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Virtual Host Dynamic Cooperative Transfer Mechanism Based on Service Driven and Content Aware for Cloud Computing

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Abstract. *According to virtual host dynamic migration efficiency and quality of service support capability, the mechanism of the dynamic cooperation of virtual host transport service driven and content aware cloud computing was studied for Cloud Computing. First, with the research of the bottleneck problem between host populations, data center and service in all service quality decline, through the base to establish a set of services and host a bidirectional link channel model, the service drive system model was created. Secondly, in view of the two-dimensional matrix of the host group, with host migration content transmission probability and idle time slot as the optimization objective, the content aware cloud computing the dynamic cooperation of virtual host migration was researched. Finally, the virtual host dynamic cooperative transfer mechanism is proposed for cloud computing and content aware cloud computing. Experimental results show that the proposed mechanism in the content throughput, service delay, host transfer efficiency and service quality more excellent than POST-COPY mechanism.*
Keywords: Virtual host dynamic; Cooperation; Service driven; Content aware; Cloud computing.

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1. **Introduction.** In cloud computing system, the progress of virtual host dynamic transfer and the randomness of service content brings many challenges. A method to identify the workload cycles of a VM and based on that information it can postpone or, in some situations (Artur Baruchi *et al*, 2015). A hybrid approach that combines offline and online scheduling was proposed (Banerjee A. *et al.*, 2008). The maximum achievable UDP data transfer throughput was measured (Bortolotti D. *et al.*, 2011) the frame rate and the CPU loads of the sender/receiver processes and of the interrupt handlers as a function of the datagram size. An alternative remote direct memory access-based migration technique was propose significantly which reduces VM migration overheads. An analytical model (Moradi M. *et al.*, 2013) was presented and validated by finite element method simulation, to provide insight and accurate formulation for strain transfer mechanism for bonded sensors. A method for accelerating content usage control information transfer (Masue T. *et al.*, 2011) was presented between a host device and a storage device. Shuttle was proposed (Shan Zhiyong, *et al.*, 2014) means that a novel approach for facilitating inter-application interactions within and across OS-level virtual machines. A novel parallel simulation technique (Yun Dukyoung, *et al.*, 2012) was proposed, which performs time synchronization with the simulation backplane on behalf of the associated component simulator itself. Liquid was proposed (Zhao Xun, *et al.*, 2014) means that a

