Implementation of Cloud Computing Based on Infrastructure as a Service (IaaS) to Improve Transaction Quality (Case Study Shop of Central Mart Pekanbaru)

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Article Info	ABSTRACT
	An virtually infinite number of connected information and communication technology (ICT) resources can be found using a method known as cloud computing. Customers can use these resources on-demand over a network in the form of a public IP because both infrastructure and applications are fully owned and managed by third parties.To enhance staff performance and services in the context of transactions made by parties engaged in the buying and selling industry, a computer-based system is required, particularly for cashiers who handle customer payment transactions. There are still a lot of cashier programs available today that can only be accessed via a device linked to the same network or over the local network.In order to facilitate transactions and enable remote control, this research makes use of cloud computing technology that employs Infrastructure as a Service (IaaS) offerings. IaaS is a service that "rents" out fundamental information technology resources, such as storage space, computing power, memory, operating systems, network capacity, and others, so that customers can use them to execute their applications.Azure gives developers access to tools like Visual Studio and the ability to construct applications in a variety of languages, including.NET, Java, and Node.js. Because businesses don't have to worry about the expense of server equipment, implementing cloud computing can make it simpler for them to manage their business apps and finances. The ability for store administrators to use this program remotely (online) may then be aided or made simpler by this IaaS solution.

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1. Introduction

The advancement of science and technology is currently accelerating quickly, and many connected areas are doing the same [1]. Particularly in the modern era of communication, computers with both software and hardware components play a crucial role in assisting the development process [2]. As a result, many organizations or businesses are attempting to replace their manual transaction system with a digital one [3]. Cloud computing is a type of computer technology that uses the internet as its primary terminal to administer infrastructure and software as a service [4]. According to the National Institute of Standards and Technology

(NIST) cloud computing is an information technology model that is easy to use, can be accessed anywhere with computing resources that are quickly released with minimal effort on the part of management [5] [6].

The cashier is an important aspect in terms of transactions carried out by the buying and selling business parties [7]. To improve performance, a computer-based system is needed to improve the performance of employees and services, especially cashiers who serve customer payment transactions [8]. [9]. In the cashier service, many manual transaction errors are caused by the absence of a system that can help cashiers complete transactions [10]. Currently, there are still many cashier applications that are accessed using the local network or can only be accessed through devices connected to the same network. The weakness of this local network system is that business actors must provide a device that becomes a server for storing transaction data for the cashier application [11]. This is, of course, very risky for data loss if the server device is damaged or even a physical loss of the device occurs. In addition, transaction reports cannot be monitored online if you are still using a local network. The cloud computing technology that is used with the services that are applied to this system is the Infrastructure as a Service (IaaS) service.

IaaS (Infrastructure as a Service) is a service that "rents out" basic information technology resources, which include storage media, processing power, memory, operating systems, network capacity, and others, which can be used by users to run their applications. [12] [13]. Some of the advantages of IaaS are reduced capital costs because, with this service, there is no need to incur additional costs [6] to buy new computers or server equipment. The use of IaaS allows business actors to make adaptations in the form of increasing or decreasing resources quickly under certain conditions [14], [15]

IaaS implementation has been carried out by previous researchers, such as [16], using the owncloud platform as a private cloud type and Nextcloud as a public cloud type to build hybrid cloud storage utilizing infrastructure as a service services to add storage capacity and not require extra costs. By applying the benefits of infrastructure as a service, we get 39% memory and CPU usage when uploading 3 data files measuring 300MB, 500MB, and 1024MB with 3 clients almost simultaneously. Another study [17] produced a cloud computing application for web-based server service providers using the Proxmox VE hypervisor with the IAAS service model.Based on some of these studies, this research will apply cloud computing-based technology to the cashier application system to improve transaction quality. So that the transaction process becomes better and more efficient.

