

PROFESSIONAL TRAINING REPORT
Sathyabama Institute of Science and Technology
(Deemed to be University)

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Information Technology

By

DEEPAK S

REG.NO 40120025



DEPARTMENT OF INFORMATION TECHNOLOGY
SCHOOL OF COMPUTING

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI, TAMILNADU-600119

APRIL 2023



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(Established under Section 3 of UGC Act, 1956)
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SCHOOL OF COMPUTING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **DEEPAK S (Reg.No: 40120025)** who carried out the project entitled "**ENABLE BILLING SYSTEM IN OPENSTACK CLOUD**" under my supervision from January 2023 to April 2023.

V. Nirmalrani
28/04/2023
Internal Guide

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for R Subhashini
Head of the Department
Dr.R.Subhashini, M.E., Ph.D.,

Submitted for Viva voce Examination held on 28/04/2023

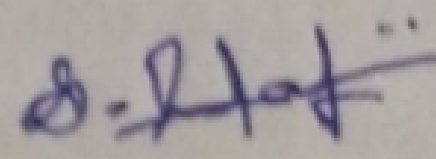
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DECLARATION

I, KAVIYA S hereby declare that the project report entitled **ENABLE BILLING SYSTEM IN OPENSTACK CLOUD** done by me under the guidance of **Dr.V.Nirmalrani** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology Degree in Information Technology.

DATE: 28.04.2023
PLACE: CHENNAI


SIGNATURE OF THE CANDIDATE

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I am pleased to acknowledge my sincere thanks to **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Information Technology** who were helpful in many ways for the completion of the project.

TRAINING CERTIFICATE

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सूचना प्रौद्योगिकी मंत्रालय
MINISTRY OF
ELECTRONICS AND
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COURSE COMPLETION LETTER

It is certified that

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Sathyabama Institute of Science and Technology

has successfully undergone the Bridge Course Training Program on

Cloud Computing Technology

Under "FutureSkills PRIME" Programme

commenced from 11 Mar, 2023

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ABSTRACT

Fleio Openstack billing blends the conventional billing used by web hosting companies with the more modern, dynamic billing, which is primarily used by cloud service providers. With a standard billing strategy, as a service provider, you presume a product has a fixed price during the billing term, which could be monthly or similarly (every three months, six months, or annually, etc.). Since the price is set, it is simple to send out invoices in advance because both you and the customer are aware of the price at the end of the month or period at all times. Prices may change during the billing term with add-ons and/or extra customizations, although they are typically fixed and known in advance. The new method of service billing avoids making assumptions about the cost associated with the billing period. Instead, a predetermined price for a brief period of time—let's say, 1 hour or even 1 second—is applied. The provider can only charge for the time the resources were really used in this fashion. If the customer requests a partial refund and there aren't many other customers, the supplier may decide to comply. It is obvious that manually managing billing with a monthly set price is difficult when considering a complete cluster for a single large application, continually bringing Each billing method has its own uses, thus one is not always superior to the other. A customer who has a single shared hosting account for their website, for instance, won't remove and create their account within a month.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
IaaS	Infrastructure as a Service
PaaS	Platform as a Service
SaaS	Software as a Service
OS	Operating System
VM	Virtual Machine
VMM	Virtual Machine Monitor
VLAN	Virtual Local Area Network
VxLAN	Virtual eXtensible Local Area Network
ARP	Address Resolution Protocols
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
NAT	Network Address Translation
NIC	Network Interface Card
SOA	Service Oriented Architecture

CHAPTER – 1

INTRODUCTION

1.1 BILLING SYSTEM

BILLING SYSTEM is a process where the service providers use to bill and charge customers. It's a piece of software that streamlines the process of accepting payments and delivering typical invoices. Billing systems usually contain features for tracking invoices and purchases. Billing software guarantees that your customers can pay for your goods and services with ease. Because they provide several advantages, billing services are crucial for small firms. For instance, a billing system is crucial for cloud service providers for the following reasons:

- Administrative monitoring, control, and tracking are applied to payments.

- Payment agreements and payment transparency between service providers and customers.

- the ability to more easily oversee the cash flow of your business than manual invoicing

- Automatically reducing mistakes through pricing and estimate gathering in billing

- the ability to enhance reporting processes and business operations

Data used in the creation of bills

Subscription information - the user's subscriptions for the time period considered in bill generation. Each use plan to which the customer was subscribed during the billing period has its own subscription record.

use information - The user's use details during the specified period of bill creation.

Pricing approach - This explains how users will be paid for subscriptions and overuse.

Billing system helps to determine the workflows you're going to end up using for creating and organizing invoices. As well, it will contribute to everything from payment processing to project management.

1.2 OVERVIEW OF CLOUD COMPUTING

Cloud computing is on-demand access to computing resources. It is 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 service). Rapid provision and release with minimal management effort or service provider interaction. Characteristics of cloud computing:

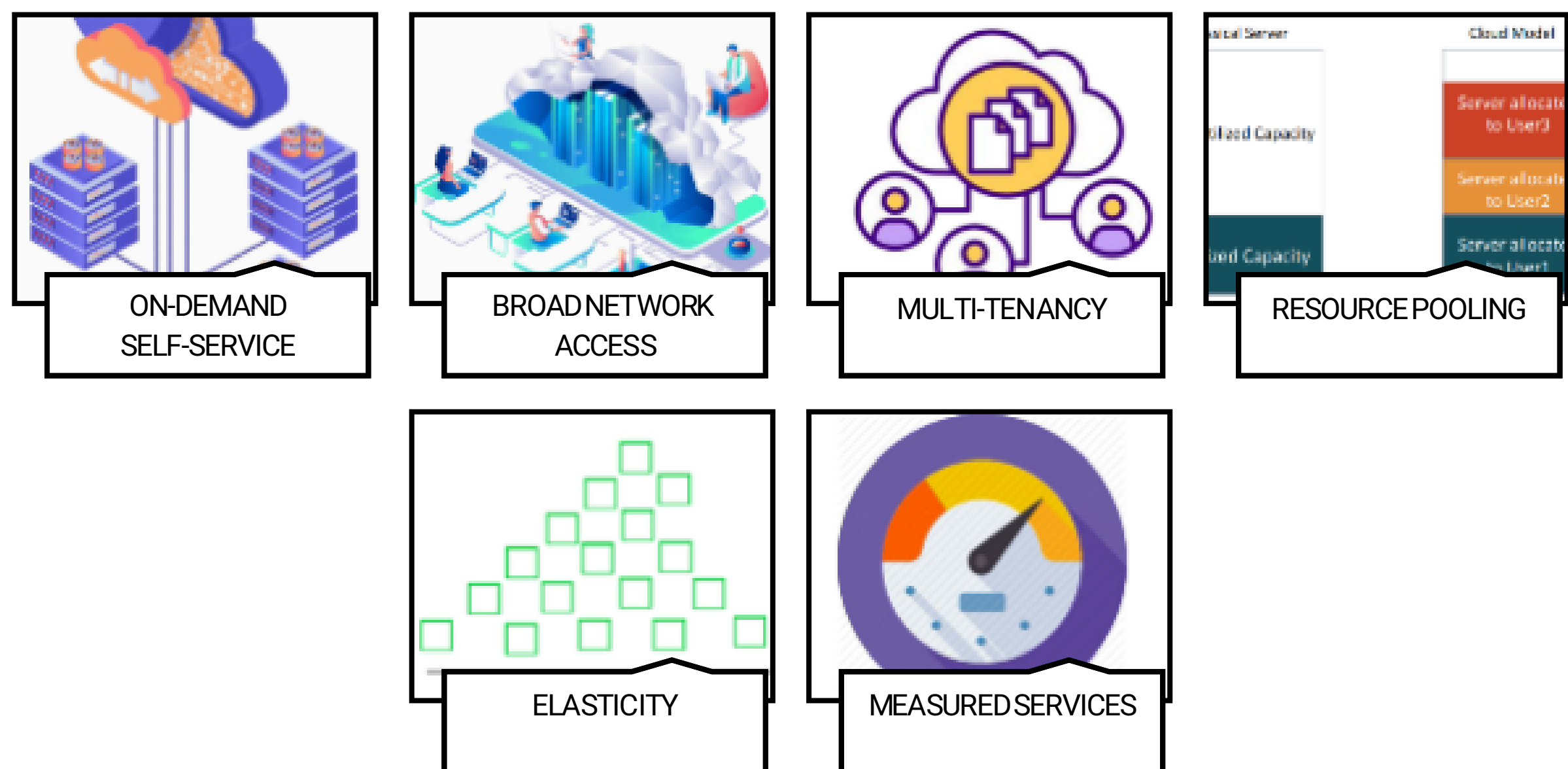


Fig 1.1 Characteristics of cloud computing

Recently, as a result of the development of cloud computing, new technologies have also evolved.

Hardware Evolution

Mainframe → Client Server → Super Computer → Cluster Computing →

Distributed Computing → Utility Computing → Grid Computing

Software Evolution

WEB 1.0 → WEB 4.0 → SOA

Network Evolution

Telecommunication Network → Local Area Network → Internet

Layers of Cloud

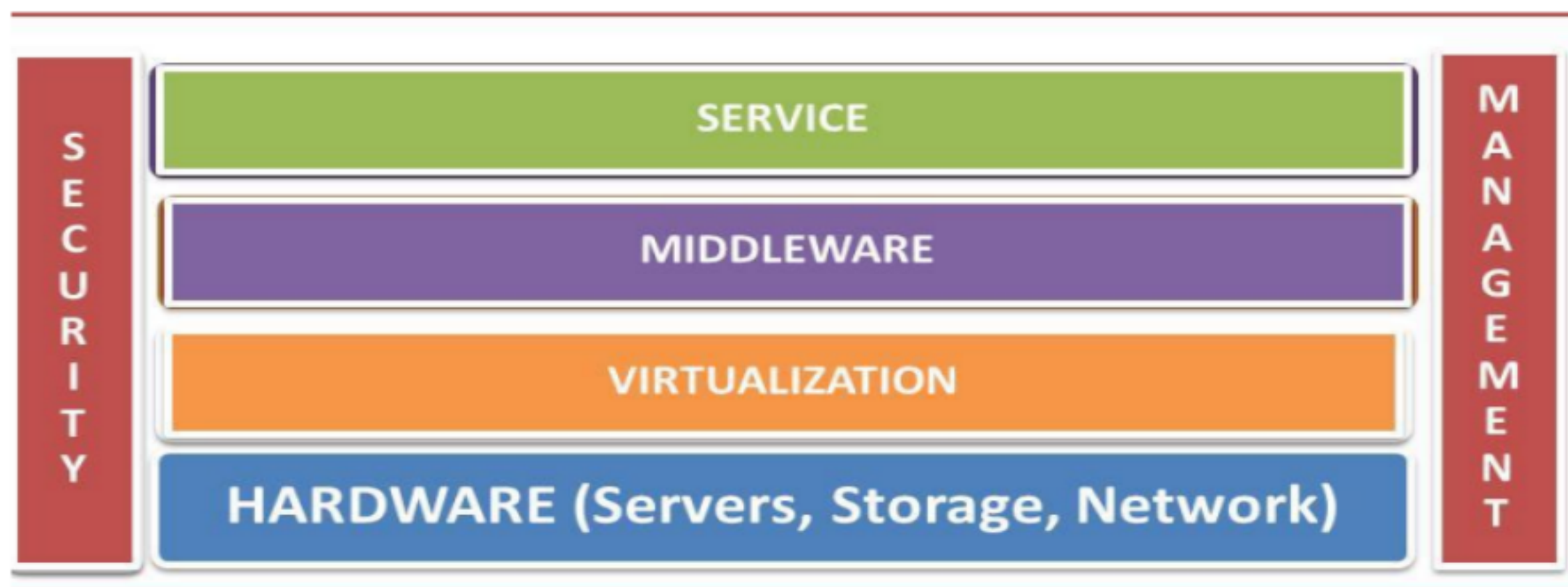


Fig 1.2 Layers of Cloud

Hardware - Provides Compute, Storage and Network to create Cloud services. Typically, hardware layer refers to Data centre

Virtualization - Process of creating a virtual version of underlying hardware / software as an isolated service using a specialized software named Hypervisor. Backbone of Cloud, Cloud services are provisioned based on resource virtualization such as Processor, Memory, Storage and Network components are virtualized (split up and isolated) to create Virtual Machines and delivered as IaaS. Application and Database are virtualized to deliver SaaS.

Middleware - Brain of Cloud. Provide scheduling, orchestration, management of cloud and Controls underlying hardware and network resources.

Service - Responsible for service delivery. User interaction and control.

Security - Secures resources, services and workloads includes server, storage, network, operating system, hypervisor, middleware, application, database, data security.

Management - Operation and maintenance of resources and services Includes monitoring, metering, compliance to service level agreements, backup, replication and recovery process, user profile management.

Advantages of Cloud Computing

Optimization of resources

- Quick roll out of services
- Improved performance and scalability
- Cost reduction

Disadvantages of Cloud Computing

- Internet Connectivity
- Limited Control
- Security
- Vendor lock-in

1.3 CLOUD SERVICE MODEL

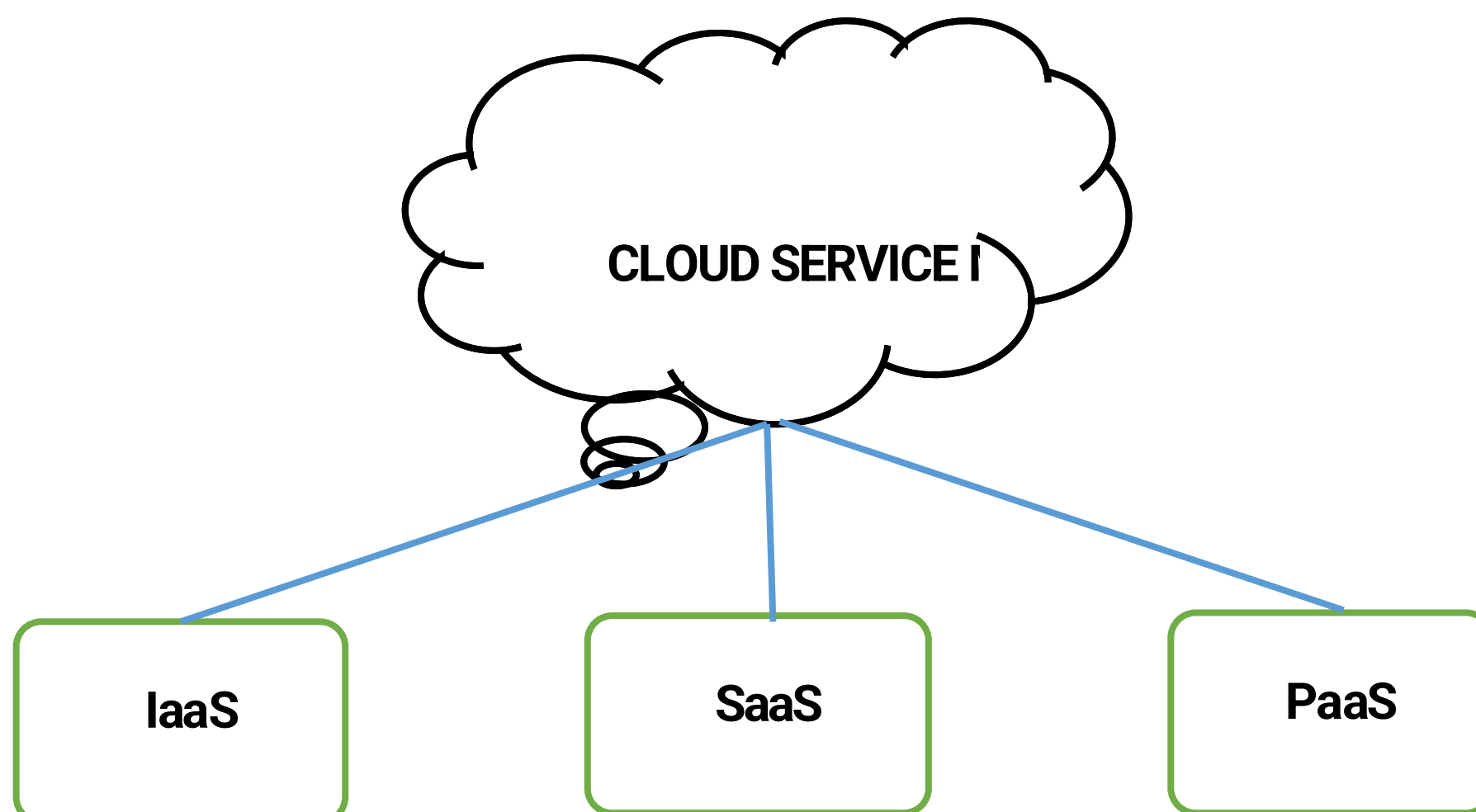


Fig 1.3 Cloud Service models

Infrastructure as a Service

A service model known as "Infrastructure as a Service" (IaaS) provides computer infrastructure on an outsourced basis to support diverse functions. IaaS is often a service where infrastructure is offered as outsourcing to businesses, including networking hardware, devices, databases, and web servers. Hardware as a Service (HaaS) is another name for it. IaaS clients often make per-user payments by the hour, week, or month. Customers may also be charged by some providers according to how

much virtual machine space they consume. For constructing such applications and services, installing development tools, databases, etc., it only offers the underlying operating systems, security, networking, and servers.

Platform as a Service

PaaS is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet. PaaS services are hosted in the cloud and accessed by users simply via their web browser. A PaaS provider hosts the hardware and software on its own infrastructure. As a result, PaaS frees users from having to install in-house hardware and software to develop or run a new application. Thus, the development and deployment of the application take place independent of the hardware. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment. To make it simple, take the example of an annual day function, you will have two options either to create a venue or to rent a venue but the function is the same. Software as a Service

Software as a Service

Software-as-a-Service (SaaS) is a way of delivering services and applications over the Internet. Instead of installing and maintaining software, we simply access it via the Internet, freeing ourselves from the complex software and hardware management. It removes the need to install and run applications on our own computers or in the data centers eliminating the expenses of hardware as well as software maintenance. SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. Most SaaS applications can be run directly from a web browser without any downloads or installations required. The SaaS applications are sometimes called Web-based software, on-demand software, or hosted software.