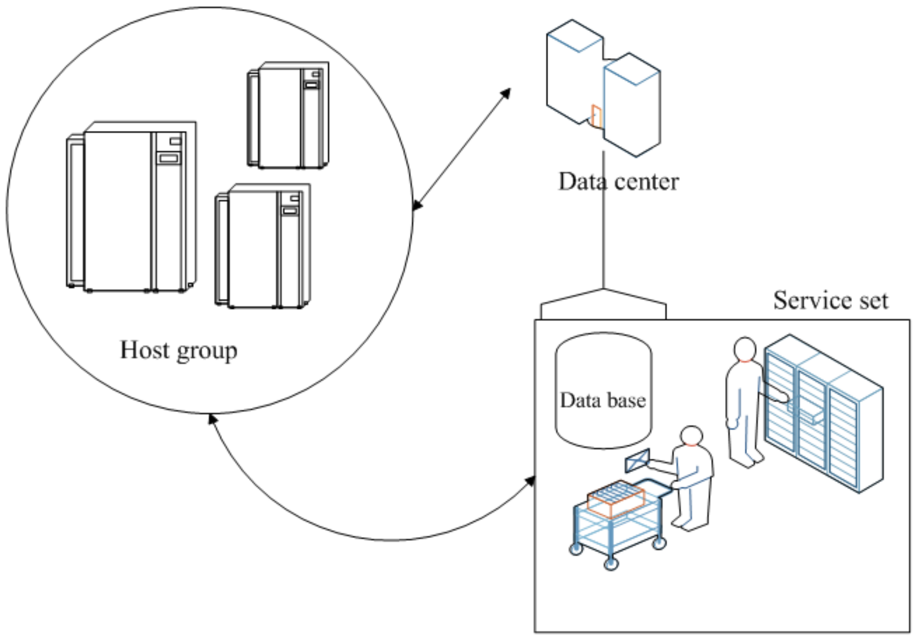

Figure 1. Relationship between host and service

scalable deduplication file system that has been particularly designed for large-scale VM deployment. A solution based on lightweight virtualization technologies was presented (Zhang Youhui, *et al.*, 2010) which can convert the enormous existing desktop software into on-demand software across the Internet without any modification of source code.

Our main work is as follows: (1) the service drive system model was created with the research of the bottleneck problem between host populations, data center and service, (2) he content aware cloud computing the dynamic cooperation of virtual host migration was researched, (3) he virtual host dynamic cooperative transfer mechanism is proposed for cloud computing and content aware cloud computing.

The rest of the paper is organized as follows. In Section 2, service driven model for cloud computing is summarized briefly. In Section 3, the proposed content arware virtual host dynamic cooperaive transfer mechanism is described. In Section 4, experiments are presented and the results are discussed. Finally, a conclusion is provided in Section 5.

2. **Driven model for cloud computing.** In cloud computing, how to provide services for users is the main object of host deployment and calculation. The structure and relationship of the cloud system is given by Figure 1. The service mode is shown as Figure 2. The host group provide various services protection through the data center for service collection. The service can establish the bidirectional link relationship directly with the host group. Channel model is given by formula (1) and (2).

$$H_S = \sqrt{P_S Q_B} h_a + \eta \tag{1}$$

Here, let H_S denote the sending signal from host. Let P_S denote the host transmit module power. We assume that each host in the host group has the same value of P_S facing to all the same services. Let Q_S denote the distance from host to data center and h_a denote the channel fading coefficient between the host and service set. The mean value of h_a is 0. The mean square deviation obeys Poisson distribution. η is the Gauss white noise figure, which has the complex Gauss random feature.

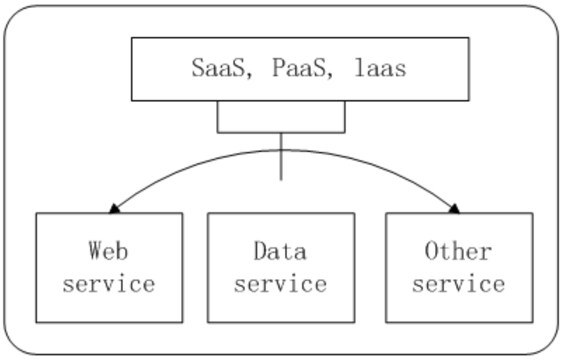

FIGURE 2. Service model

$$S_S{}^e = \sqrt{P_e Q_e{}^{L(S)}} h_e + \eta_e \tag{2}$$

Where, let H_S denote the service set received signal from the host group. Let P_e denote the service set receiving power. Let $Q_e{}^{L(S)}$ denote the service set distance of L(S). Let h_e denote the two-way link channel interference factor. Let η_e denote channel Gauss noise jamming intensity.

Assume that three known quantity which are K_X, K_N and K_E. The random variable $K_E\{e = 1, \cdots, E\}$ expresses the service set. The random variable $K_X\{x = 1, \cdots, X\}$ expresses the data set of data center. The random variable $K_N\{n = 1, \cdots, N\}$ denote the host matrix in host group.

$$\begin{cases} E\{K_E, K_X\} = \int_0^{+\infty} \varphi(K_E, K_X)dx \\ \varphi(t) = \frac{|h_e|\lambda}{D_{(s,d)}} t \end{cases} \tag{3}$$