2. Research Method

The research stages will discuss the flow of the methodology that will be carried out by researchers for implementing cloud computing in cashier applications to improve service quality. The following is the flow of the researchers as follows:
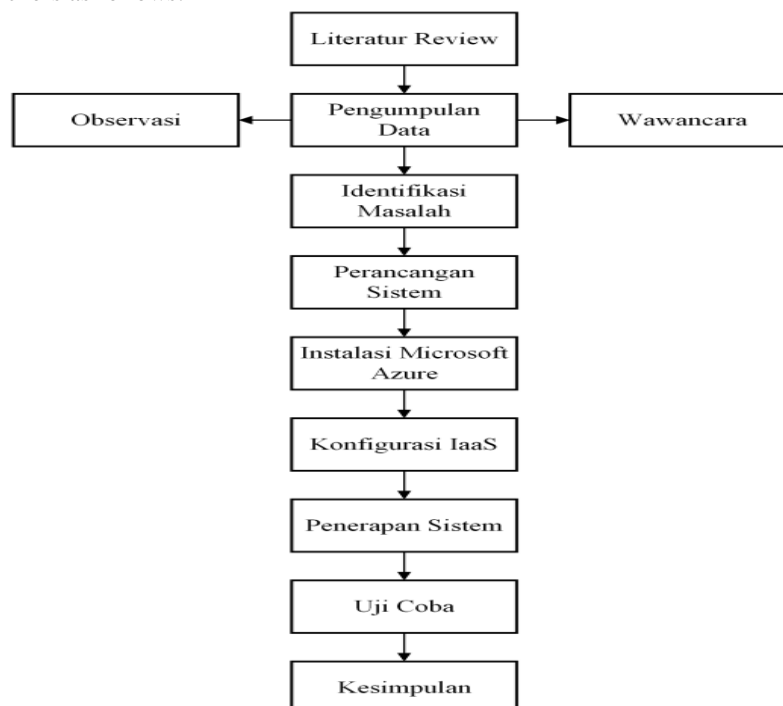

Figure 1. Research methodology

2.1. Literature Review

The literature review is the initial step in the research process and serves as the basis for preparing a research report [18]. The literature review in this study covers descriptions of IaaS-based cloud computing and other research materials gathered from reference materials to serve as the basis for activities in the research done. In the literature review, this study also incorporates reviews, summaries, and the author's thoughts on the different sources of literature used, such as articles, books, slides, information from the internet, etc., on the themes mentioned.

2.2. Identification of problems

The problem analysis is known from the results of the preceding literature review, which is the reference for researchers. References that appear will be investigated to determine ways to implement and complete them. Based on the results that became a reference from the literature review, it can be stated that the problem that has been found in this study is related to the deployment of cloud computing to improve services in the cashier application. The problems found are that currently there are still many cashier applications that are accessed using the local network or can only be accessed through devices connected to the same network. The weakness of this local network system is that business actors must provide a device that becomes a server for storing transaction data for the cashier application. This is of course very risky for data loss if the server device is damaged or even a physical loss of the device occurs. In addition, transaction reports cannot be monitored online if you are still using a local network. Figure2 is the schematic of the checkout.
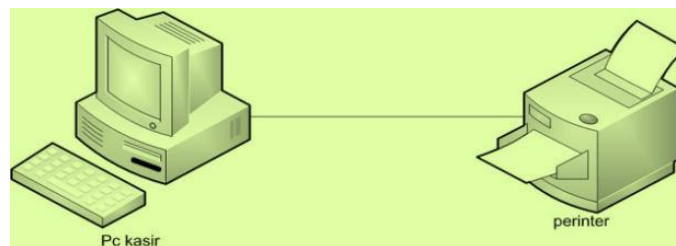

Figure 1. local network cashier

2.3. Data collection

Based on the necessity for data collection, it is carried out to get the information needed to meet research objectives [19]. The aim given in the form of a hypothesis is a temporary answer to the research question. This response still needs to be tested, and it is for this goal that data collection is essential. The data was obtained from a preset sample. The sample consists of a set of analysis units as research goals. In this study, interviews will be conducted following interview criteria. The data collection approach is carried out by conducting direct interviews with the leaders or shop owners to discuss the problem of the transaction system that is utilized in connection with the subject under study and gather objective data.The data collection carried out in this investigation was employing

- Observation
  Direct observation or observation of the store directly by looking at the current system.
- Interview
  interviews were done to find out the difficulties that arise in present systems or even do not exist at all. Observations were made by asking many questions that were posed directly by store owners in the Pekanbaru neighborhood. The points asked during the interview.