1.4 CLOUD DEPLOYMENT MODELS

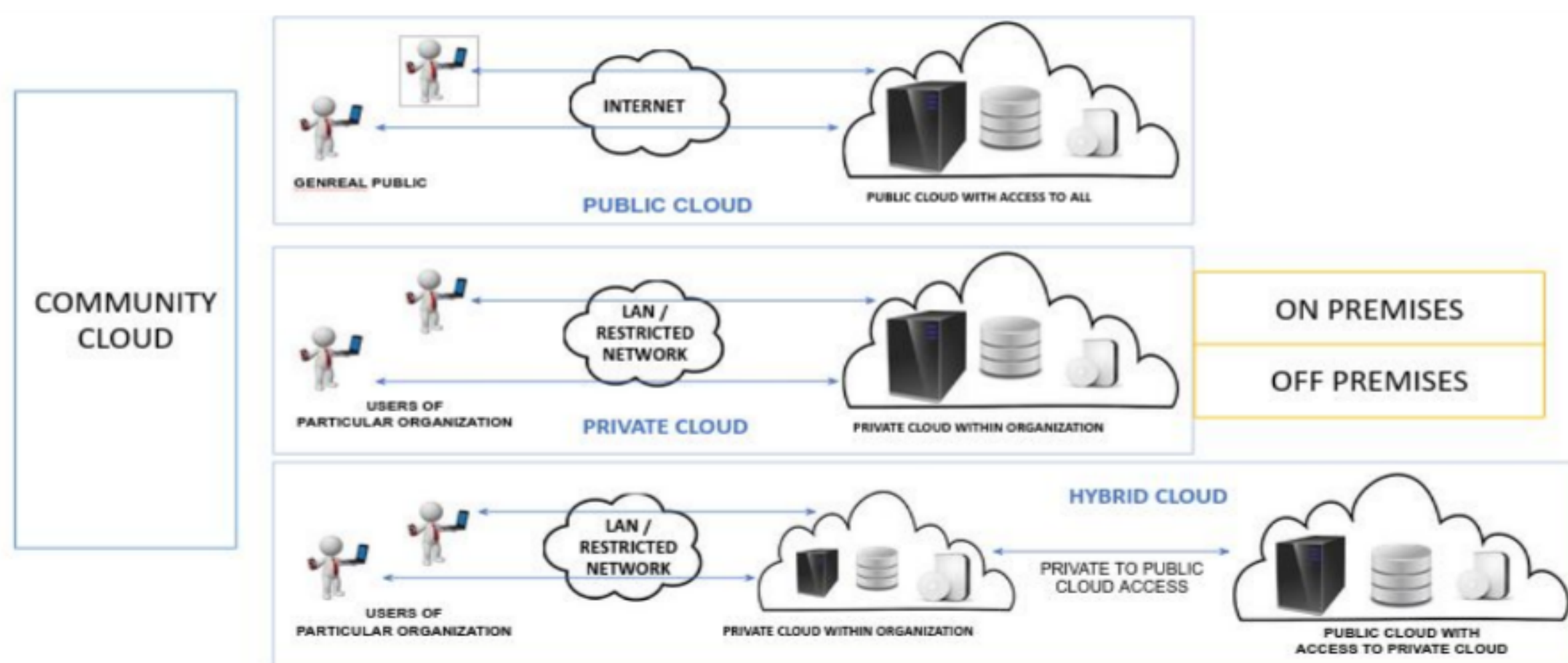


Fig 1.4 Deployment Models

Public Cloud

Public clouds are run by third parties who offer cloud services to the general public through the internet with pay-as-you-go invoicing options. They provide ways to reduce the cost of IT infrastructure and develop into a viable choice for managing peak demands on local infrastructure. Small firms may launch their operations without making significant initial expenditures by depending only on public infrastructure for their IT requirements, making public clouds the go-to choice for these companies. Multitenancy is one of the essential properties of public clouds. A public cloud is designed to service many users, not just one particular client. A user needs a virtual computing environment that is distinct from other users and most likely isolated.

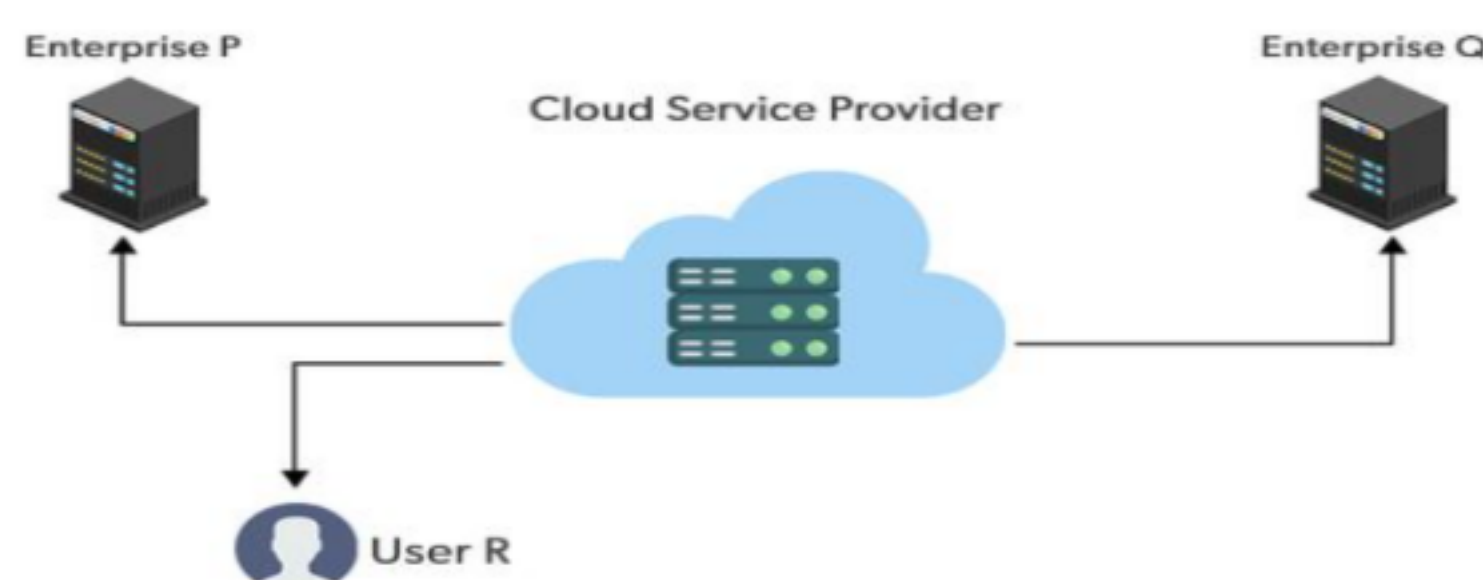


Fig 1.5 Public Cloud

Advantages of using a Public cloud are - High Scalability, Cost Reduction, Reliability and flexibility, Disaster Recovery.

Disadvantages of using a Public cloud are - Loss of control over data, Data security and privacy, Limited Visibility, Unpredictable cost

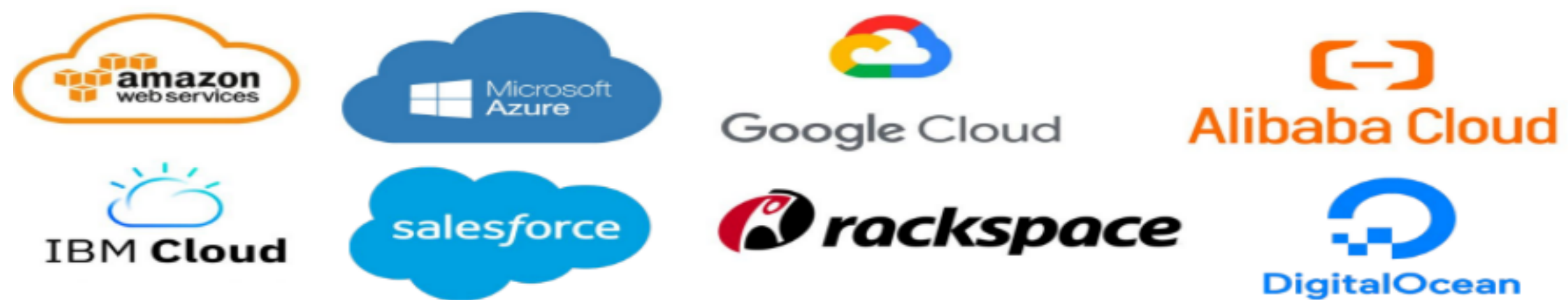


Fig 1.6 Public Cloud Providers

Private Cloud

Private clouds are distributed systems that operate on private infrastructure and give users access to computer resources that are dynamically allocated. There may be additional plans that regulate cloud usage and appropriately charge the various departments or areas of an organisation in place of the pay-as-you-go approach used in private clouds. HP Data Centres, Ubuntu, Elastic-Private cloud, Microsoft, and more companies provide private clouds

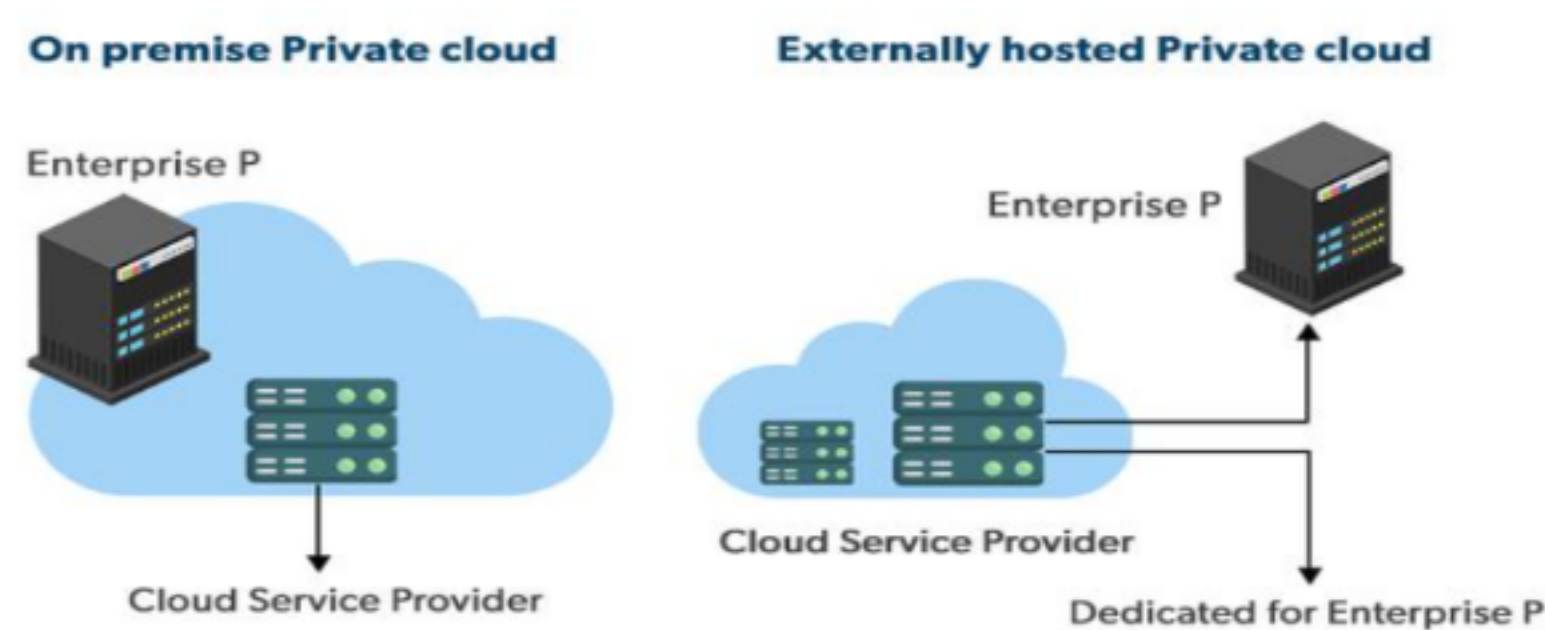


Fig 1.7 Private Cloud

The advantages of using a private cloud are - Customer information protection, Infrastructure ensuring SLAs, Compliance with standard procedures and operations.

Disadvantages of using a private cloud are - The restricted area of operations, Expertise required.



Fig 1.8 Private Cloud Providers

Hybrid Cloud

A hybrid cloud is a heterogeneous distributed system formed by combining facilities of the public cloud and private cloud. For this reason, they are also called heterogeneous clouds. A major drawback of private deployments is the inability to scale on-demand and efficiently address peak loads. Here public clouds are needed. Hence, a hybrid cloud takes advantage of both public and private clouds.

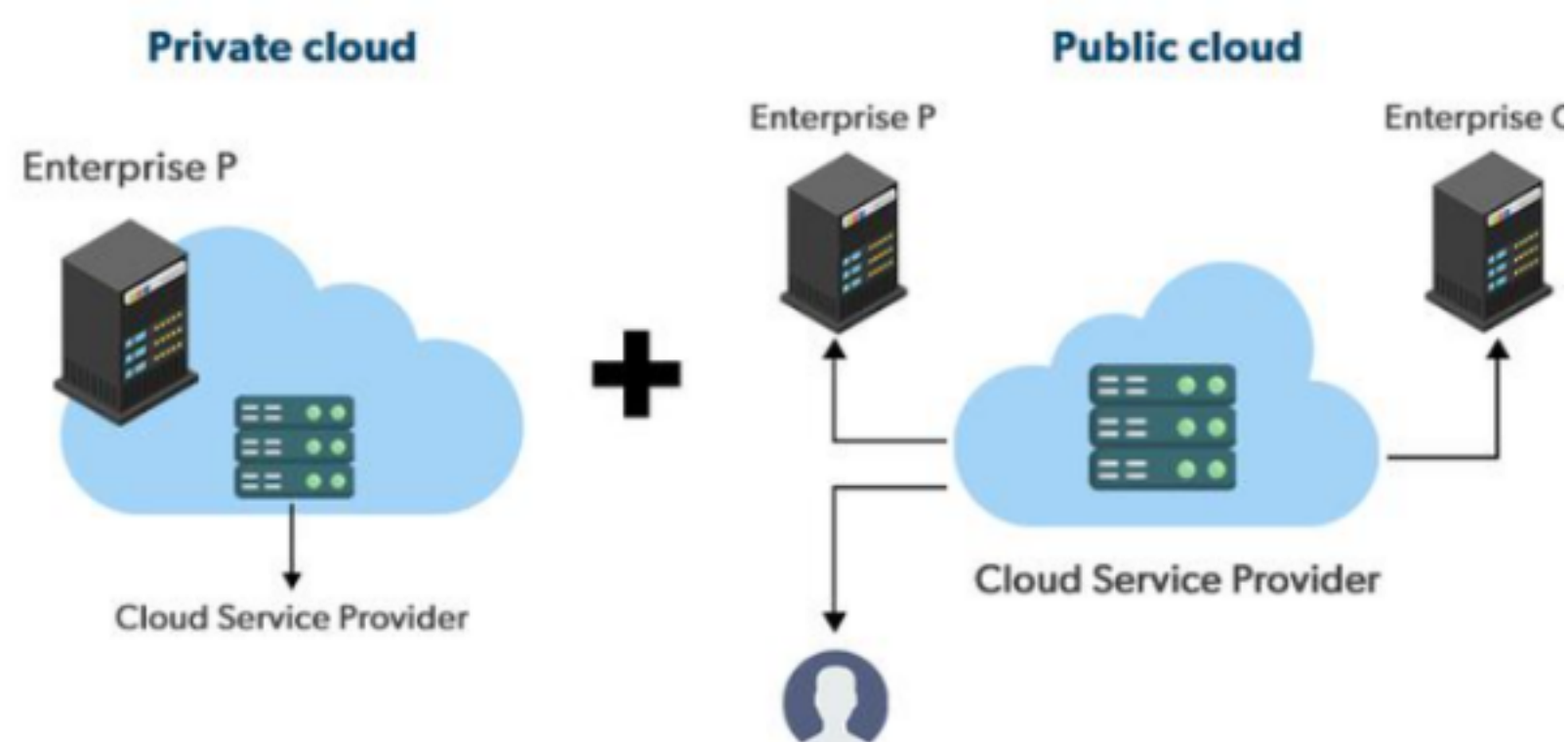


Fig 1.9 Hybrid Cloud

Advantages of using a Hybrid cloud are - Cost, Speed, Security.

Disadvantages of using a Hybrid cloud are - Managing security and managing a hybrid cloud may be more difficult.

Community Cloud

Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector. But sharing responsibilities among the organizations is difficult. In the community cloud, the infrastructure is shared between organizations that have shared concerns or tasks. An organization or a third party may manage the cloud.

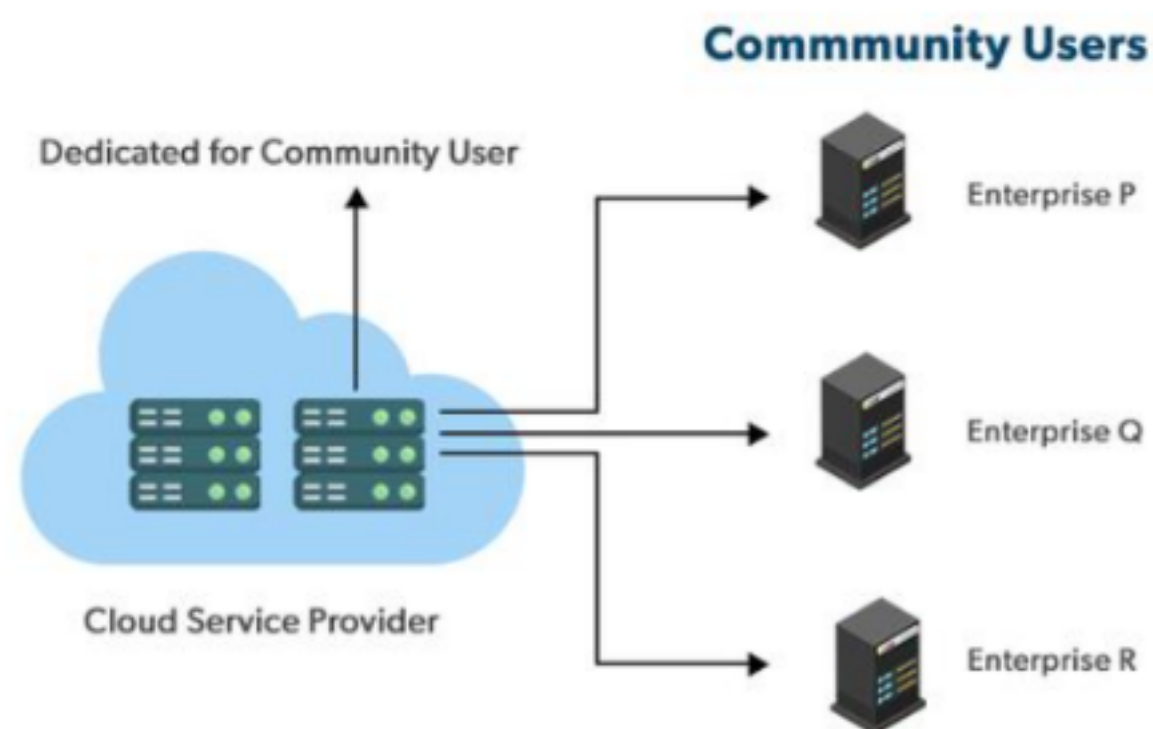


Fig 1.10 Community Cloud

Advantages of using Community cloud are - community clouds are cost-effective, adaptable and scalable, alter the documents according to their needs and requirements, more secure than private cloud, share cloud resources, infrastructure, and other capabilities between different enterprises.