Here, let $D_{(s,d)}$ denote the communication distance between the sending end and receiving end. Function $\varphi(t)$ is used to consider the relay forwarding network communication loss. Service encapsulation process is illustrated by formula (4). Where, the service was encapsulated based on the probability density function of cloud X and random variable $K_X\{x = 1, \cdots, X\}$.

$$f(x) = \int_t^T f(E\{K_E, K_X\} \,|\varphi(t))d\mu = \int_{-\infty}^{+\infty} \frac{1}{\sqrt{\phi\mu^2}} e^{[-\frac{(\mu - K_N)}{2K_E}]} \tag{4}$$

Here, $\frac{1}{\sqrt{\phi\mu^2}}$ is the service drive coefficient. Service driven process is equivalent to the progress from $t \to T$ to $-\infty \to +\infty$.

3. **Content aware virtual host dynamic cooperative transfer mechanism.** The host group is deployed as a planar matrix, which is defined as $M_H(M_{HO}, M_{LO})$. Let M_{HO} and M_{LO} denote the host number of horizontal and longitudinal ownership of providing service. Assume that and denote the state of host group with different content. Hence, the number of horizontal and longitudinal active hosts are given by formula (5) and (6).

$$M_{HO} = \sqrt{M_{HO}{}^1 M_{HO}{}^2} + m_H{}^1 + m_H{}^2 - \sqrt{M_{LO}{}^1 M_{LO}{}^2} \tag{5}$$

$$M_{LO} = \sqrt{M_{LO}{}^1 M_{LO}{}^2} + m_H{}^1 + m_H{}^2 - \sqrt{M_{HO}{}^1 M_{HO}{}^2} \tag{6}$$

