needs of the client, therefore, increasing the efficiency of waste of any delays or unused capacity
- no investment in hardware; To save time and cost to the client side, an IaaS service set up and managed by the cloud provider that supports the underlying physical hardware
- the cost of utility-style; The service can be accessed on-demand, and the client only pays for the resources they actually use
- Location independence; The service is usually as long as the cloud security protocol is an Internet connection and can be accessed from any place there is to it
- the location of the data center physical security; From the physical security of its data center servers hosted in a public cloud, or externally hosted private clouds with the cloud provider, the purpose of the services available through the
- No single point of failure; A server or network switch, for example, if you fail, due to a wide range of service and redundancy configurations of hardware resources will be unaffected by the rest of the group. An entire data center, if a server goes offline Yes, for many services, IaaS service could still run successfully.

2) Description of the problem:

COMPONENT failures are a normal phenomenon in a large distributed environment. However, the large service providers' data centers should be designed to guarantee a certain level of accessibility to the customer. Infrastructure-as-a-service (IaaS) cloud in the wake of the failure to ensure the high accessibility of computing resources (eg, CPU, and memory), storage resources, and networking capability. Service accessibility (ie, the probability of receiving the service at any time) is usually the time of year or minutes of service downtime by up to a year, such as service level agreements (SLA s) specified in there. So, the cloud service providers service may experience a period of time, considering the expected downtime is required to perform an accessibility analysis. They have a variety of system components and the failure / repair of the complex interaction between the behaviors proper modeling techniques. Among these analysis can be performed by holding the accessibility of cloud, government space models popular. However, a large IaaS cloud, the model becomes too large for the space. Markov chains a range of single or guided by a simple modeling, modeling with state-of-the-art representative of the accessibility of the cloud. The growth of the state space model Markov models [1] to take account more details of the

system is known as the largeness problem. They (the underlying) as a Markov model enables the automated generation of random Petri Nets (SPNs), can tolerate greatness problem. Still, the solution of large models is an issue. In this project, we are physical machines (PMS) based on the power consumption and provisioning delay characteristics were divided into three pools where is considered an IaaS cloud. Failure P / repair events can be migrated from a pool to another. We examined the accessibility of such a system [2] is limited to a few simple assumptions scenarios is limited to the application name. After relaxing in the common model predictions, we use a variation of the Railway Time Table fiction SPNs a monolithic model of development that would follow the normal method of random reward Nets (SRNs) [3]. However, due to the underlying Markov chain model for such a monolithic large state- space is not scalable for large clouds. To solve this problem, we have a scalable stochastic modeling approach based on the current sub-models. Please note, has already published a number of models [4], [5] are hierarchical in nature. In our case, the complexity of the large IaaS clouds (eg, from a pool of PMS migration) Fixed-point iteration is necessary, the sub-models to the cycle of dependency on touristic. Through the simulation model generation underlying the Mar- metal can be prevented by addressing the stochastic the height of the net Another solution is shown. We have shown the effectiveness of this approach for solving the state space models. After careful review of the relevant research to solve the accuracy of previous research models and the accessibility of large IaaS cloud solution does not solve the problem of the spread of the mark in terms of time. Therefore, this paper contributions are as follows:

1. We assessed the accessibility of an IaaS cloud the issue for the state and state-of-the-art of the

original monolithic representative of the proposed model.

2. We have to deal with the problem of monolithic height of the avail- ability of the model to propose an interacting sub-models approach.

3) The current system:

Defined SLA analysis of the accessibility of the underlying infrastructure, providing the ability to create, as well as to evaluate the capabilities of an existing one is useful for the service provider. By interacting sub-models have three pools. Proved the existence of a solution to coordinate them for it can be solved using fixed point iteration. There are a number of models, the hierarchical nature of the publication. In our case, the complexity and the large IaaS clouds symptoms (eg, from a pool of PMS immigrants) need fixed point iteration, the sub-models to the cycle of dependency.