Disadvantages of using Community cloud are - Not all businesses should choose community cloud, gradual adoption of data, It's challenging for corporations to share duties.

1.5 OVERVIEW OF OPENSTACK

OpenStack is a platform for free and open-source software. For cloud computing, this is fundamentally utilised and implemented as an IaaS. We may refer to OpenStack as a software platform that enables the creation and management of both private and public clouds using a pooled virtual resource. Numerous cloud-related services (including networking, storage, image services, identification, etc.) are by default provided by OpenStack. Users may manage this via command-line tools, a RESTful API, or a web-based dashboard. Since OpenStack maintains so many virtual computers,

less physical resource utilisation is possible. OpenStack is a cloud OS that is used to control the large pools of computing, storage, and networking resources within a data centre.

The most popular open source programme for building both private and public clouds is called OpenStack. Thousands of community members as well as some of the top names in hosting and software development support the OpenStack suite of open source software technologies. OpenStack provides the framework for quick creation, testing, and deployment of mission-critical and massively scalable applications. Hundreds of the biggest brands in the world rely on it to operate their operations every day. Developers have more flexibility to innovate thanks to self-service access to on-demand IT resources, while automated processes allow for more control and rigorous capacity planning. Enterprises may get the packaging, upkeep, and support they need from a business-critical IT infrastructure from the worldwide OpenStack ecosystem.

Mission-critical and massively scalable applications may be developed, tested, and deployed quickly using the OpenStack platform. Developers have more flexibility to innovate thanks to self-service access to on-demand IT resources, while automated processes allow for more control and rigorous capacity planning. Enterprises may get the packaging, upkeep, and support they need from a business-critical IT infrastructure from the worldwide OpenStack ecosystem. OpenStack offers independence from vendor lock-in and the ability to transfer workloads between private and public clouds depending on business requirements thanks to its open APIs and support from almost all major IT suppliers.

Fundamentals of OpenStack

Open Source: OpenStack was developed and made available under the Apache 2.0 licence. Apache makes it available to the public without charge.

Open Design: The development team will convene a Design Summit every six months for the upcoming upgrade.

Open Development: The creators have a repository of source code that is publicly accessible through initiatives like the Ubuntu Linux distribution via entig100s.

Open Community: OpenStack enables the community's open and transparent documentation.

1.6 WORKING ENVIRONMENT

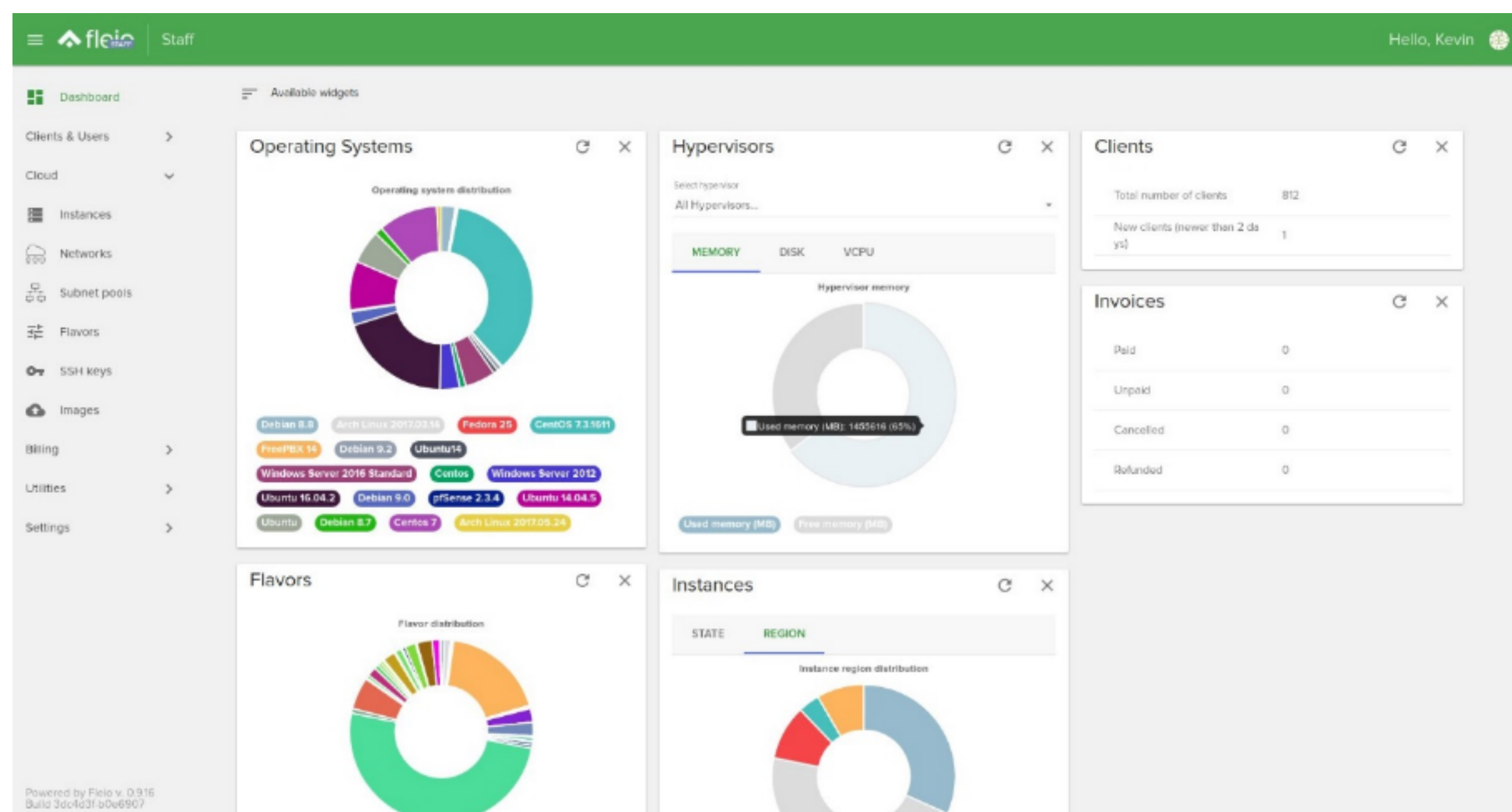


Fig 1.11 Fleio

Fleio OpenStack Billing System and Self-Service Portal for Service Providers.

1.7 INTRODUCTION TO FLEIO OPENSTACK

Fleio is an OpenStack billing and control panel for public cloud service providers, a shared web hosting automation platform for web hosting companies which is also an internet domain name automation platform. It provides full billing and control panel functionality that enables service providers to offer public cloud services. End-users can sign up, add credit (or post-pay), and create and manage OpenStack cloud resources. The powerful pricing rules enable the service providers to charge services on the cloud OpenStack billing model (e.g., price per GB / hour for storage, price per vCPU / minute, etc.).

Features of Fleio Openstack

Customer on-boarding - New users can sign up and add invoicing information. VAT ID is validated online and the client is marked as tax-exempt if a valid VAT ID is provided.

Orders fraud check - Customers' orders fraud check by using the Max Mind API.

True multi-currency - Each client has a default currency and when you change the client's currency, it will not change the currency on the already-issued invoice. Clients may have invoices issued in any currency. Services may have fixed pricing or dynamic pricing updated automatically based on the exchange rate.

Product configurable option - Define setup options and pricing options for products. Widgets are available for configurable options: drop-down, radio button, quantity input, or text field. Configurable options support billing cycles, multi-currency, and price per option.

Mass emails - You can send mass emails to filtered clients. You can filter your clients based on their status or type of service. You can also filter your clients by their details regarding the OpenStack region, OpenStack node, instance type, operating system, flavor/flavor group, and so on.

Staff user's authorization system - Define authorized operations per staff user or group of users.

Modern architecture - Fleio is a Single Page web Application (SPA) and everything is based on an API available to developers and third-party tools. Our modern architecture allows serving the frontend files from a CDN network, running the staff panel in a VPN, and using our REST API to integrate with other systems.

Custom-defined themes - A customizable colour scheme with a simple JavaScript function.

cPanel licensing for NOC partners - Sell cPanel licenses to your customers. Fleio leverages the cPanel manage2 API to create and manage cPanel licenses.

Feature toggle - Fleio features may be disabled individually. You can enable or disable compute instances, backup, instance snapshots, volumes, OpenStack end-user API, DNS PTR, network, security groups, and many more.

Two-factor authentication - You can let your users choose if they enable it or you can enforce users to enable it. Time-based One-time Password is available through the Google Authenticator mobile app or other compatible applications. Authentication is also available with a module for Amazon SNS SMS. You can easily add other SMS providers by writing one simple Python function that sends SMS.

Billing for any service or product - You can define pricing for other kinds of services, like system administration monthly charges. Define one-time price or recurring on a calendar month, X days, X months, X years.

Tax rules - Define tax rules per country and county/state. You can also define a start and end date for a rule to apply - useful when VAT rates are changing, for example.

Recurring payments - Fleio offers support for recurring payments with multiple gateways.

Email notification templates - Staff users can edit email notification templates including translations in other languages. The notifications are sent based on the client's language.

The Hosting Billing Edition empowers web hosting companies to manage and charge for web hosting services and internet domain names and manage customer support tickets.

Domain name registration and management - End-users can order new domain name registration and transfer. Unique feature: domain names registration/transfer/renewal cost prices are retrieved from the registrar API and staff users can compare costs and choose the lowest. Registrar modules available: OpenProvider and ResellerClub.

cPanel shared web hosting automation - Sell cPanel web hosting accounts: automatic setup, suspend, terminate.

Ticketing system - The Fleio tickets plugin adds a ticketing system, support departments and configurable signatures for staff users. Tickets can be created from the Fleio interface or automatically generated when a department receives a message on its related email. Staff can configure email notifications for ticket actions (open/close/reply) based on the associated department.

CHAPTER – 2

AIM AND SCOPE OF THE PRESENT INVESTIGATION

2.1 AIM

The aim of this project is to enable a billing system in Openstack Cloud and to manage the billing system as an end-user and as a staff.

2.2 SCOPE

The plan is to use Fleio Openstack to enable a billing system. Billing System is almost used in every sectors, In Cloud based companies the billing system is used by the cloud service providers to generate invoice, add payments to the user's resource utilization and so on.

2.3 LITERATURE SURVEY

Fleio's billing is based on a new, more flexible payment system that has been introduced mainly by cloud service providers as compared to the classic payments applied in the Web Hosting Industry. As a provider of services, your expectation is that the product contains an agreed set price during the entire duration of the period on which its conventional billing practices are used, e.g. monthly or similar every three months, six months and annually. The price is settled and invoices can be issued in advance, as both you and your client know at any one time what the prices are for each month or period. However, the prices are usually locked and known in advance when addon or other configuration options allow for price changes within a billing period. The price relating to the time period is not taken into account by the new method of charging services. Instead, for a small period of time, say an hour or even one second, the fixed price is added. This means that the provider can charge only for a given period of time during which resources were used. Suppose, as an example, that a customer is buying the server for 5 USD per month. He shall receive the full

amount upfront or at the end of any month, even if he terminated the server 15 days after it was purchased, through a standard billing arrangement. A provider may decide to issue partial refunds if the customer asks and as long as the number of customers is small. Imagining a whole cluster for one big application, which would always have servers up and down throughout different periods of time when there was greater or lesser resource needs, Clearly, it is difficult to manually handle billing in a monthly fixed price. This case is perfectly suited to dynamic resource billing, where a price is set for a second use of a given resource. There are different applications for each billing type, but they're not really superior in any way. For example, a customer who has one shared hosting account to his website will not be able to delete it and set up an account within the month. The product module is an important part of the product. A module decides what is created, where and how. The cPanel module knows how to connect to a WHM server and to create an account. Similarly, the OpenStack module knows how to talk to OpenStack and to create a new OpenStack Project for a customer. Fleio has 3 types of pricing models -**Free** - the product is free no pricing is applied. **Fixed plus dynamic** - a fixed price is charged, if greater than zero plus a dynamic price is calculated by the module. The dynamic price in the case of the OpenStack module is the total price of resources used during the billing period (or cycle). As an example, creating a server that costs 0.0015 USD / Hour will have a dynamic price of 10 USD at the end of a month or 5 USD if the server is removed after 15 days. That is why an OpenStack product usually has a fixed price set to zero. **Dynamic but at least fixed** - this is similar to Fixed plus dynamic except that when a fixed price is set, the total cost of the product at the end of the month is either the fixed price or the dynamic price, whichever is greater.

CHAPTER – 3

EXPERIMENTAL OR MATERIALS AND METHODS

3.1 END-USER MANGEMENT

The end-user panel is for the service provider's customers. They can order new services and manage their cloud resources. An existing end-user logs in with her email address and password or can sign up for a new account. “Create new account” button is present by default, but you can choose to disable sign-up through feature toggles.

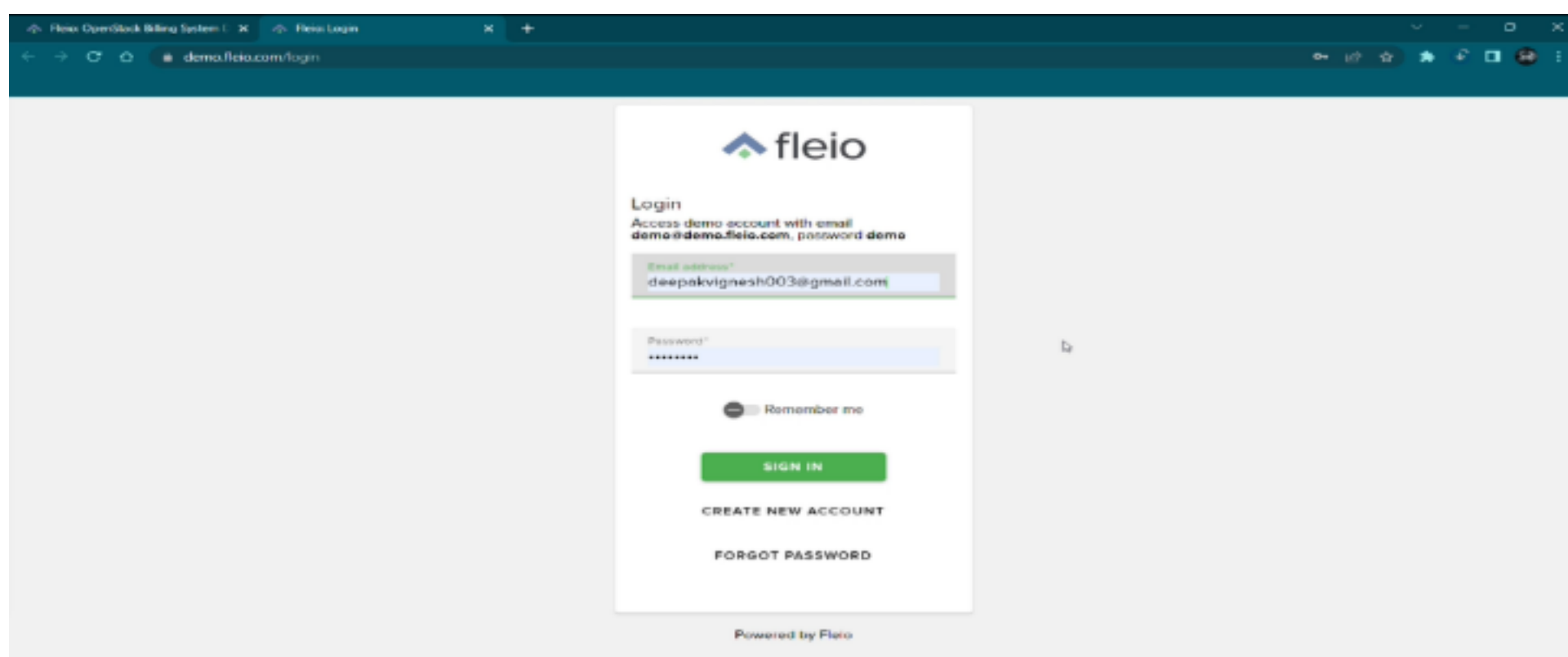


Fig 3.1 End-User Login

After the successful completion of signup or login end-user home page will be opened.

Secure your billing account with the two factor authentication(2FA). 2FA protects against phishing, social engineering and password brute-force attacks and secures your logins from attackers exploiting weak or stolen credentials. This dramatically improves the security of login attempts.