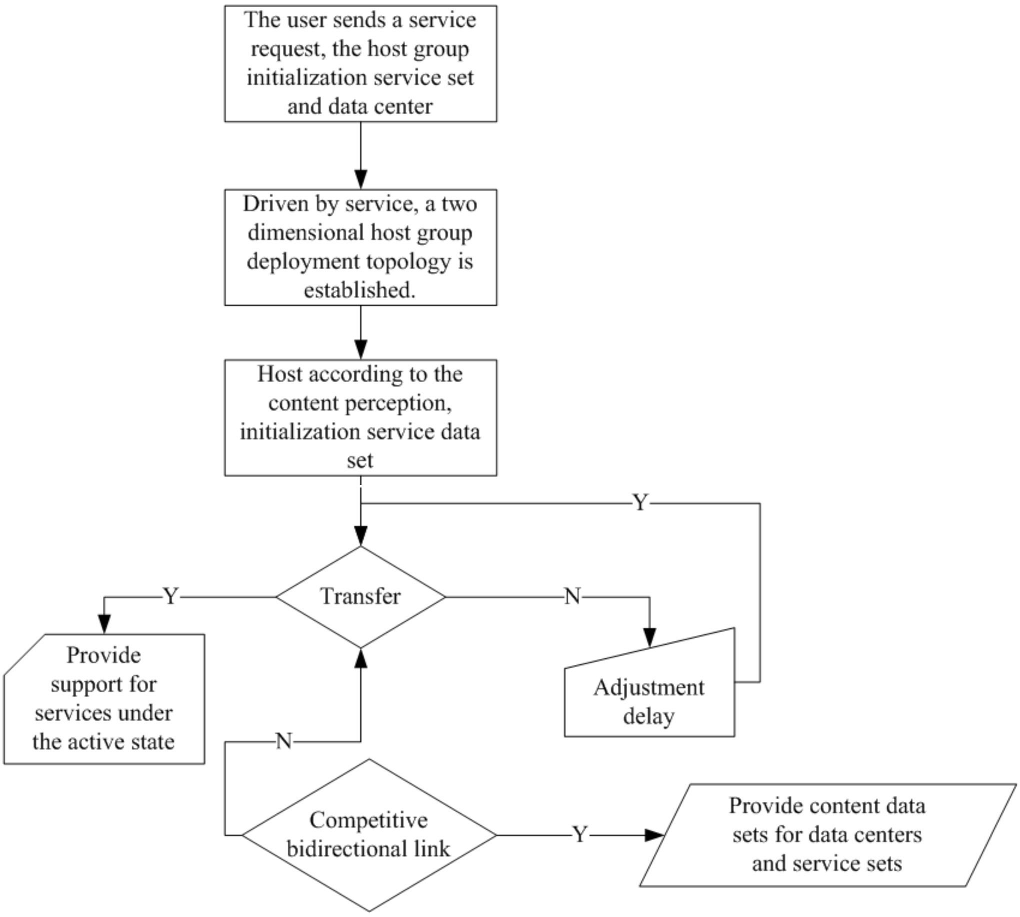

FIGURE 3. Progress of content awareness process and service drive

Here, denote the number of migrating hosts with different content state in host group. Under ${m_H}^1$ station, all the hosts are independent and have no competition status. Host transfer probability P_{Transfer} is defined by status transfer of horizontal and longitudinal active hosts, which could be obtained by formula (7).

$$\begin{cases} P_{\text{Transfer}}\left({m_H}^i\right) =_i^M \left|\varphi(t)\gamma^{M_H - M_{Id}}\right. \\ \varphi(t) = \begin{cases} 1, t < TH_t \\ 0, t \geq TH_t \end{cases} \\ i = -2, -1, 0, 1, \cdots, M \end{cases} \tag{7}$$

Here, function $\varphi(t)$ denote the content occupancy bidirectional link coefficient. It is 1 means that the link has been occupied. It is 0 means that the link has been released. The value is defined by the delay of content data transmission. Let TH_t denote the threshold of releasing the bidirectional link. Parameter i is the serial number of hosts. When it is -2, -1 or 0, local host is finding the content data.

When idle slot $\varphi(t)$ is 0, host dynamic migration was dealing for avoiding competing for limited channel resources. So, the bidirectional link provides services for the content driven active state host. When host state transfer and migration is successful, the probability of successfully occupying a bidirectional link P_{Occupy} is given by formula (8).

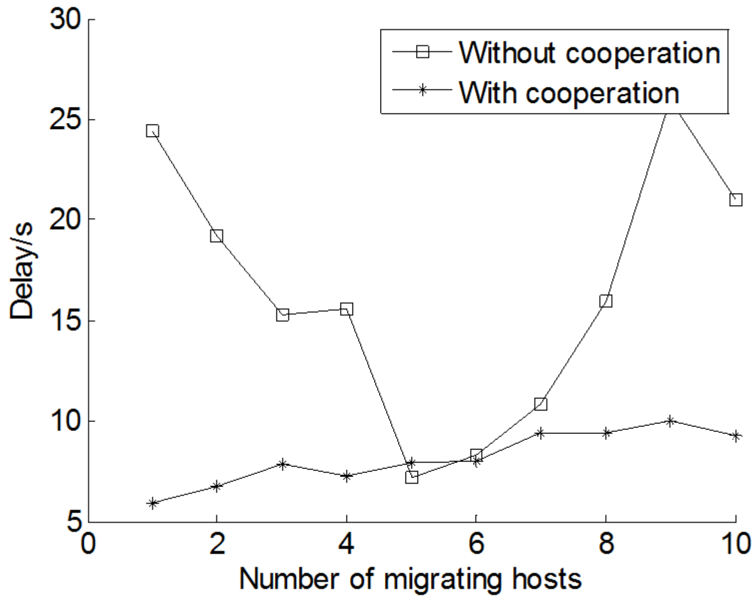

FIGURE 4. Delay of Host dynamic migration

$$\begin{cases} P_{\text{Occupy}}\left(m_H{}^i\right) = \frac{P_{\text{Transfer}}}{P_{\text{Migration}}} \sum\limits_{i=-2}^{M} \gamma^{\sqrt{M_{HO}{}^i + M_{LO}{}^i}} \\ \gamma = \begin{cases} 1, P_{\text{Transfer}} < \sqrt{P_{\text{Transfer}} + P_{\text{Migration}}} \\ 0, P_{\text{Transfer}} \geq \sqrt{P_{\text{Transfer}} + P_{\text{Migration}_t}} \end{cases} \\ \quad i = -2, -1, 0, 1, \cdots, M \end{cases} \tag{8}$$