2.4. Design

The next stage is design, where modeling activities are carried out, starting from system modeling and architectural modeling to database modeling. System and architectural modeling uses Unified Modeling Language (UML) diagrams, which consist of use case diagrams, sequence diagrams, and so on [20]. This study uses use cases to design this system. The use case is a model for the behavior of information systems that will be made [21]. Use cases describe an interaction between one or more actors and the information system to be created [22]. This diagram is important for organizing and modeling the behavior of a system that is needed and expected by users [23]. Use Case Diagram describes the function, and the needs of the user's perspective [24].

2.4.1. Use case diagrams

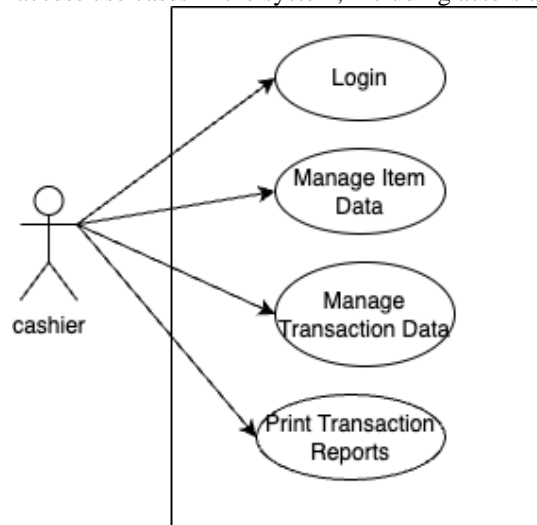There are actors who can access use cases in the system, including actors as users.

Figure 3. *Use case diagrams*

Table 1 is a description of Figure3.

Table 1. Description of the use case diagram

Actor	Explanation
Cashier	Can login to the application
	Can manage goods data on the website
	Can make sales transactions

2.5. Network topology and system network architecture

Figure 4 is the IaaS infrastructure used in this study..
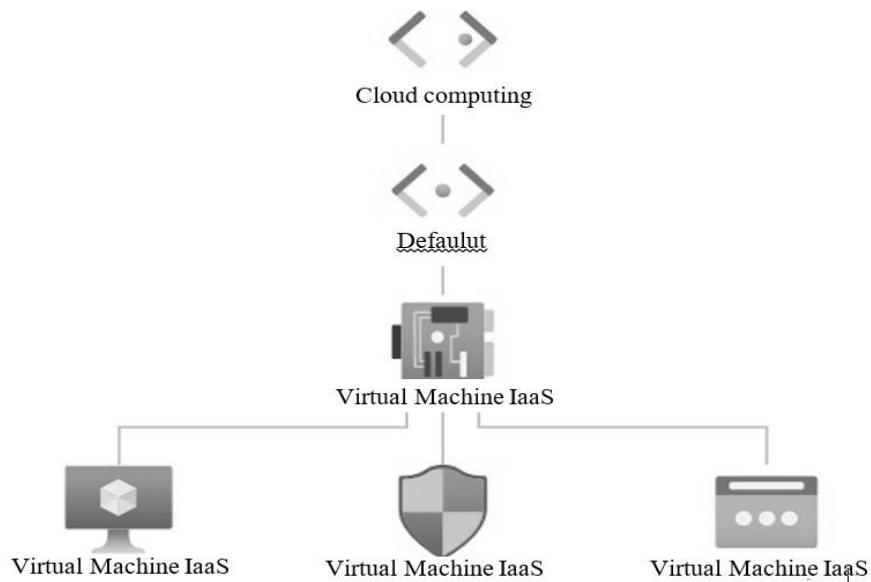

Figure 4. IaaS infrastructure

The design of the new system to be built can be explained as follows:

1. The process of creating a virtual machine through Cloud computing through Azure IaaS

2. The installation and administration processes are carried out automatically by the service provider, in this case, Azure IaaS.
3. Virtual Machines that have been successfully built via IaaS are also equipped with security features, and their IP addresses have been determined (private IP and public IP).
4. The client only needs to set up the web server and applications on the operating system of the IaaS virtual machine that has been built.