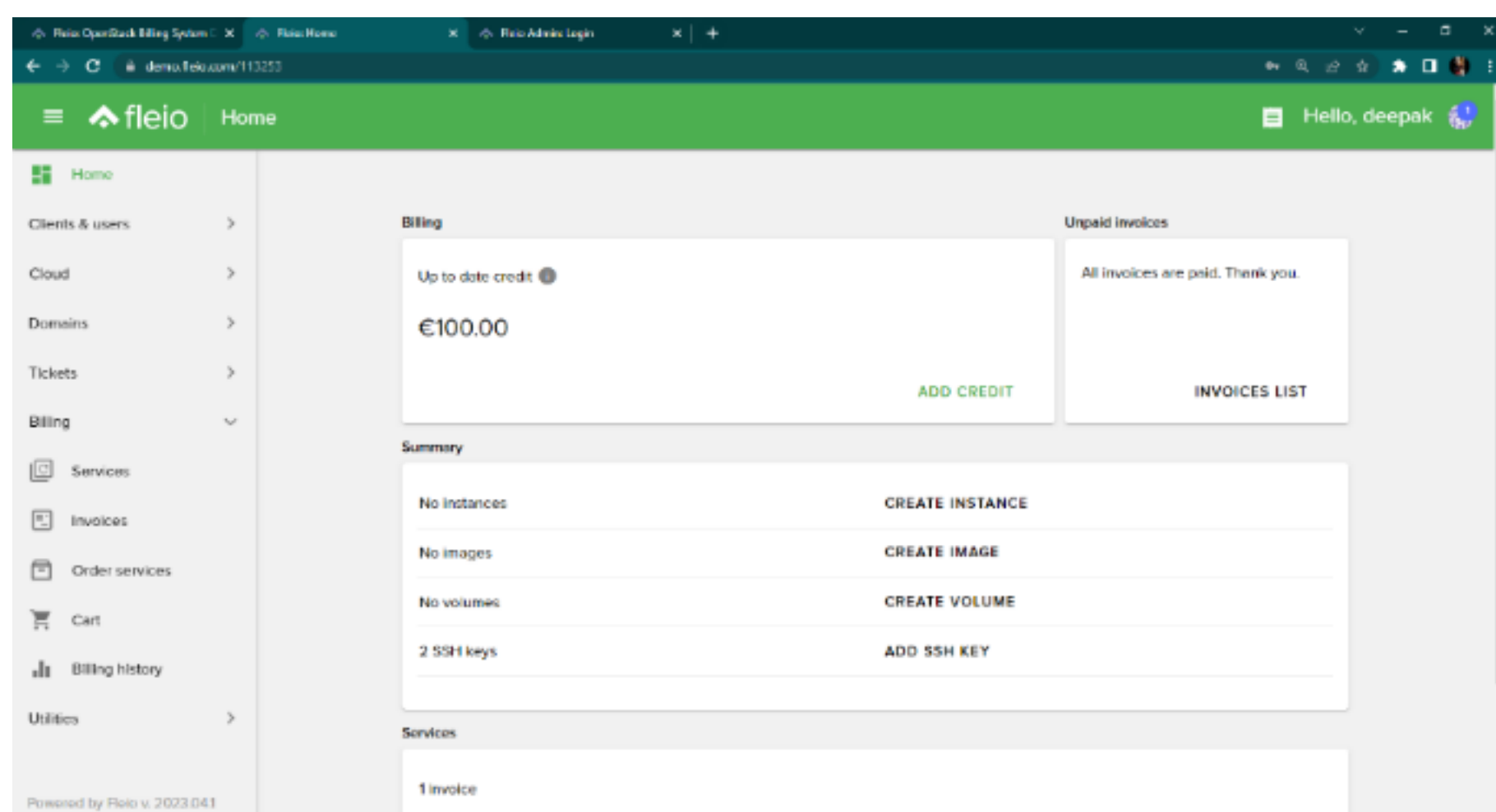


Fig 3.2 End-user home page

Enable 2-Step verification in your billing account by clicking the profile choose my profile option. QR will be generated. Download the Google Authenticator app from playstore to scan the QR.

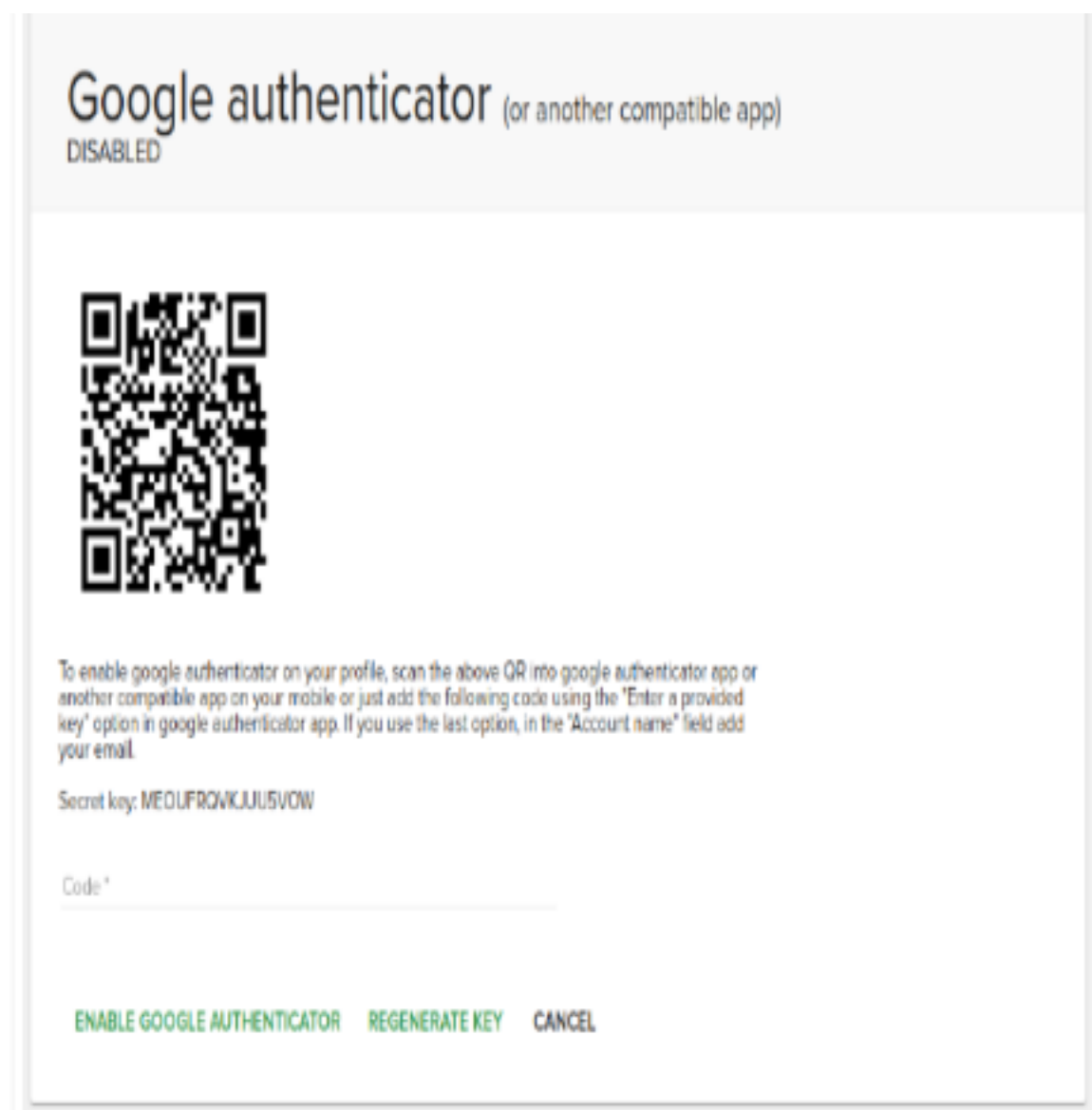


Fig 3.3 Authentication

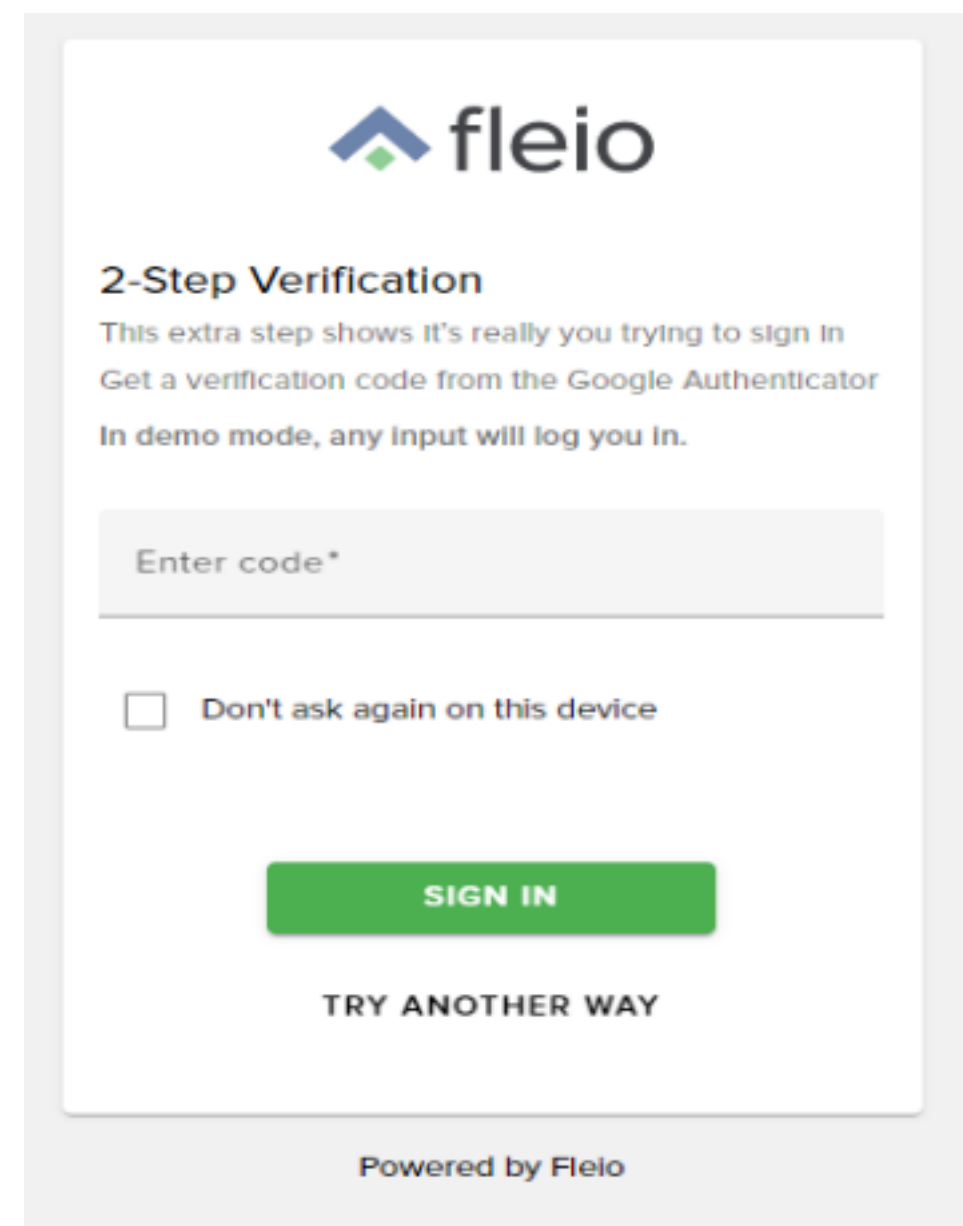


Fig 3.4 2-Step Verification

Scan the QR using the google Authenticator app a Authentication code will be displayed, enter the code in the provided space. Then click enable google authentication. Now, your end-user billing account is secure, whenever you try to login into billing account verification page will be shown enter the code in google authenticator app, each time logging a new code will be generated in order to protect the data. Add credits to the billing account.

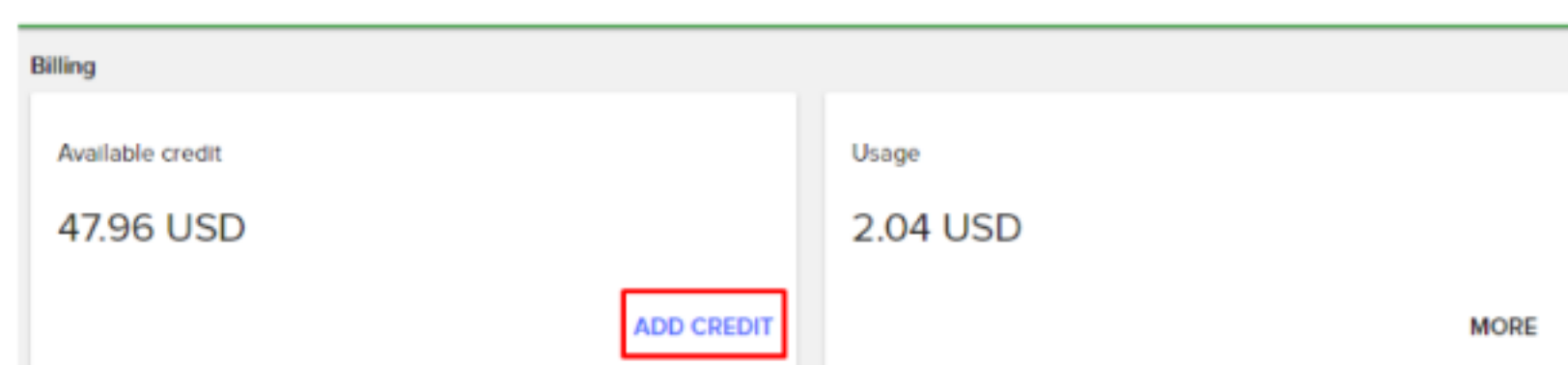
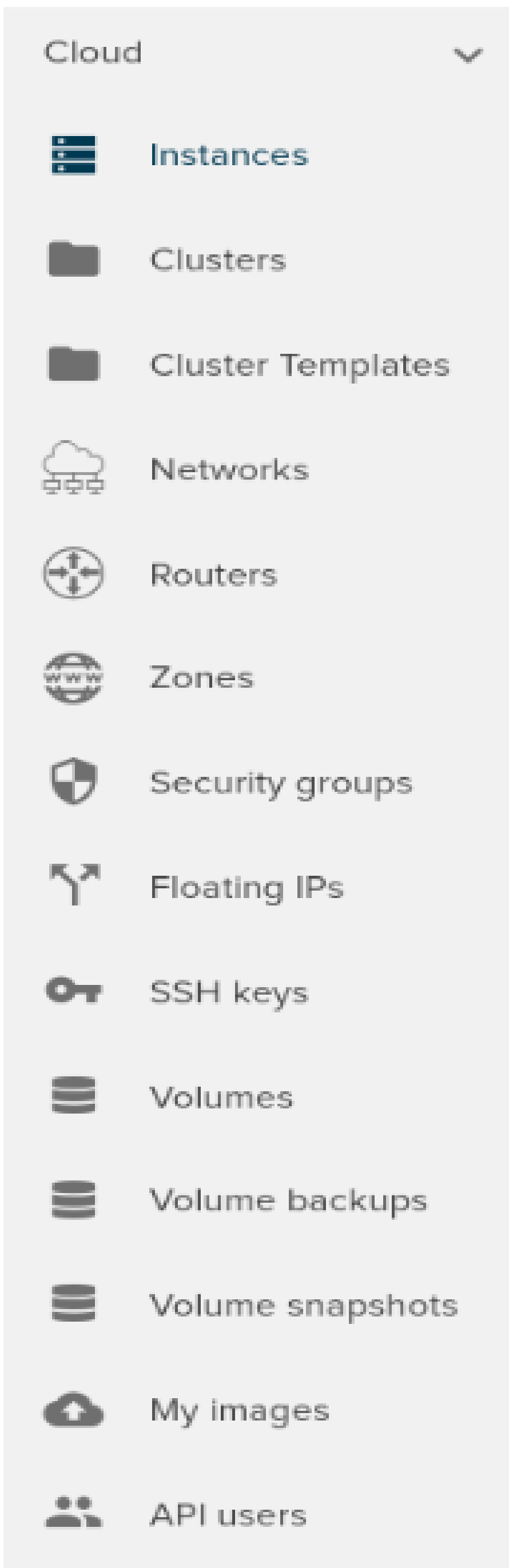


Fig 3.5 Adding credits

The charges for the amount of resource utilized will be measured and according to the Openstack Pricing rules the amount will be deducted from the credits. The credits are used to pay the invoice. With credit auto invoicing, end users are able to configure a client so whenever certain conditions are met, he'll be invoiced before reaching the credit limit (before a certain number of hours the admin chooses) with the amount necessary for him to be able to keep his services active for the next month without

having to pay in the meantime any other invoice if his credit consumption remains the same. Thus, a client that would reach the credit limit every 3 days, will have an invoice generated with an estimated amount that will make sure no other invoice will be needed in the next 30 days. However, users will also have the option to choose a fixed amount, rather than the estimated one. The feature is enabled by default but you can disable it using the advanced settings file, setting “False” for related feature (‘billing-credit-auto-invoicing’). If enabled, the following page will be accessible from end users profile page.

Fig 3.6 Cloud Tab



Instances: Manage your instances. View details for your instances.

Clusters: Manage your clusters.

Cluster Template: Create and manage your cluster’s template.

Networks: Create or see details about your networks

Routers: Create and manage your routers

Zones: Create and manage DNS zones

Security groups: Manage your security groups

Floating IPs: Manage your floating IPs.

SSH Keys: Manage your SSH keys.

Volumes: Manage your volumes.

Volumes backups: Create and manage volumes backups

Volume snapshots: Create and manage volumes snapshots

My images: Manage your created images (snapshots).

API users: Manage your API users

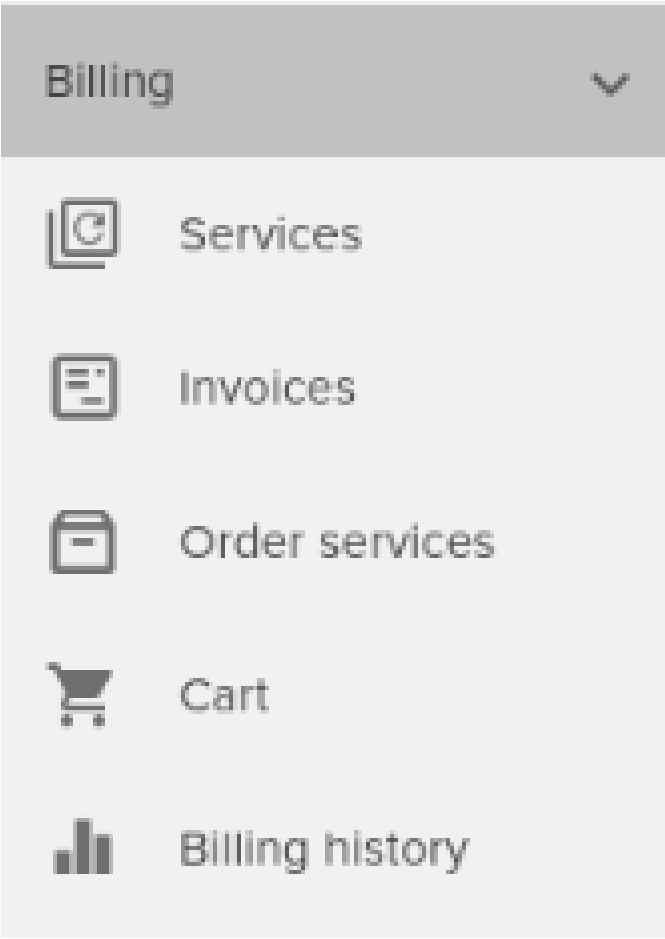


Fig 3.7 Billing Tab

Services: See details about all services

Invoices: List all the invoices and manage them

Order services: Order services page

Cart: Cart containing services ordered

Billing History: The cost for each instance, image, volume or for all.