Where, let γ denote the content aware weight coefficient, which is defined by transfer intensity. Progress of content awareness process and service drive is illustrated by Fig. 3, which is given as follows:

(1) The user sends a service request, the host group initialization service set and data center.
(2) Driven by service, a two dimensional host group deployment topology is established.
(3) Host according to the content perception, initialization service data set.
(4) If transfer is successful, go to step (5). If not, go to step (6).
(5) To provide support for services under the active state, the competitive bidirectional link. If successful, go to step (7). If not, go to step (4).
(6) According to formula (8), adjusting the delay and going to step (4).
(7) Provide content data sets for data centers and service sets.

As shown in Fig.3, the cooperation with host dynamic migration would consider the idle slot and bidirectional link deeply, which could obtain the channel gain and time domain gain shown as formula (9). The analysis results of host dynamic migration delay of without cooperation and with cooperation are shown in Figure 4. We found that the delay jitter and the delay caused by the transfer of the host are not only smooth and delay.

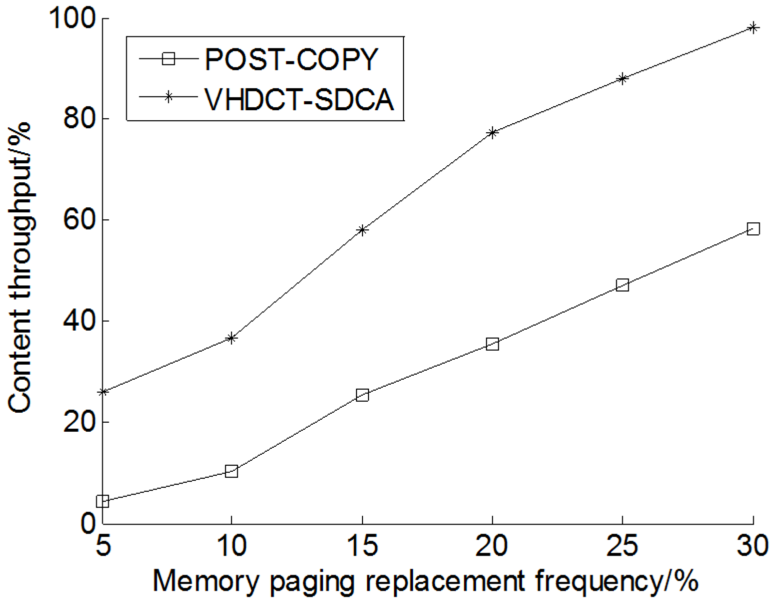

FIGURE 5. Content throughput

$$\begin{cases} S_{\text{CO\_H}}\left(\begin{matrix}\max(M_{HO}, M_{LO}) \\ i\end{matrix} |{m_H}^i\right) = \prod_{k=0}^{K_{CO}} \sum_{i=-2}^{M} \sqrt{P_{CO}{Q_{CO}}^{L(S)}}h_{CO} + \eta_{CO} \\ T_{Gain} = \begin{cases} 0, \max(M_{HO}, M_{LO}) < \sqrt{M_{HO} + M_{LO}} \\ 1, \max(M_{HO}, M_{LO}) \geq \sqrt{M_{HO} + M_{LO}} \end{cases} \\ CH_{Gain} = \begin{cases} 0, P_{\text{utilization}} < P_{\text{Occupy}} \\ 1, P_{\text{utilization}} \geq P_{\text{Occupy}} \end{cases} \\ i = -2, -1, 0, 1, \cdots, M \end{cases} \quad (9)$$

4. **Computational results and comparisons.** For evaluating the performance of virtual host dynamic cooperative transfer mechanism based on Service driven and content aware for cloud computing (VHDCT-SDCA), we selected three different type of hosts for host group. Then, the performance of VHDCT-SDCA and POST-COPY were evaluated and studied from content throughput, service delay, host transfer efficiency and service quality.