Application of cloud computing to cashiers using Microsoft Azure. The first stage of this research is to install and configure IaaS. Then implement the cashier system and conduct trials.

3. Result and Discussion

3.1. IaaS installation
The details of the IaaS system that has been built are as follows:
Virtual Machines

Computer name	: KASIR
Operating system Windows	: **Windows Server 2019 Datacenter**
Publisher	: MicrosoftWindowsServer
Offer	: WindowsServer
Plan	: 2019-datacenter-gensecond
VM	: generation V2
Agent status	: Ready
Agent version	: 2.7.41491.1057

Networking

Public IP address	: **23.101.52.19**
Public IP address (IPv6)	: -
Private IP address	: 10.0.0.4
Private IP address (IPv6)	: -
Virtual network/subnet	: SKRIPSI-vnet/default
DNS name	: Configure

Apart from Network in Total, you can also monitor Network Out Total, which is useful to see the total outgoing connections from the virtual machine being built.
Size

Size	: Standard D4as v4
vCPUs	: 4
RAM	: 16 GiB

Disk

OS disk	: KASIR_OsDisk_1_56dbfc2b6898409794a00ea40d4ed8f5
Encryption at host	: Disabled
Azure disk encryption	: Not enabled
Ephemeral OS disk	: N/A
Data disks	: 0
Disk size	: 127GB
Disk sku	: Premium SSD LRS

An overview of the built-in disk or storage virtual machine can be seen in the following figure:
Security type
Security type   : Standard

The security network on the built virtual machine describes the Inbound Security Rules and Outbound Security Rules. The appearance can be seen in Figure 8.

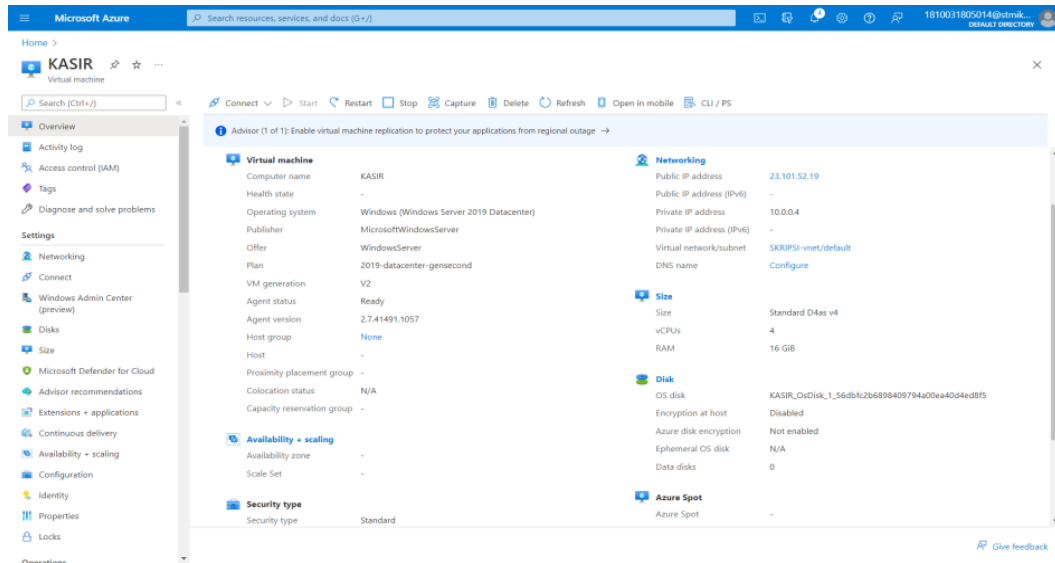The IaaS overview page display can be seen in Figure 5 below:

Figure 5. Overview IaaS

3.2. System Testing

The final stage of this research is testing the system that has been designed and built. The hardware specifications used can be seen in Table 4.1 below:

Table 2. Testing Hardware

No.	Device Name	Specifications	Amount	Usability
1	Laptop	OS: Windows 10 Pro 64 Processor: 11th Gen Intel(R) Core (TM) i7-1165G7 @ 2.80GHz (8 CPUs), ~2.8GHz Memory: 16384MB RAM Storage: 1 TB SSD	1	Shop Admin page test laptop
2	Laptop	OS: Windows 10 Home 64 Processor: Intel i3-1005G1 Memory: 8 GB RAM Storage: 250 GB SSD	1	Shop Cashier page tester laptop
3	Smartphone	OS: Android Versi 8.1 Memory: 4 GB RAM	1	Smartphone Client Tester

The software used can be seen in Table 3 below:

Table 3. Software used

No.	Device Name	Description	Amount
1.	Azure IaaS	Cloud Computing service provider	1
2.	Windows Server 2019 Datacenter	The operating system used on IaaS	1
3.	Apache	Web Server installed in the IaaS virtual machine as a place to store application files	1
4.	MySQL	DBMS is used in IaaS virtual machines as database storage.	1
5.	Windows 10	The operating system used on the test device	2
6.	Android	The mobile device used in the test device	1

3.2.1. Laptop Equipment 1

This device is simulated as a device used by cashier 1 with the device IP address **192.168.100.96**. The IP address can change depending on the connection used. But when testing is done, the device gets the IP as above.
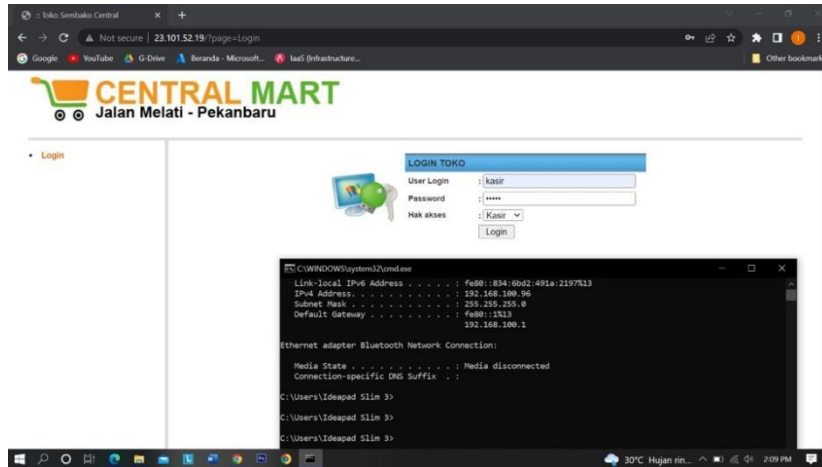

Figure 6. Application Login Page on Device 1 (Cashier)

3.2.2. Testing on Laptop 2 Devices (As Store Admin)

This device is simulated as a device used by the admin with the device IP address **192.168.100.94**. The IP address can change depending on the connection used. But when testing is done, the device gets the IP as above.
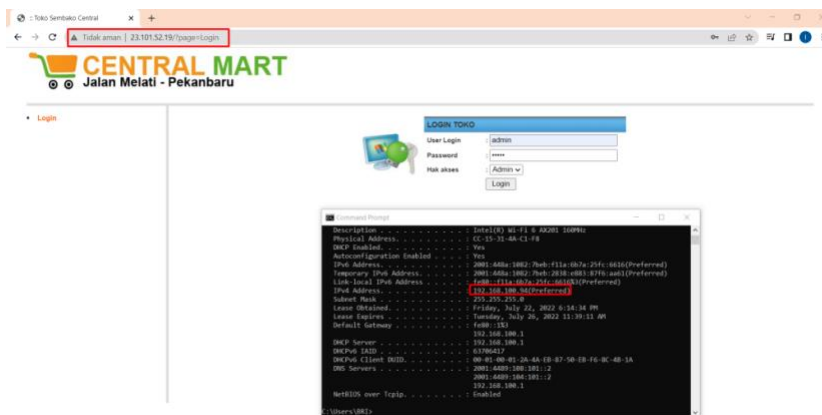