SSH keys are a pair of public and private keys that are used to authenticate and establish an encrypted communication channel between a client and a remote machine over the internet.

Fig 3.8 Create SSH key

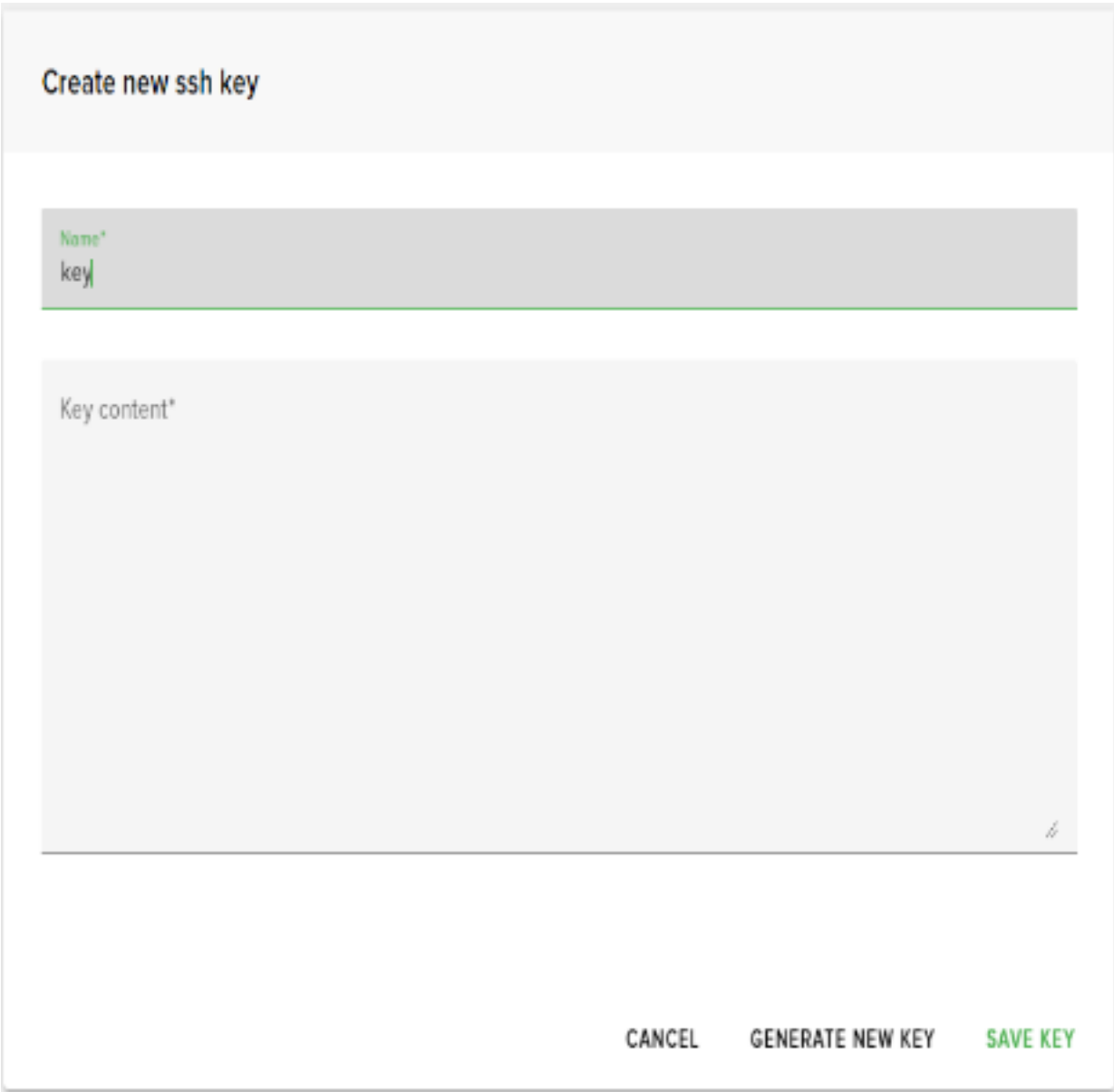


Fig 3.9 Save SSH key

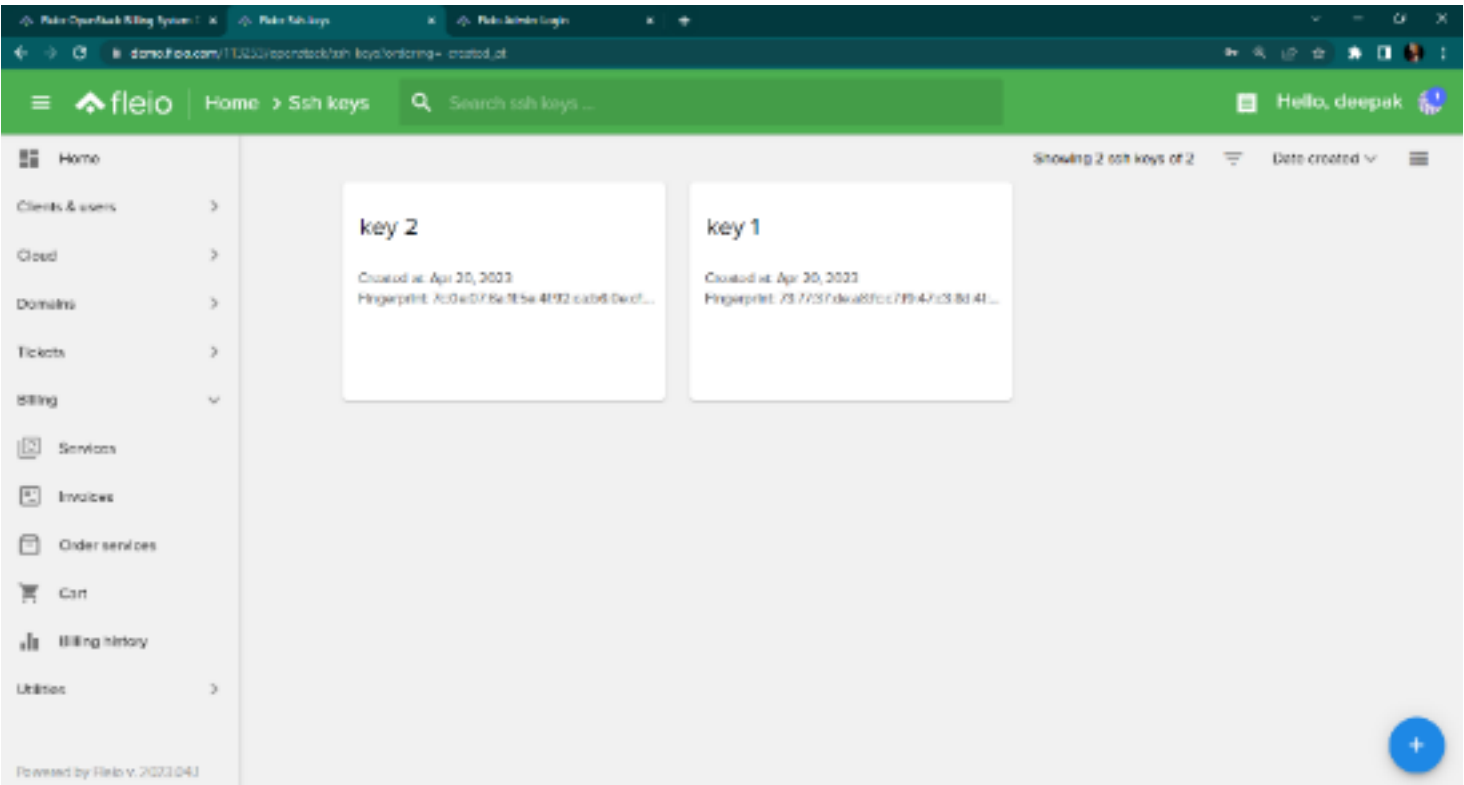
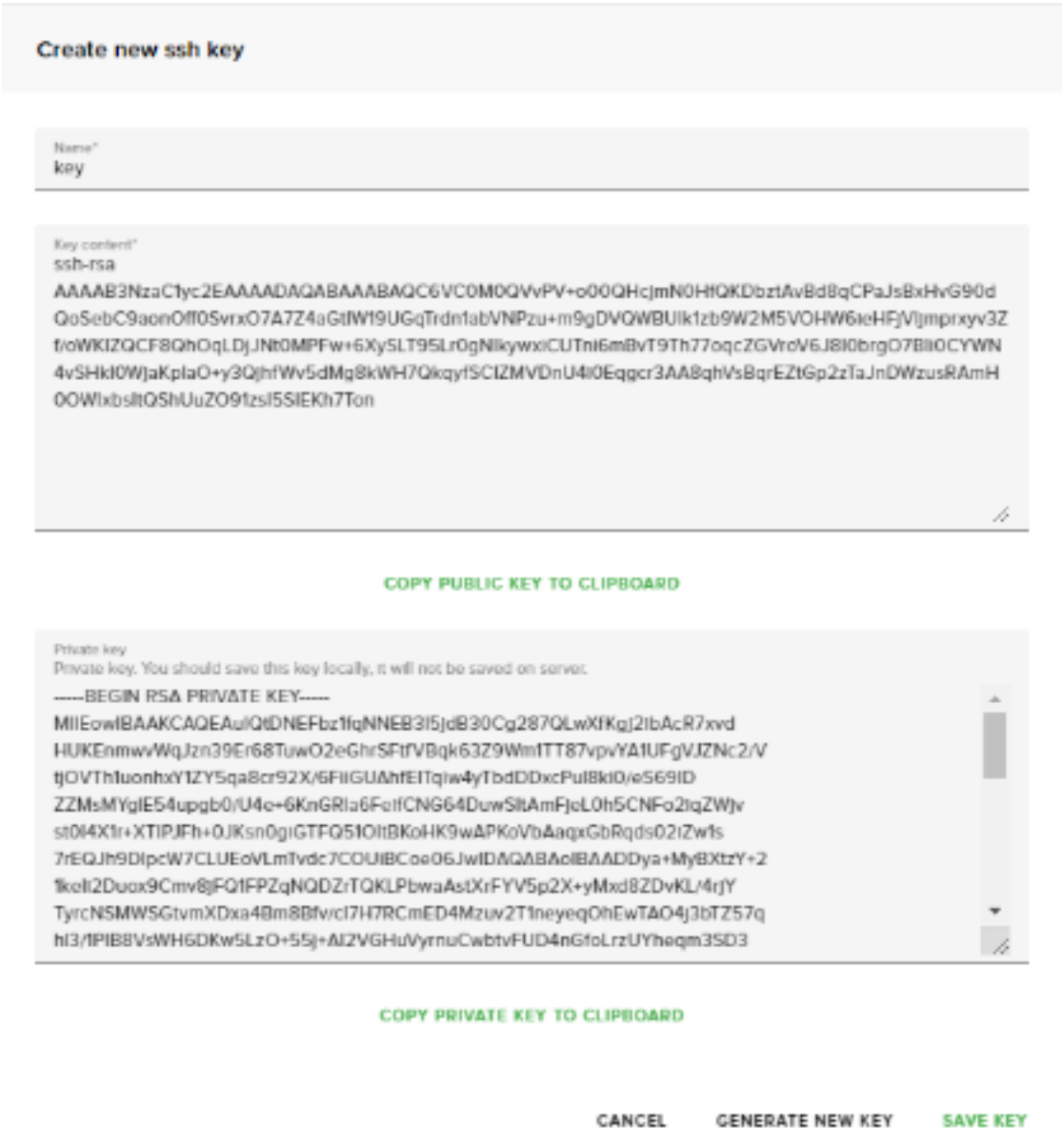


Fig 3.10 SSH key

The newly created SSH key will be displayed.

SSH keys added in Fleio are saved only in the Fleio database and are not added to the Openstack key-pair. On new instance creation, the key is deployed through cloud in-it (see Cloud-in-it). When deploying a cluster, the key will be added to Openstack and assigned to the selected API user. User can track the billing amount and can view the billing history.

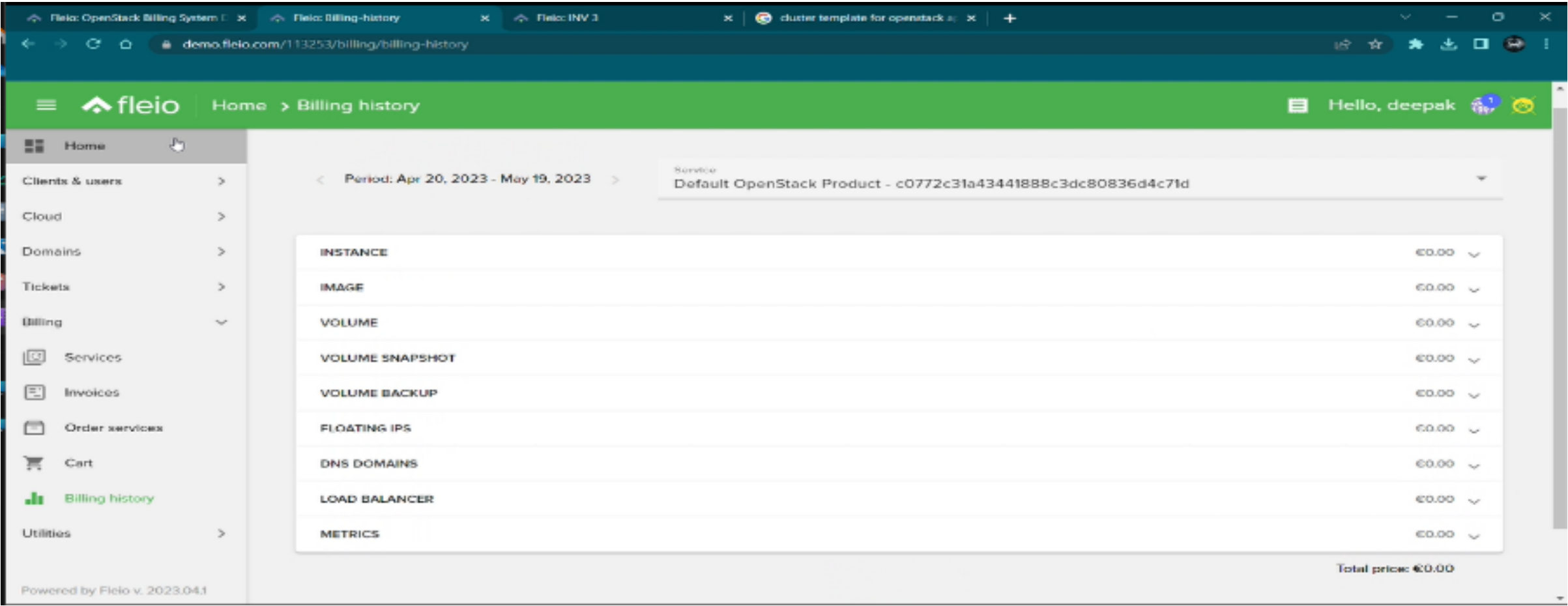


Fig 3.11 Billing History

User can view payment invoice and can download as pdf if needed. An invoice is a business record used to describe and itemize products sold or services performed. It can be on paper or in a digital document such as a PDF. In addition to a description of the products or services provided, an invoice will state the amount due, the due date, and list the most recent previous payment. Invoices serve as legally enforceable agreements between a business and its clients, as they document services rendered and payment owed. Invoices also help businesses track their sales and manage their finances.