In experiment 1, we changed the memory paging replacement frequency and used benchmark test case. Host content select HD video and service type based video transcoding. The client waiting for service delay analyzed by the failure rate of the page. At the same time, the effect of CPU occupancy rate and network load changes on the system performance are considered, and the results are shown in Figure 5 and 6, as well as parameter settings as shown in Table 1.

In experiment 2, the host transfer efficiency was studied with network load. We choose the same CPU settings in the hosts of host group, which as shown in Table 2. Fig. 7 shows the host transfer efficiency with network load and Fig.8 gives the service quality SP with SNR which could be defined as formula (10).

$$S_P = \frac{SNR\left|\sum_{i=1}^{M} \varphi(i)\gamma^{M_H - M_{Id}}\right.}{S_{Tatal}}\rho \quad (10)$$

Table 1. Parameters settings of experiment 1

Parameter	**Range**	**Parameter**	**Value**
Number of idel slot	[1,10]	Delay threshold	13
Delay	[5,25]	Channel loss	3
Memory paging replacement frequency	[5%,30%]	Host number	20
CPU occupancy rate	[10%,50%]	Transfer probability threshold	36%
Network load	[10%,50%]	Allowable competitive probability	45%

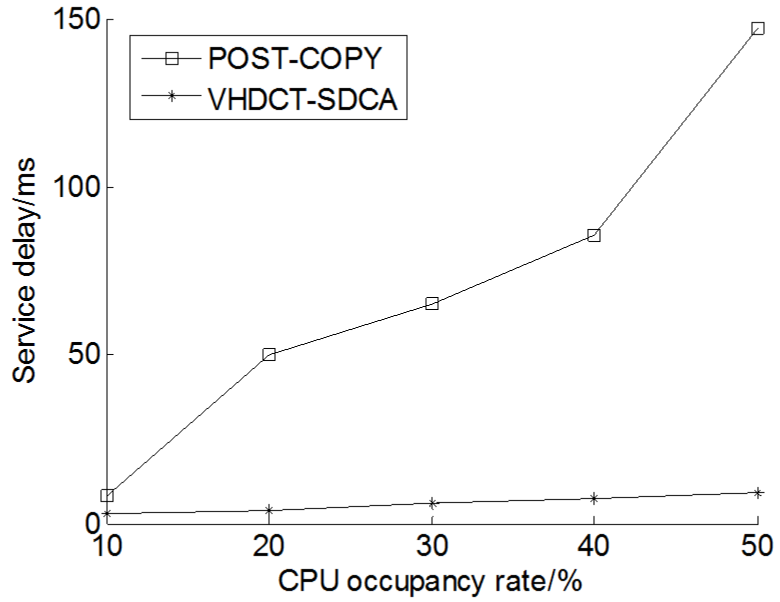

Figure 6. Service delay

Table 2. Parameters settings of CPU

Parameter	**Value**	**Parameter**	**Value**
DDR RAM	4GB	Main frequency	2.5GHz
Network interface	1Gbps	Storage space	1T
Operating system	Linux	Kernel	2.4.20
IO protocol	iSCSI	Number of migration	10
Network load	[10%,50%]	Allowable competitive probability	45%

Here, ρ is the service quality subjective evaluation coefficient.

The host transfer efficiency and service quality of VHDCT-SDCA is superior to one of POST-COPY, which has been proved by Fig.7 and 8. The improvement of these properties mainly benefits from service driven and content aware for cloud computing.