Disadvantages:

1. These works do not take into account the extent and height issues.
2. VMs to address the problem of schedule
3. The experience of PMS were found in cloud systems for hardware failure / repair rates.
4. Optimization problems that are produced here,

4) The proposed system:

Since the proposed procedure and the analytical-numerical solutions are compared to a single model. We were errors introduced by interacting sub-models and our approach to handle the very large size of the IaaS cloud. Simulative solution considered for the proposed model, and the techniques of the time compared to the solution. We estimate the accessibility of an IaaS cloud the issue for the state and the accessibility of a single representative sample of the greatness problem propose a realistic macro model. The amount of the individual sub-model solution over a fixed point in the results obtained by the model solutions. The two-level hierarchical model proposed here to solve such problems, hierarchical composition introduced (and many other books on the sand paper) is. Created by a Markov chain and the system for each subsystem. The specific case of cloud computing, focusing on dependability modeling techniques have been proposed in recent years. A measure of the failure of hardware components to scan / repair costs can be used to parameterize the model proposed in this work we describe the scalable random approach is complementary. Robust hosting infrastructure to achieve an extraordinary assessment system (warning) is proposed. Special cases. Closed form solutions to solve quickly, producing a large cloud models. Cloud IaaS cloud service providers design, develop, test, and operation can benefit from the proposed modeling approach.

Benefits:

1. The reduction of the complexity of the analysis and solution of the time
2. IaaS clouds can handle large size.
3. We have a very large state-space models show the effectiveness of this approach for solving

5) Scope

However, a large IaaS cloud, the model becomes too large for the space. Markov chains with a range of single or guided by a simple modeling, modeling with state-of-the-art representative of the accessibility of the cloud. For more details on the system as a model to take into account the growth of the state space Markov models is that greatness takes issue [1]. They (the underlying) as a Markov model enables the automated generation of random Petri Nets (SPNs), can tolerate greatness problem. Still, a problem to solve large models.

6) Inspiration

In this project, we are the physical machines (PMS) is divided into three pools based on power consumption and provisioning features of delay is considered an IaaS cloud. Failure P / repair events can be migrated from a pool to another. We [2] some common assumptions to assess the accessibility of a similar system in the limited circumstances where the application is limited. After relaxing in the common model predictions, we Using a variation of the first SPNs a monolithic model of development that would follow the normal method of random reward Nets (SRNs) [3].

II. FORMATTING YOUR PAPER

Page should be of A4 size with normal margin. All printed material, including text, illustrations, and charts, must be kept within a print area. Do not write or print anything outside the print area. All text must be in a two-column format. Text must be fully justified. A format sheet with the margins and placement guides is available in Word files as <format.doc>. It

contains lines and boxes showing the margins and print areas. If you hold it and your printed page up to the light, you can easily check your margins to see if your print area fits within the space allowed.

III. Main Title

The main title (on the first page) should begin 1-3/8 inches (3.49 cm) from the top edge of the page, centered, and in Times 14-point, boldface type. Capitalize the first letter of nouns, pronouns, verbs, adjectives, and adverbs; do not capitalize articles, coordinate conjunctions, or prepositions (unless the title begins with such a word). Leave two blank lines after the title.

A. Modules Description:

1. Monolithic accessibility model
2. Model Outputs
3. Repair Module

B. Monolithic accessibility model:

Fig. 1 IaaS cloud accessibility analysis shows that the model for the SRN is a monolith. Input parameters for such a model are: 1) the initial number of PMS in each pool (NH, NW, and NC), 2), hot, and the cold of PMS MTTFs (1 = h, 1 = w and 1 = c, respectively) Each pool (NR) of a PM, 4) MTTR (1 = m) repair facilities, 3) the number, and the pools of PMS 5) MTTMs (1 = GWh; 1 = gch; 1 = ghw; 1 = GCW; 1 = ghc; 1 = GWC). NH, NW, NC, and NR design parameters, MTTF, MTTR, and MTTM values are measured experimentally. Warm Table 1. Hot Model guard duties, and a cool pool Ph, PW, and PC, respectively, and with the number of tokens in the pool, such as the number of non-represented positions P have failed. Heat the event of failure transitions PM Tbwhf, Tbchf, and represents Thf fi ring. PM fails to migrate a PM from a different pool of hot and three cases arise: a warm PM heated pool (Tbwhf fi res) to the transmission can be avail- 1), 2) the warm pool was empty, but a cold PM (Tbchf fi res) can be migrated and 3) both warm and cold pool) failed to heat the space and any other PM PM (Thf fi res are unable to be replaced. The three mutually exclusive cases [G2] [G1] guard duties are by the pattern and. the amount of heat available for PM fail- ure rate So multiply that by the number of P h should be equal to the heat, the rates reported in Table 2. # transitions can be considered depending on the number of tokens in the input Ph place near the map