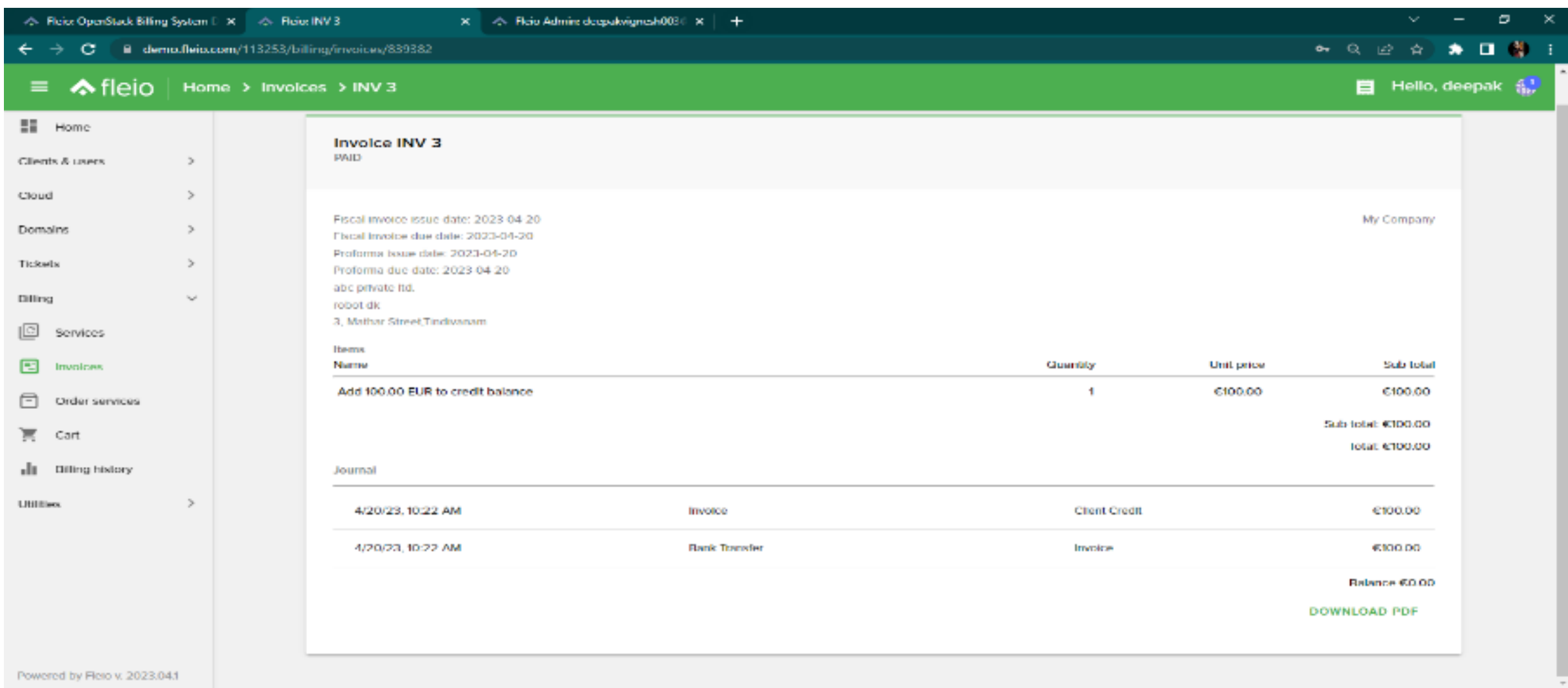


Fig 3.12 Invoice

3.2 STAFF MANAGEMENT

The staff panel is for the service provider's employees. Staff can configure general settings, manage pricing rules, and all customers' cloud resources. An existing staff user logs in with her email address and password. Staff users cannot self-sign-up for security reasons, but can be added by other staff users from the staff panel or can be created.

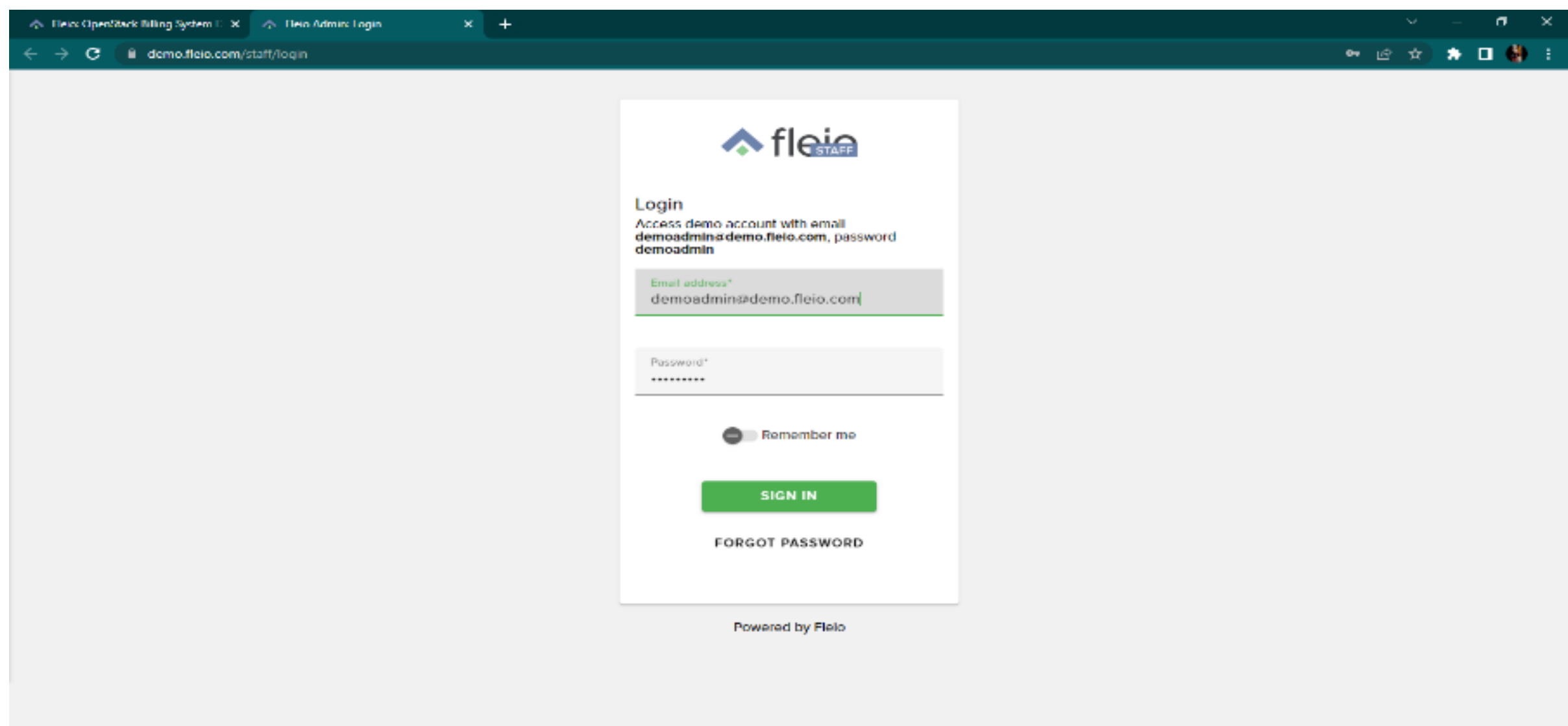


Fig 3.13 Staff login form

After Successful login the Staff panel dashboard or the home page will be showed.

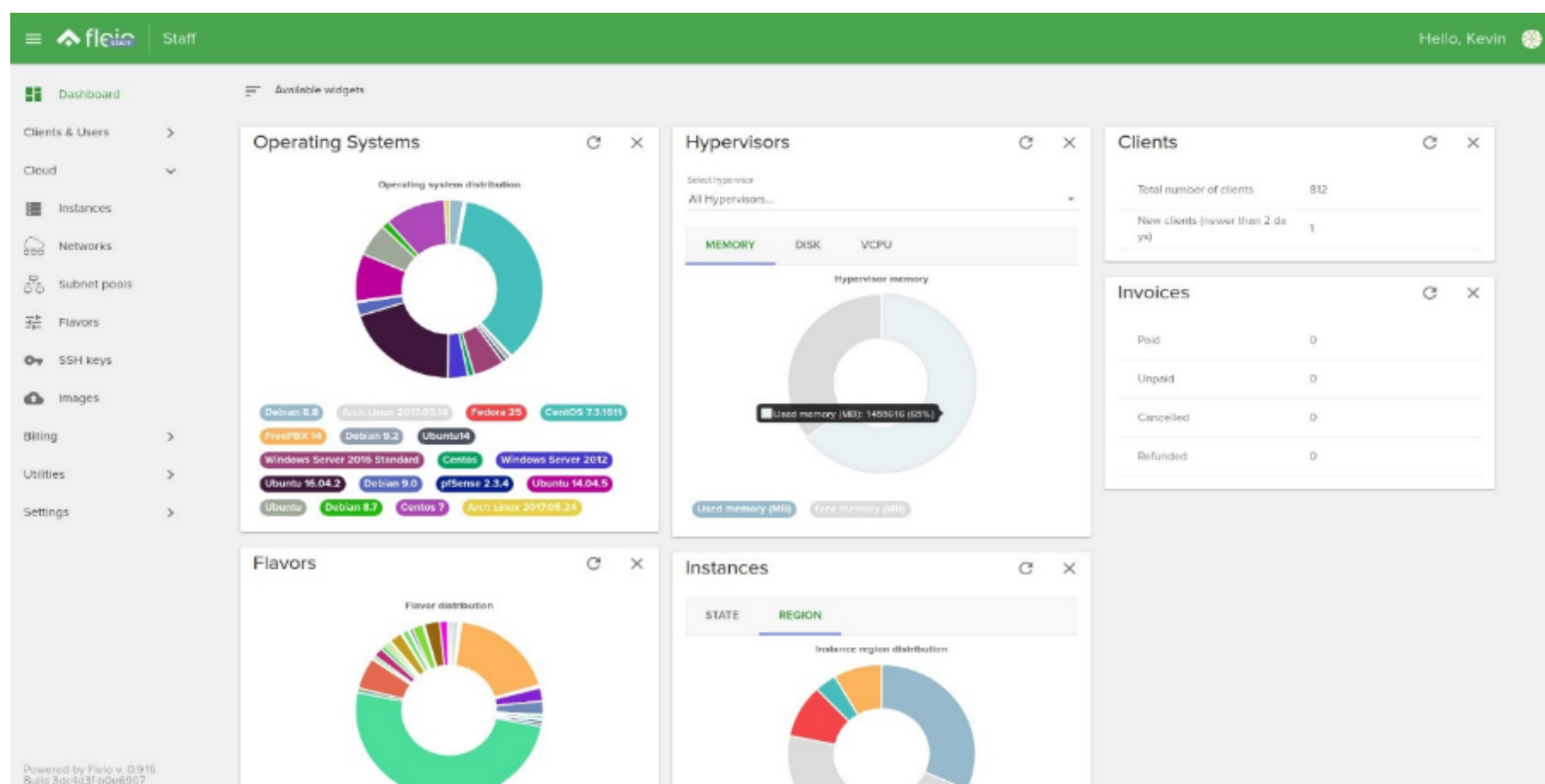


Fig 3.14 Staff Panel Homepage

The main menu area contains these categories: Clients & Users, Cloud, Billing, Servers, Utilities, Settings, Domains, TODO and Tickets. It can be hidden or displayed using the top-left button from the app.

Clients & Users - Users: See all users and manage them, User groups: See all user groups and manage them, Clients: See all clients and manage them, Client groups: See all client groups and manage them.

Billing - Journal: See a list of all the journals entries, Gateways: Enable payment gateways, Invoices: List all of the invoices and manage them, Services: Manage the services, Orders: See and manage orders, Products: Create or edit products/groups, Configurable Options: Create and edit configurable options, Tax rules: Create and manage tax rules.

Servers - Groups: View server groups. Create, edit and delete groups, Server list: View servers. Create, edit and delete servers.

Utilities - Activity log: See a list of activity logs, Operations: See a list of running, completed or failed operations, Reports: View reports. Create new reports or delete existing ones.

Settings - General: Manage currencies and fleio license, Configurations: Create configurations for clients, Authorization: Manage users and user groups permissions, Notifications: Manage notifications such as new order notification, account credit low, suspension and termination notifications and so on, OpenStack: Set up your OpenStack settings, OpenStack plans: Create and manage OpenStack plans.

You can reload data from a widget or hide the widget from the panel using the highlighted buttons from the above image. If you want to add again a widget that you hid you can do so using the button from the top-left side of the panel like the one highlighted in the above image and you will get something like this: (*) On the App services widget you will see the last date and hour that cron run. If the date is green, it means that the cron has run in the last 24 hours. If it's red then it means that the cron did not run in the last 24 hours and needs attention.

Available widgets: Invoices widget, Instances widget, Flavors widget, Clients widgets, App services widget, Hypervisors widget, Operating systems widget.

TODO notification: Manage and view TODO notifications

Ticket notifications: Manage and view tickets

User Notifications: Enable user related notifications

Profile: Edit user profile, such as email address, password, Log out, etc.

The Staff can view the users. Staffs can delete, edit and add a user as a service provider.

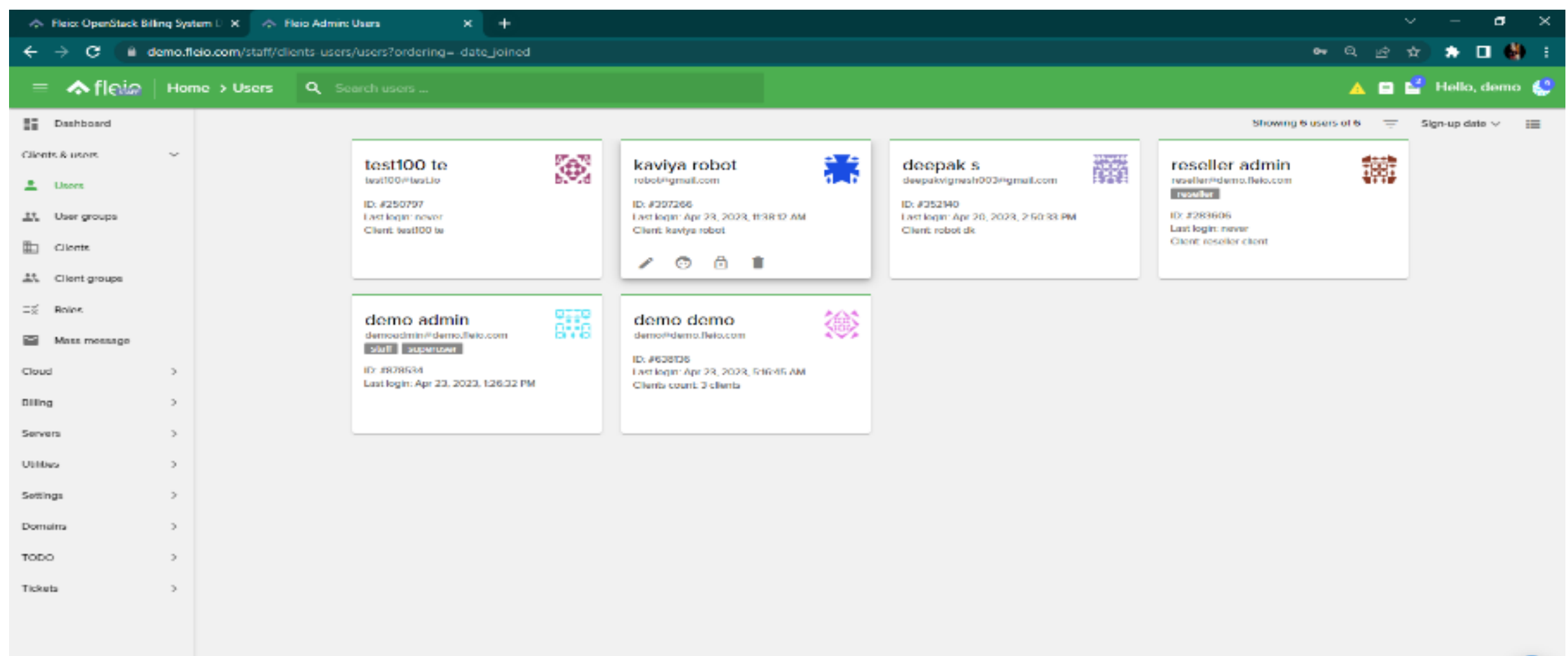


Fig 3.15 View Users

A user can have one of the following statuses - active (marked with green), inactive (marked with red). Staff can filter them by: Date joined, Last login, Is active, Is staff, Is super user, User group. Staff can also sort the clients by: Last login, Sign-up date, Username, Email. To execute actions on a user, just hover your cursor over the chosen user (both in card and list view). Click on the user's name to get a detailed page about him.

Staff panel can assign roles to the existing registered users and give permission to access certain settings. The Staff can add payment to the unpaid invoice from the user credits. Staff can also check the log details, overview of the users registered. After adding payment, the payment added toast will be displayed. The payment which is added is the amount deducted from the end-user credit for the usage of the resources according to the price.

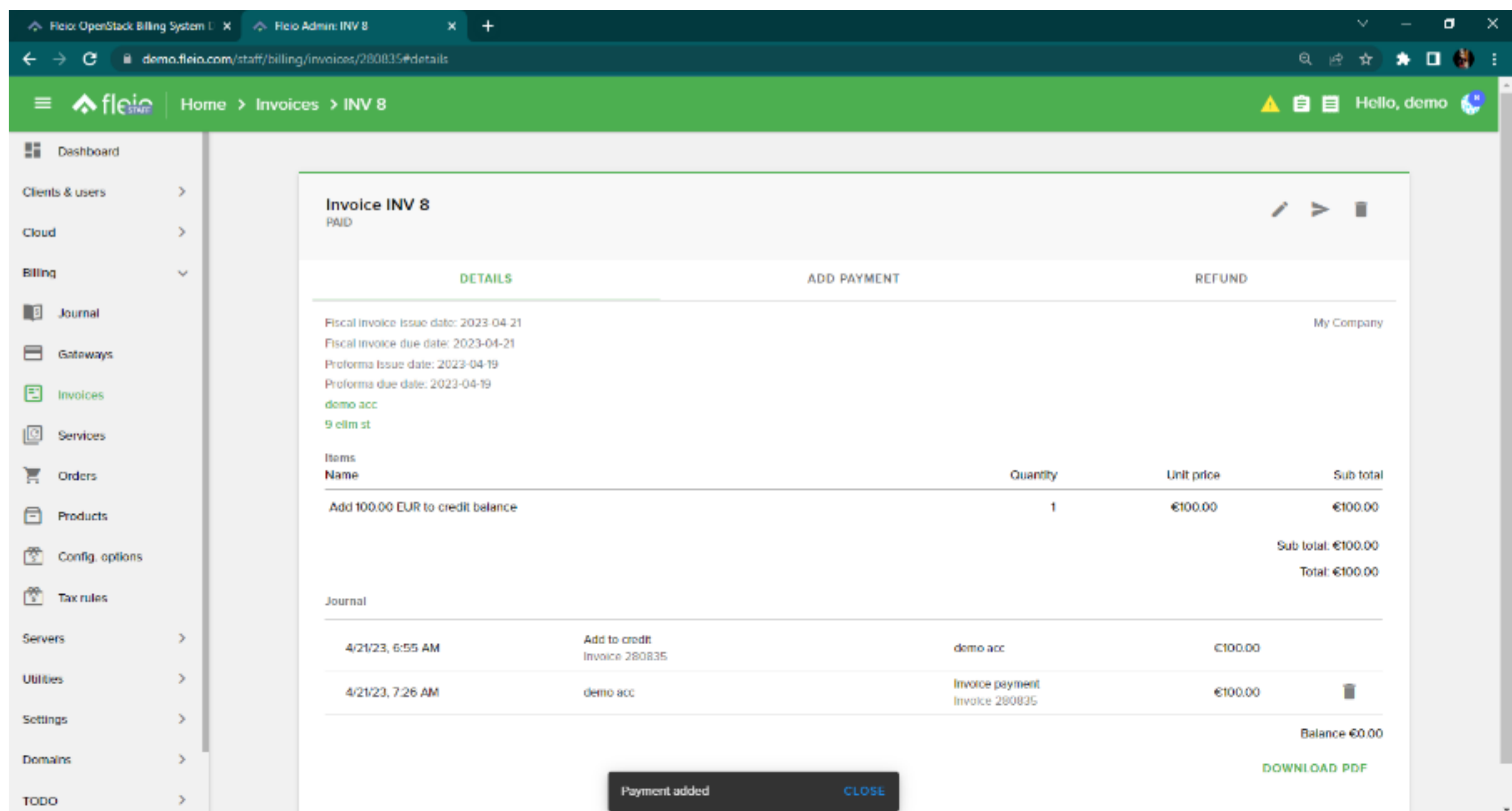


Fig 3.16 Adding Payments

As a service provider we can create a Pricing rule for the Openstack resources in the Openstack plans / service.