Figure7. Login Page on Device 2 (As Admin)

1. View the Admin page.
   After the admin has successfully logged in, the page will display as shown in Figure below:
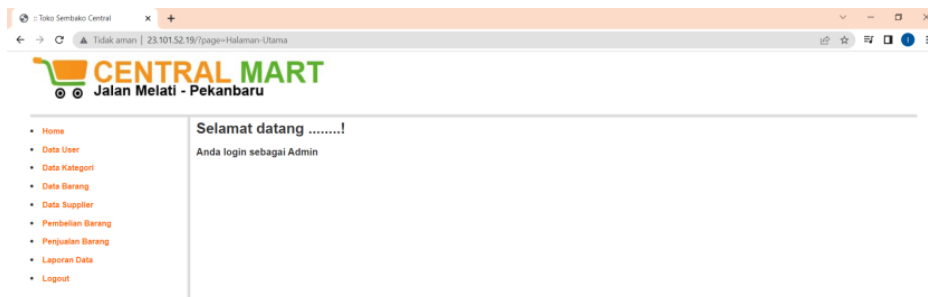

Figure 8. Admin Page view

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2. User data page display
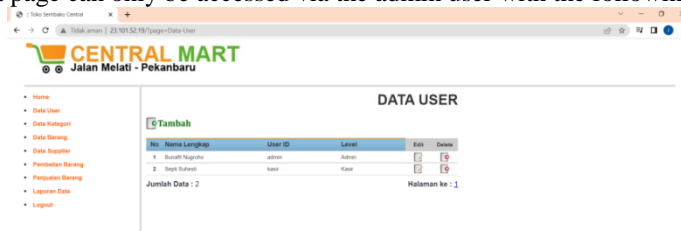   The user data page can only be accessed via the admin user with the following display:

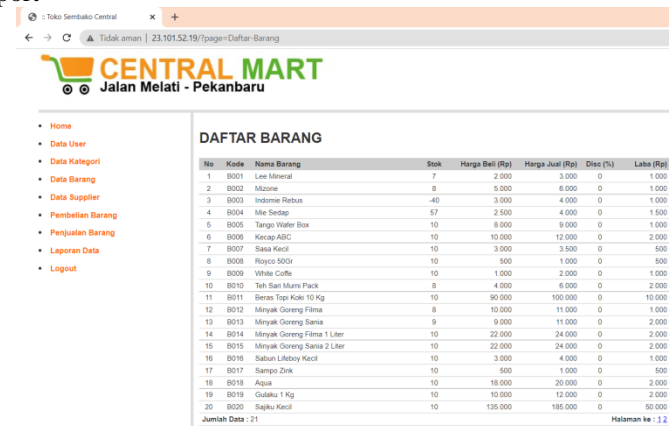Figure 9. User Data page.

3. Goods list report

Figure 10. Goods List Report.