5. **Conclusion.** In this paper, For improving the dynamic transfer efficiency and service quality assurance capability of the host in cloud computing, we proposed the virtual host dynamic cooperative transfer mechanism based on service driven and content aware for cloud computing. First, based on the analysis result of performance bottleneck of

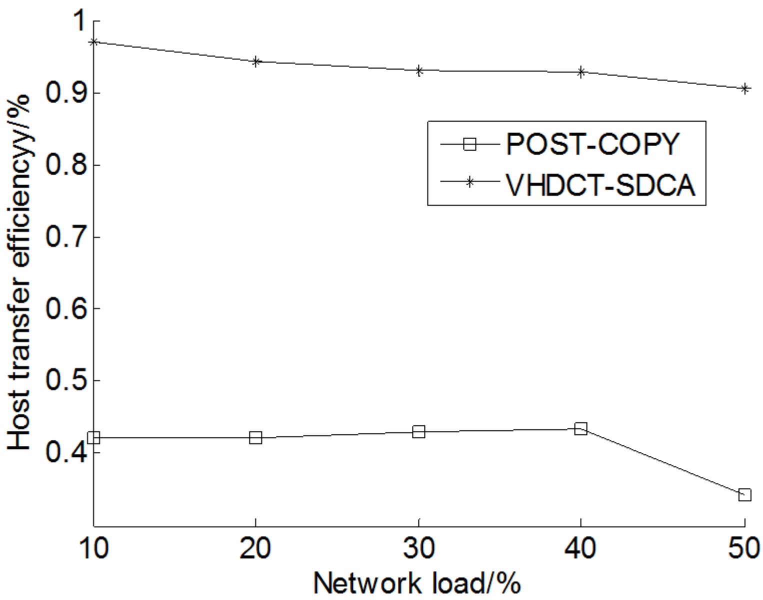

Figure 7. Host transfer efficiency

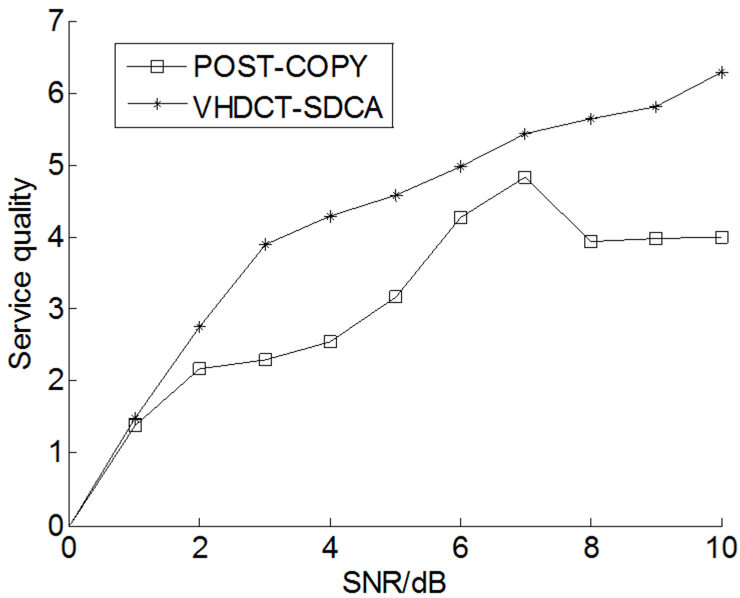

Figure 8. Service quality

providing support for the service through the data center of various services in host group, a bidirectional link between service set and host group is built up channel model and thus the service drive system model is obtained. Second, with the host group is deployed as a planar matrix, combining the content transmission efficiency of the host transfer probability and the free time slot, the virtual host dynamic cooperative transfer in the content aware cloud computing is proposed. Finally, the virtual host dynamic cooperative transfer mechanism based on service driven and content aware for cloud computing was proposed. Experimental results show that the proposed mechanism has high Content throughput, small service delay, high Host transfer efficiency and service quality, compared with the POST-COPY mechanism.

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