The rates depend on the figuring arcs are used to represent such a marking. Pwhm places tokens; Pchm, and wait until the end of colonial Pcwm heated pool, refer to p. In particular, the transition Tbwhf fi res, PW and Ph places a token for each one is taken from the hot pool as a token borrowed a warm PM modeling, Pwhm put in place. Subsequently, the transition Twhm (full migration) Fi on the ring, a token and a token is removed from the places Pwhm pH and each deposited Pbw. Twhm rate of transformation performed in parallel to all the immigrants P migration process modeling is based on the number of tokens in Pwhm. Place Pbw repaired and returned at the end of the repair process, the number of P failed to keep track of the warm pool. Similarly, the transition to fiction Tbchf on the ring, a token, a token is deposited to Pchm places each and will be removed from the PC and Ph.

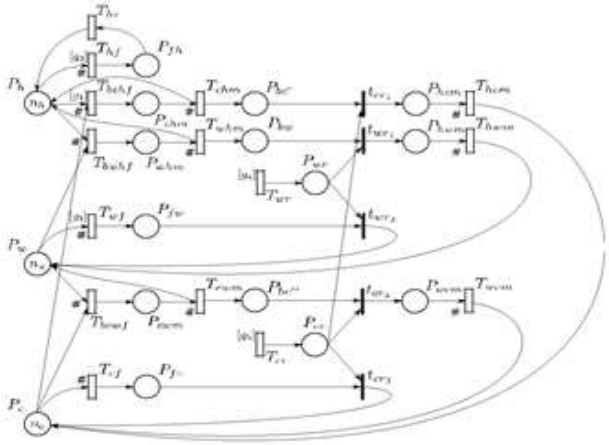

Fig. 1. Monolithic SRN model for accessibility analysis of IaaS cloud.

Guard functions	*Values*
[g1]	$1 \quad if \#P_w = 0$ $0 \quad Otherwise$
[g2]	$1 \quad if$ $\#P_w = 0 \; and \; \#P_c = 0$ $0 \quad Otherwise$
[g3]	$1 \quad if \#P_c = 0$ $0 \quad Otherwise$
[g4]	$1 \quad if \#P_{fw} + \#P_{bw} > 0$ $0 \quad Otherwise$
[g5]	$1 \quad if$ $\#P_{fc} + \#P_{bcI} + \#P_{bcII} >$ $0 \quad Otherwise$

T_{wf}	$\#P_w.\lambda_w$
T_{bcwf}	$\#P_w.\lambda_w$
T_{cf}	$\#P_c.\lambda_c$

TABLE 2: Rates of Transitions Modeling the Failure of PMsin Monolithic SRN Model

Tchm the transition to fiction on the ring, a token and a token is removed from the Pchm depos- ited places will each pH and Pbc0. Tchm conversion rate is based on the number of tokens in Pchm. Repairs and renovations at the end of the pro cess Pbc0 needs to be given back to the cold pool failed to keep track of the number of P. Thf transition fi res, a token reduction of PMS modeling available to a place by the heated pool and a token is removed from PH repaired and given back to the pool to be heated to represent PM in place of the failed when they were deposited in Pfh. Failure in the warm pool, repair, and PMS immigrants are represented in the same way. Tbcwf