4. Purchase Transaction List Report

Figure11. Purchase list report

5. Purchase details report

Figure12. Purchase details report

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6. Sales List Report

Figure13. Sales List Report

3.2.3. Testing on Smartphone Devices (As Store Admin)
  1. Display of the start page when accessed via a smartphone

Figure14. The start page when accessed via a smartphone

  2. Display page after successful login via smartphone

Figure15. smartphone page after successful login via smartphone

3.3. Discussion

1. *Azure Infrastructure as a Service (IaaS)*
    Azure Infrastructure as a Service (IaaS) is a cloud-based service that offers many advantages, including a free version available for students and a strong level of security [25]. Azure allows developers to build applications in their choice of languages, including.NET, Java, and Node.js, and then gives them access to tools such as Visual Studio. This allows developers to stay productive while concentrating on the coding rather than managing it. The following is a Figure showing the Azure IaaS homepage.
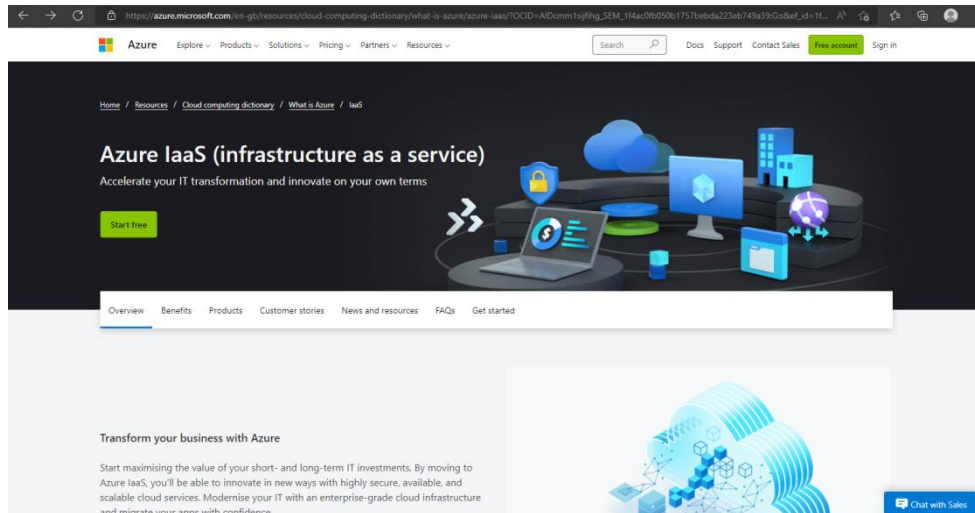
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Figure 16 Home Page Azure IaaS

2. *Web Server dan Database Management System (DBMS)*
        The web server that I use is Apache because this web server software is free and open-source which allows users to upload websites on the internet. Meanwhile, the DBMS used is MySQL because apart from being open source, MySQL is also a database server that is free with the GNU General Public License (GPL) so that it can be used for personal or commercial purposes without having to pay for the existing license.
        Based on the results of implementing the new system, researchers will conduct interviews with the owner of the Central Mart Store, Mr. Musaat Zaki, on July 28 2022 at Jl Melati - Pekanbaru. The following is a list of questions and answers from the sources:

1. How do you respond after the cashier system can be accessed online?
    Answer: I don't have to worry about my data being lost if the computer equipment in my shop is damaged or lost.
2. What convenience do you get after the cashier application is online, right?
    Answer: The application makes it easy for me to access via my cellphone even when I'm outside the store.
3. DWhat results do you see after this system is made online?
    Answer: The transaction monitoring process is easier and faster. So that I can quickly find out the stock of goods and my store's financial reports.
4. After going online, how easy is it for you to improve the quality of transactions?
    Jawaban: Dengan mudahnya saya dalam mengontrol stok secara online, saya dapat segera memenuhhi stok barang yang akan habis sebelum barang tersebut kosong.
5. What changes have you encountered in storing data using the cloud?
    Answer: Previously, all transaction data was on the same device as my application, now the device in my store only functions as a device to run the application.

From the description of the interview above, it can be concluded that applications using cloud computing can make it easier for businesses to manage their business applications and finances because they do not need to think about the cost of server equipment. In addition, the application can be accessed online which makes it easier for businesses to monitor their store stock.

4.   Conclusion
        Based on the results described in the previous chapter, several conclusions can be drawn, as follows:
1. Azure IaaS can be an option for building cloud computing because it has been proven to be easy to use and powerful.
2. Existing public IP addresses can be accessed using the internet without any significant obstacles.

3. With this IaaS service, it can help or make it easier for store admins to access this application remotely (online).

For the improvement and development of the application system that the author has built, the author suggests that this research has several suggestions that can be used as a basis for future research, such as:

1. Subsequent research is to provide additional domains on IaaS public IPs to make it easier for users to remember when they are accessed.
2. ncrease the type of service used so that you can determine the public IP that will be used for IaaS access yourself.
3. To increase security, it is necessary to install SSL Source Socket Layer on the domain or public IP.

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