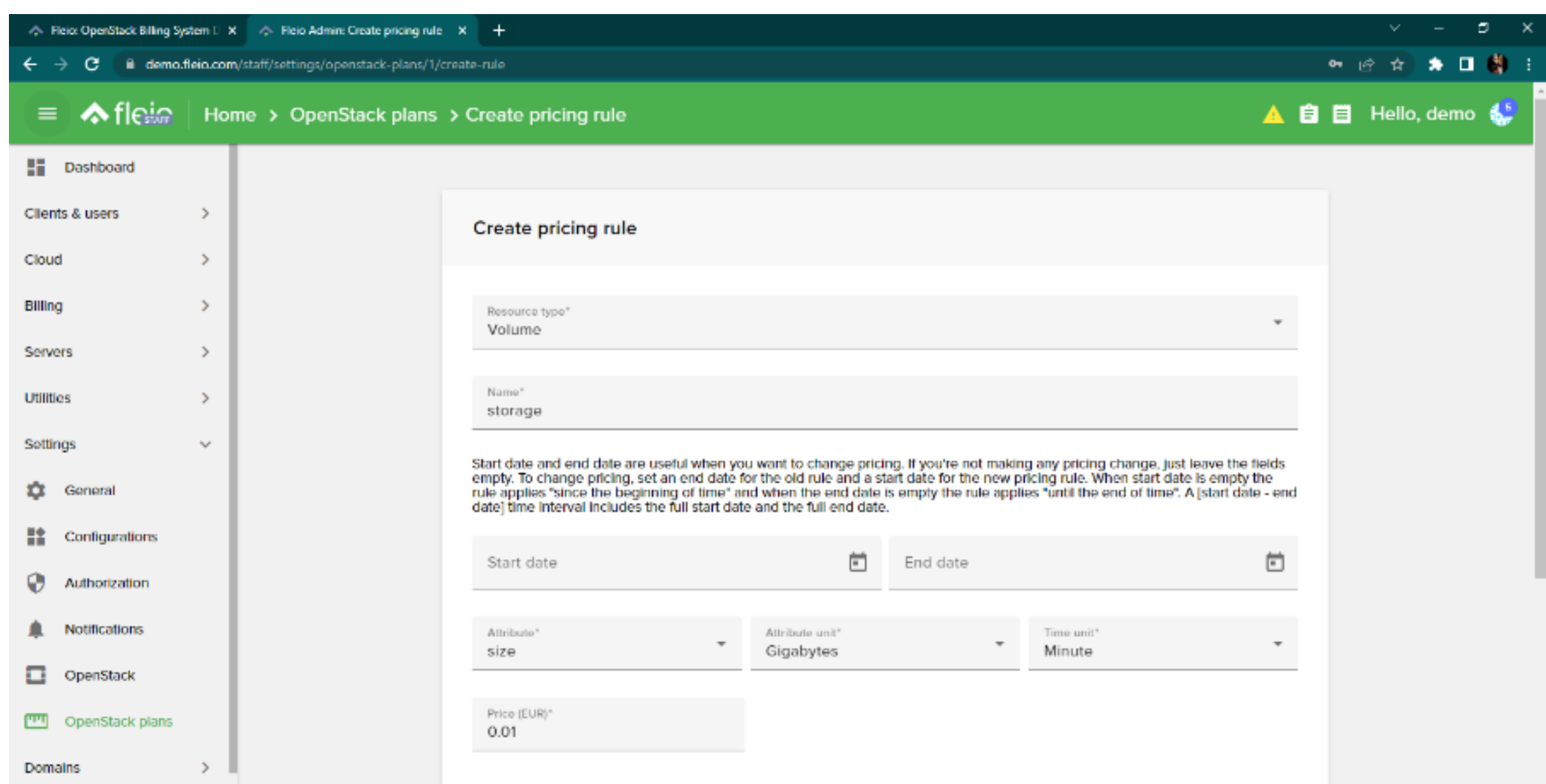


Fig 3.17 Create pricing rule

To add a new price rule, mouse over an item on the openstack plan details page or the openstack plans page and click the (+) button. Each pricing rule in one plan has its own set of filters and modifiers. The billing plan is utilized for all pricing regulations in that plan.

Staff can Impersonate the users and check whether the charges deducted from the credits after adding payments and can also track the usage of resources by checking the billing history.

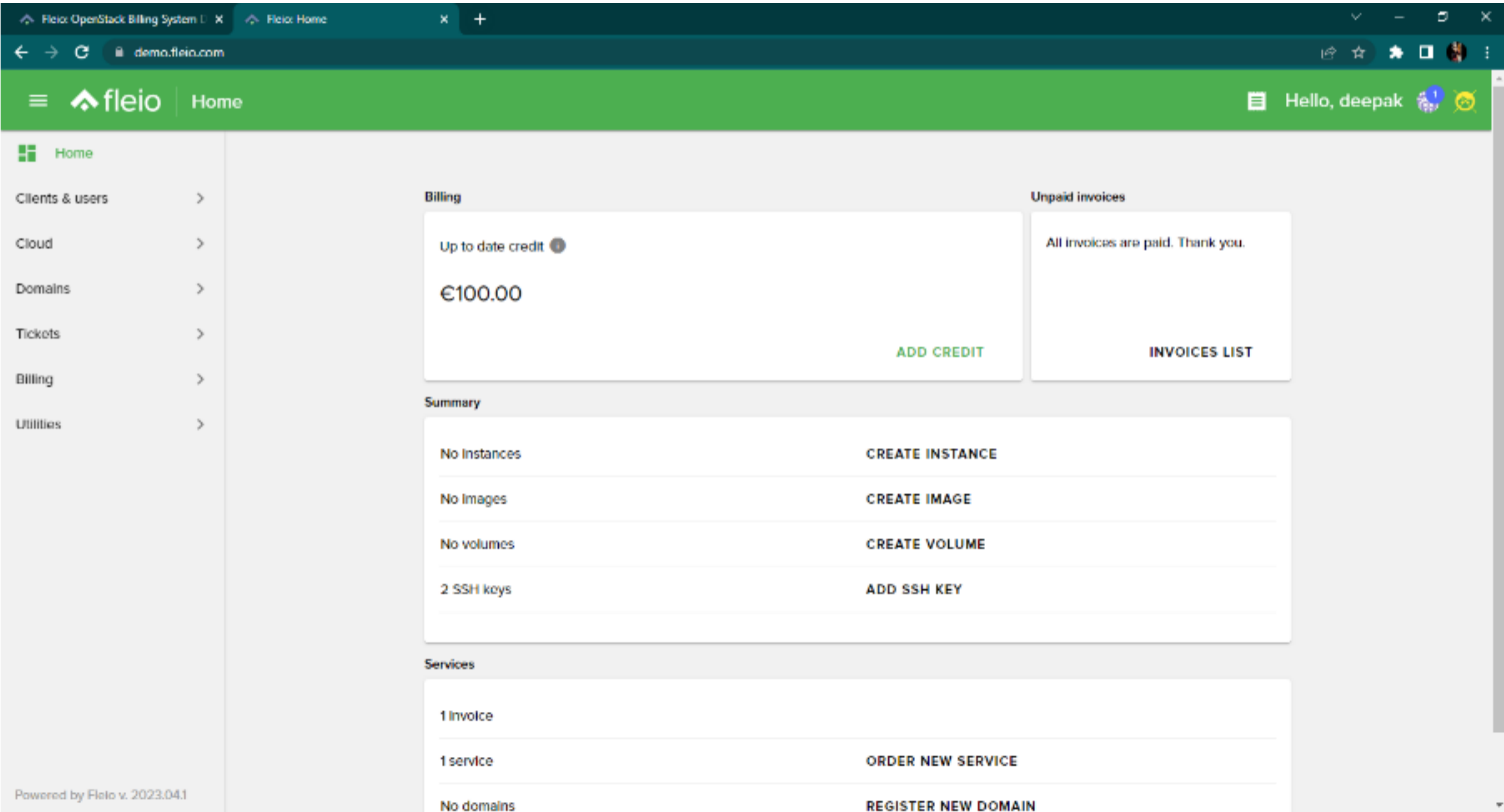


Fig 3.18 Impersonate User

Clicking the impersonate user button will redirect you to the impersonation page. After checking Staff exit impersonation. When you click on the user card, you'll be sent to a website with further information on the individual.

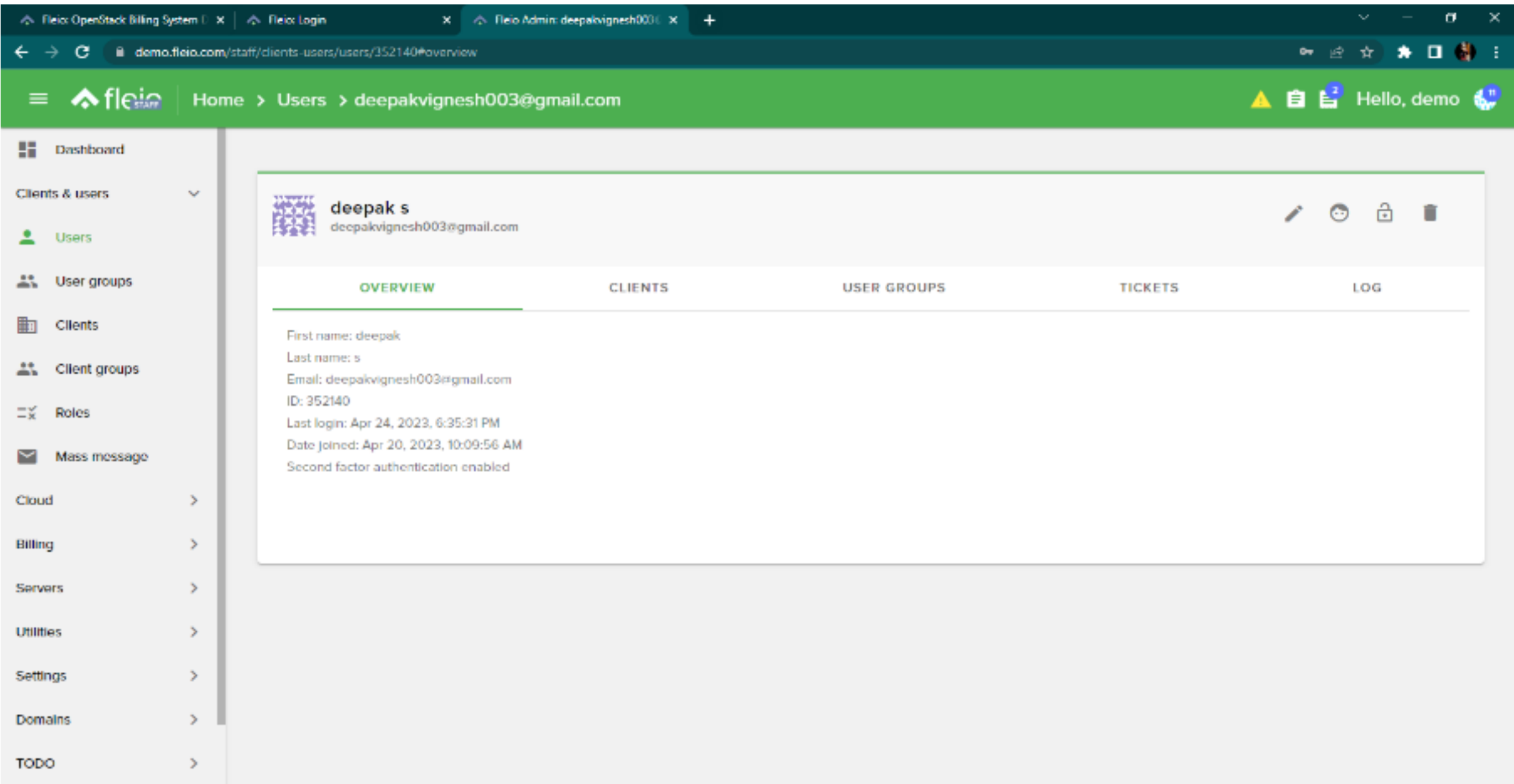


Fig 3.19 User board

Overview- This section displays the user's information, including first and last name, username, email address, user ID, last login date, and join date.

Clients -A list of clients linked with this user may be found here. When you click on the allocated customer, you will be sent to the client information.

User groups - You may manage the user's group here. You can associate the user with a group or revoke the relationship.

Tickets - This is where you can view what tickets are linked with the user. When you click on a ticket, it will take you to the appropriate ticket.

Once the Staff Panel work is done the Staff can log out from their billing account.

3.3 OPENSTACK RESOURCES TYPES AND PRICING RULES

Each pricing rule must be specified on a certain type of resource. Openstack Resource types are as follows:

	Instance
	Image
	Volume
	Network
	Object storage
	Instance traffic
	Ceph object storage
	Volume snapshot
	Volume backups
	Floating IPs
	DNSDomains
	Instance IPs

Fig 3.20 Resource Types

Instance Pricing Rule

Price can be applied on compute instances based on:

existence: A price per Time Unit (second, minute, hour, billing cycle).

vcpu: The price per Time Unit is multiplied with the number of virtual CPU cores.

root_gb: The price per Time Unit is multiplied with the number of GB of the instance's main disk.

memory_mb: The price per Time Unit is multiplied with the number of MB of the instance's memory.

ephemeral_gb: The price per Time Unit is multiplied with the number of GB of the instance's ephemeral disk size.

Image Pricing Rule

OpenStack Glance image storage can be priced on:

existence: A price per Time Unit (second, minute, hour, billing cycle) regardless of the size in GB.

size: The price per Time Unit is multiplied with the size of the image. You can select the Size Unit: Bytes, Kilobytes, Megabytes, Gigabytes, Terabytes, Petabytes.

Volume Pricing Rule

OpenStack Cinder volumes (also known as block devices) are priced on the same characteristics as images:

existence: A price per Time Unit (second, minute, hour, billing cycle) regardless of the size in GB.

size: The price per Time Unit is multiplied with the size of the image. You can select the Size Unit: Bytes, Kilobytes, Megabytes, Gigabytes, Terabytes, Petabytes.

Network Pricing Rule

The rules apply to the amount of data sent over an L3 network. Flat pricing entails multiplying the amount of GB by the Price per GB entered. Tiered pricing allows for different pricing based on the amount of GB charged. For example, you may specify that the first 1000 GB costs 0.05 EUR per GB, the next 1000 GB costs 0.045 EUR per GB, and the next 1000 GB costs 0.04 EUR. You may also make the first tier free. In other words, the first 2500 GB is free. For example: 0 - 2500GB will be free 2500 GB - 5000 GB, 0.003 / GB 5000 GB - infinite, 0.006 / GB.

If the client has 7000 GB of traffic he will be billed as following:

5000 GB (for the 2500 GB - 5000 GB tier) at 0.003 / GB (7.5 EUR)

2000 GB (for the 5000 GB - infinite tier) at 0.006 / GB (12 EUR)

Total billed for this instance will be 19.5 EUR (2500 GB at 0.003 / GB (7.5 EUR) + 2000 GB at 0.006 / GB (12 EUR)) . g, active, paused, rescued, suspended, resized, error.

Object storage Pricing Rules

This assumes that Ceilometer was set up to gather metrics correctly and send them to Gnocchi for further processing. Fleio has support for Swift billing on the following metrics:

storage.objects.incoming.bytes - the total incoming network traffic in Gigabytes during a month

storage.objects.outgoing.bytes - the total outgoing network traffic in Gigabytes during a month

storage.objects - the average number of objects in a month is computed and the price is per object-month.

storage.objects.containers - the average number of object containers in a month is computed and the price is per container-month.

storage.objects.size - the average size in Gigabytes of all objects is computed during a month and the price is set per GB-month.

Flei also collect the following metrics for CEPH object storage:

radosgw.api.requests - number of API requests against Ceph Object Gateway (radosgw)

radosgw.objects - number of objects

radosgw.objects.containers - number of containers

radosgw.objects.size - total size of stored objects

Assume you want to charge a client for the entire size used on Swift throughout a month with 31 days. Assume the user utilises 10 GB of storage during the first five days of the month, 15 GB over the following twenty days, and 20 GB during the final six days. Assume the pricing is set at \$1 per GB of storage per month. As a result, the following pricing computation would be made:

Price for the month = (10 GB * 5 days + 15 GB * 20 days + 20 GB * 6 days) / 31 days * \$1 = \$15.16

Instance traffic Pricing Rules

This assumes traffic data collecting was set up correctly in Fleio. See traffic monitoring for more details. Billing the following types of instance traffic.

Incoming public traffic - the incoming public traffic for an instance

Incoming private traffic - the incoming private traffic for an instance

Outgoing public traffic - the outgoing public traffic for an instance

Outgoing private traffic - the outgoing private traffic for an instance

Total public traffic - total public traffic for an instance

Total private traffic - total private traffic for an instance

Total traffic - total traffic per instance

3.4 BILLING PERIODIC TASK AND CYCLES

A Fleio Openstack billing periodic task is a job that is done on a regular basis using a celery beat. When invoked, this script will update all clients' resource consumption and, if necessary, produce bills or automatically settle usage from client credit. Client settings can be used to control the behaviour of this script. When run the fleio billing periodic task will do the following operations for each client in the following order:

- If the client is active, the system will process all client services and produce bills or settle use according on the customer's settings.

- regardless of customer status, will execute cancellation requests for client services

- will update client use regardless of client state, because even if the client is suspended, there may be ongoing services with the suspend date overruled.