transitions in the event of failure of a warm PM and will be made by TWF. A cold PM, warm pool, the transition Tbcwf fi res migration if available, to cool the pool is empty, TWF fi res. Mutual exclusion between the two cases [G3] is guaranteed by the guard func- tion. Throughout the warm PM w must be equal to the failure rate multiplied by the number of available P so warm, transitions Tbcwf and the TWF considered standard based on the number of tokens in place of the PW reported in Table 2, when the transition Tbcwf Fi res, taken from the PC as a token in place and keep it accumulated Pcwm. Until the migration is complete, place the warm pool Pcwm, are kept in cold P hold. Tcwm the transition to fiction on the ring, a token and a token is removed from the places Pcwm PW and deposited to Pbc00. PM has failed in two models, repaired and re-migrate to the cold pool. TWF-Fi on the ring, place a token moves from PW to PFW. PM has failed repaired and back in the designs migrate to the warm pool. TCF transformation models the number of tokens on the PC in a cool place for PM dependent on the failure rate of its jobs (see Table 2). In this way, the cold PM failure rate is equal to C multiplied by the number of available P cool. TCF transition fi res, place a token moves from PC when Pfc place. Failed to repair the rates for each pool of PMS NR repair facilities in order to model the presence of the marking on the THR, Twr, and TCR (Table 3 see) represents the transitions.

Transitions	***Rates of transitions***	
T_{hr}	$\#P_{fh}.\mu$	$if\ \#P_{fh} \le n_r$
	$n_r.\mu$	*Otherwise*
T_{wr}	$(\#P_{fw}+\#P_{bw}).\mu$	$if\ \#P_{fw}+\#P_{bw} \le n_r$
	$n_r.\mu$	*Otherwise*
T_{cr}	$(\#P_{fc}+\#P_{bc'}+\#P_{bc''}).\mu$	$if\ \#P_{fc}+\#P_{bc'}+\#P_{bc''} \le n_r$
	$n_r.\mu$	*Otherwise*

TABLE 3: Rates of Transitions Modeling the Repair of Failed PMs in Monolithic SRN Model and Interacting SRN Sub-Models

Twr and TCR transitions are enabled only at least a PM needs to be repaired. The guard duties [G4] and [G5] is determined. As soon as the transitions, twr2, tcr1, tcr2 twr1, and the repair process to start immediately after the completion of the migration, the fact that the model of PMS is repaired pool tcr3. Places Phcm, Phwm, and repaired migration Pwcm model holding of PMS. Migra- tion, depending on the changes in the rates of fi ring Thcm, Thwm, and will be made by Twcm. Table 4, we summarize the rates of PMS migration modeling of all transitions.

C. Model outputs:

SRN level assigned to the desired function of the rate of reward and the reward rate is estimated to be valued in stable condition [1]: a Markov model of the reward system is used to measure outputs. Interest Our actions are as follows:

In each pool of PMS

(i) the number of Mean. , Hot, hot and cold in the pool but failed to replace the Ph of the average number of PMS given by the average number of tokens, PW and PC (E½ # Ph, E½ # PW and E½ # Pcin indicated) following. These actions are summarized in Table 3 for the gift of doing things.

(ii) cloud service (A) accessibility. We are more than the total number of PMS in the hot pool, or (1 k NH with) k equally considered available if the cloud service.

Measures	***Reward rates***
Mean number of PMs in the hot pool $(E[\#P_h])$	$\#P_h$
Mean number of PMs in the warm pool $(E[\#P_h])$	$\#P_w$
Mean number of PMs in the cold pool $(E[\#P_c])$	$\#P_c$
Accessibility of cloud service(A)	$1\ if\ \#P_h \ge k;\ 0\quad o/w$
Probability to have at least one PM in warm pool (P_w)	$1\ if\ \#P_w \ge k;\ 0\quad o/w$
Probability to have at least one PM in cold pool (P_c)	$1\ if\ \#P_c \ge k;\ 0\quad o/w$

TABLE 4: Reward Rates to Compute Different Output Measures from Monolithic SRN Model

D. Repair Module

They represent a large variety of clouds can be solved for our models in a wide range of parameter values. However, some interesting results we report in this paper. MTTF 100-500 hours may be in the range of PMS is not hot, warm MTTF 500-2,500 hours of PMS should be in the range of 300- 1,750 hours, and cool to be in the range of PMS MTTF. The repair process may vary depending on the type of a PM's MTTR:

(i) The software is based on the fully automated repair (1-30 minutes),

(ii) completely manual repair (1- 5 days) and

(iii) a combination of manual and automated repair (1-12 hours). Are assumed to vary between a PM's MTTMs 10-60 minutes. 0 GHz CPU and 4 GB memory: All models have 3 can be solved by using a desktop PC. Thus, the reported figures relative to the machine, but we believe that similar trends are also using other computers.

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