- whether a client is suspended, it will check to see whether the customer has enough credit currently, and if so, it will restart the client if it was suspended due to a lack of credit.

- If the client is active, it will verify the credit status and suspend the client if the suspension conditions match, otherwise it will issue credit alerts if necessary.

- If the client is suspended, it will be checked to determine if the client has any services with suspend override.

When to launch a billing periodic task - This periodic job should be executed on a regular basis in order to process usage and suspend clients in a timely way. This should be repeated every 10-15 minutes.

Fleio Openstack billing periodic task is an Invoices are issued on a regular basis, generally once a month or, depending on the product, once a year for domains or a combination of these times. Unless the product is free, a Fleio product has one or more billing cycles (time frames for computing pricing and invoicing a client). Pricing for a product is determined by the product's billing cycles. The basic billing cycles are as follows:

One Time - a one-time charge will be made.

Hour - every hour, not a typical choice, but it allows you to charge every two weeks, for example.

Month - depending on the multiplier, every one or more months

Year - once or more years, very helpful for domain names

Setting a multiplier for the billing cycles allows a custom cycle in various ways. Example: Month with a multiplier of 3 means every 3 months or commonly known as quarterly.

A cycle has a set price that might be larger than or less than zero. Setting a price of 5 USD with the Month cycle and a multiplier of 1 indicates that the product gets charged a set amount of 5 USD each month. For items that enable dynamic pricing, setting the fixed price to zero is typically beneficial.

An OpenStack product, for example, with the Fixed plus dynamic price model enabled, will always have a dynamic price based on the resources consumed. If a fixed fee is also defined, the payment is always charged regardless of how much a consumer uses the service. Because the module does not calculate a dynamic pricing for a cPanel product, it requires a set price.

The cycle status determines whether or not the product is available when ordered. The order form does not include a private or retired status. Always provide a public billing cycle for a non-free product to make it available during the purchase process. Customers will be able to order a product when the first cycle has been added. Billing cycle as calendar month. This will make the billing cycle to be taken as calendar months. If there is already an ongoing cycle when this will be taken in consideration only after the ongoing cycle has ended. If the cycle will end on 15th of the month, the

Billing cycles



Billing cycle as calendar month

Billing cycle as calendar month

Consider a calendar month as billing cycle.

Not checking this option will use the default: each client has his own anniversary date based on the date he signed up.

new cycle will last until the last day of the month, and the new cycle will start on 1st of the next month.

Fig 3.21 Billing cycles

CHAPTER – 4

RESULTS AND DISCUSSION

4.1 BILLING IN OPENSTACK CLOUD

We have enabled a billing system in openstack cloud. In Fleio openstack one can enact as End-user as well as a Staff / admin hosting a system. Staff creates pricing rule for the resources which will be added to the openstack plans. Once the pricing rule is added to the openstack resources according to it the end-user resource utilization will be calculated and charge for the resource used. End-user tracks the usage by viewing the billing history, then the charges will be deducted from the credits added and invoice will be generated.

Fig 4.1 Billing

The screenshot displays the 'Create pricing rule' form within the Fleio Admin interface. The browser address bar shows the URL: `demo.fleio.com/staff/settings/openstack-plans/1/create-rule`. The page has a green header with the Fleio logo and navigation links: Home > OpenStack plans > Create pricing rule. A sidebar on the left contains a menu with items: Dashboard, Clients & users, Cloud, Billing, Servers, Utilities, Settings (expanded), General, Configurations, Authorization, Notifications, OpenStack, OpenStack plans (highlighted), and Domains. The main content area is titled 'Create pricing rule' and contains the following fields:

- Resource type***: A dropdown menu with 'Volume' selected.
- Name***: A text input field containing 'storage'.
- Start date** and **End date**: Date selection fields with calendar icons.
- Attribute***: A dropdown menu with 'size' selected.
- Attribute unit***: A dropdown menu with 'Gigabytes' selected.
- Time unit***: A dropdown menu with 'Minute' selected.
- Price (EUR)***: A text input field containing '0.01'.

Below the form, there is a small text block providing instructions: 'Start date and end date are useful when you want to change pricing. If you're not making any pricing change, just leave the fields empty. To change pricing, set an end date for the old rule and a start date for the new pricing rule. When start date is empty the rule applies "since the beginning of time" and when the end date is empty the rule applies "until the end of time". A [start date - end date] time interval includes the full start date and the full end date.'

Fleio: OpenStack Billing System

Fleio Admin: Pricing plan default

demo.fleio.com/staff/settings/openstack-plans/1

fleio

Home > OpenStack plans > Pricing plan default

Hello, demo

Dashboard

Clients & users

Cloud

Billing

Servers

Utilities

Settings

General

Configurations

Authorization

Notifications

OpenStack

OpenStack plans

Domains

TODO

OpenStack plan default

Name	Resource	Price	Start date	End date	Actions
CPU	Instance	0.01 (EUR) / vcpu Min	∞	∞	
MEMORY	Instance	0.01 (EUR) / memory_mb GBmin	∞	∞	
FLOATING IP's	Floating IP's	1 (EUR) / Day	∞	∞	
storage	Volume	0.01 (EUR) / size GBmin	∞	∞	

BACK

CREATE PRICING RULE

Fleio: OpenStack Billing System

Fleio Billing history

Fleio: INV 3

cluster template for openstack

demo.fleio.com/113253/billing/billing-history

fleio

Home > Billing history

Hello, deepak

Home

Clients & users

Cloud

Domains

Tickets

Billing

Services

Invoices

Order services

Cart

Billing history

Utilities

< Period: Apr 20, 2023 - May 19, 2023 >

Service
Default OpenStack Product - c0772c31a43441888c3dc80836d4c71d

INSTANCE	€0.00
IMAGE	€0.00
VOLUME	€0.00
VOLUME SNAPSHOT	€0.00
VOLUME BACKUP	€0.00
FLOATING IPS	€0.00
DNS DOMAINS	€0.00
LOAD BALANCER	€0.00
METRICS	€0.00

Total price: €0.00

Powered by Fleio v. 2023.04.1

CHAPTER – 5

CONCLUSIONS AND FUTURE WORKS

5.1 CONCLUSION

We have successfully enabled a billing system in openstack cloud with staff panel and end-user panel. In staff panel, staff can impersonate as end-user, create pricing rule for openstack resources in the plan, add payment to invoice, assign roles, grant permissions. In end-user panel, user can track the amount of resource used, view billing history, view payment invoice.

5.2 FUTURE WORKS

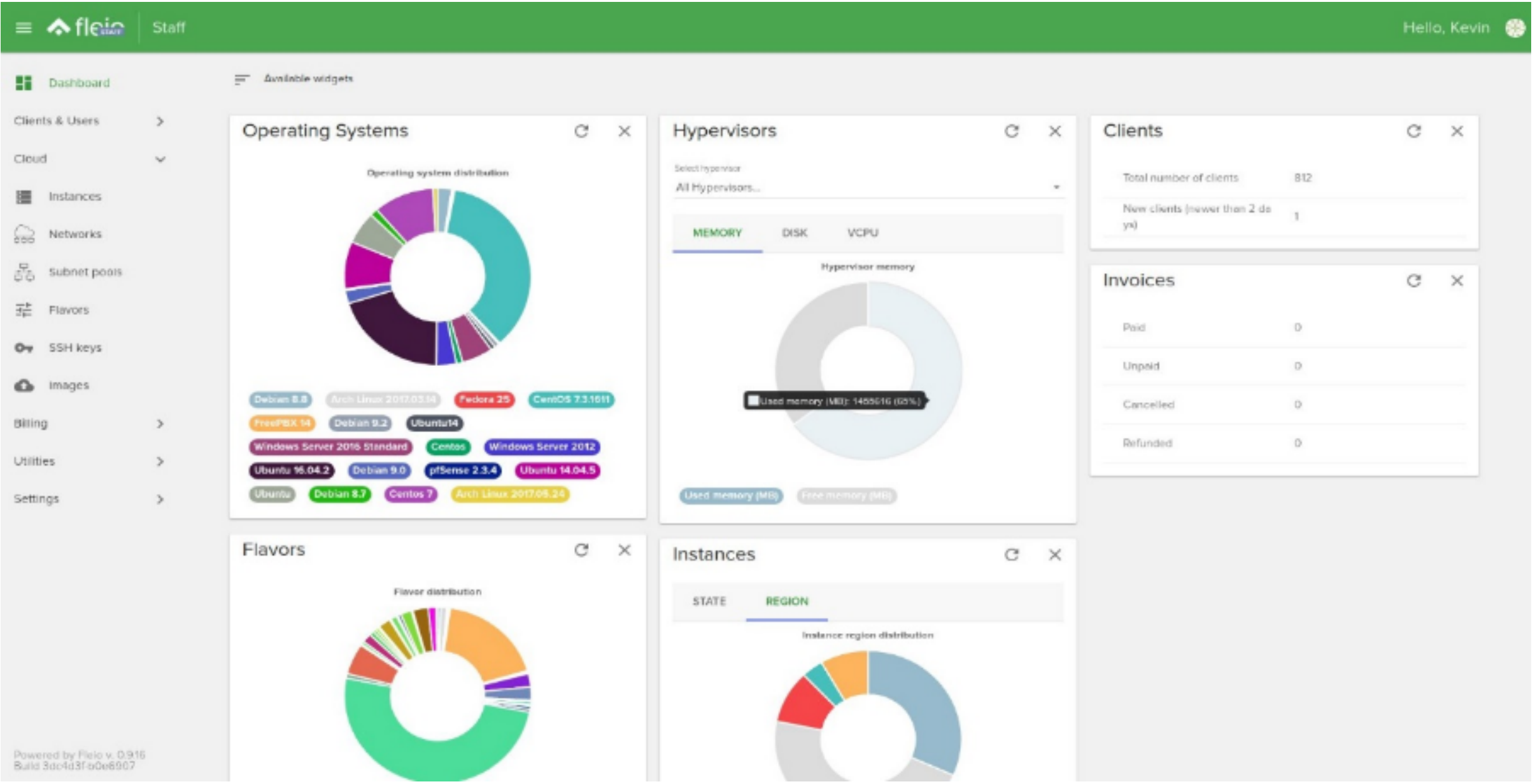
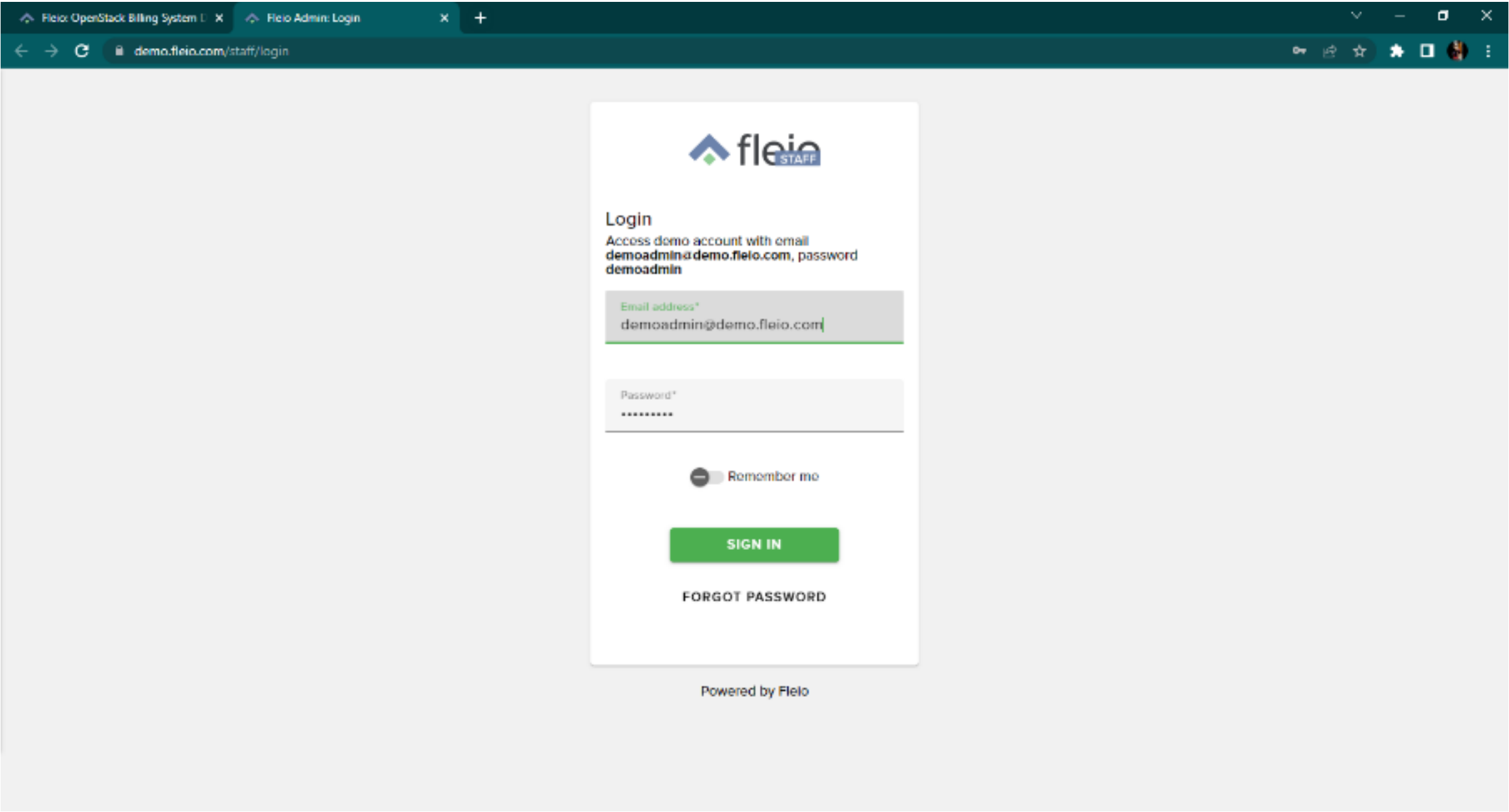
In new business models, billing takes the stage. It's apparent that a positive billing experience is critical to a long and successful client lifecycle. Business strategists see the value of flexible billing systems as a tool for future-proofing customer relationships. With the growth of networked service models, we are seeing the processing of cross-divisional as well as cross-company billing data. Consider mobility-as-a-service, in which different external services are aggregated and delivered to the customer in accordance with pre-defined business criteria. The networked environment in which we do business becomes more complex, and our billing platform needs to be able to integrate to adapt and process external billing data.

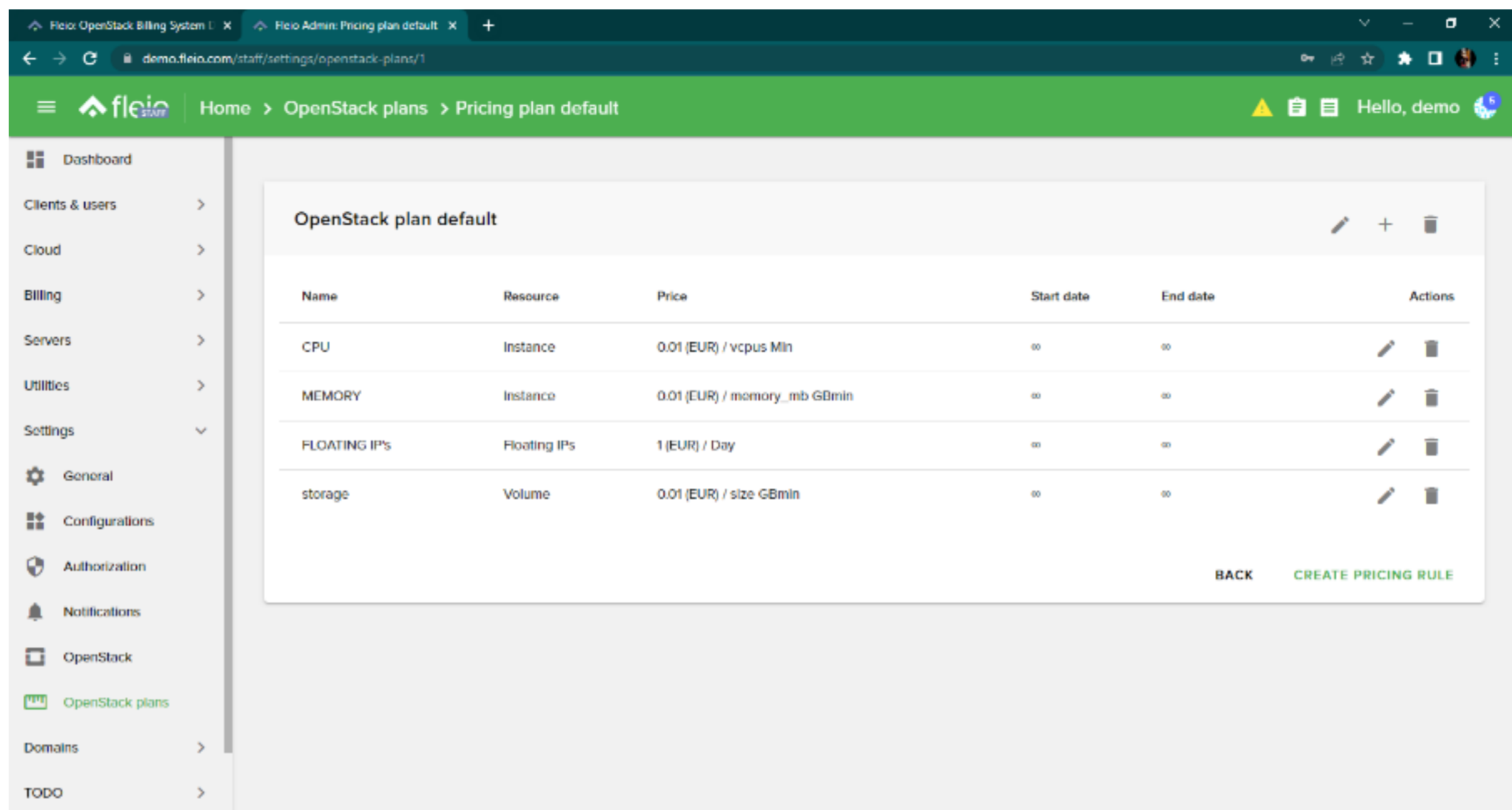
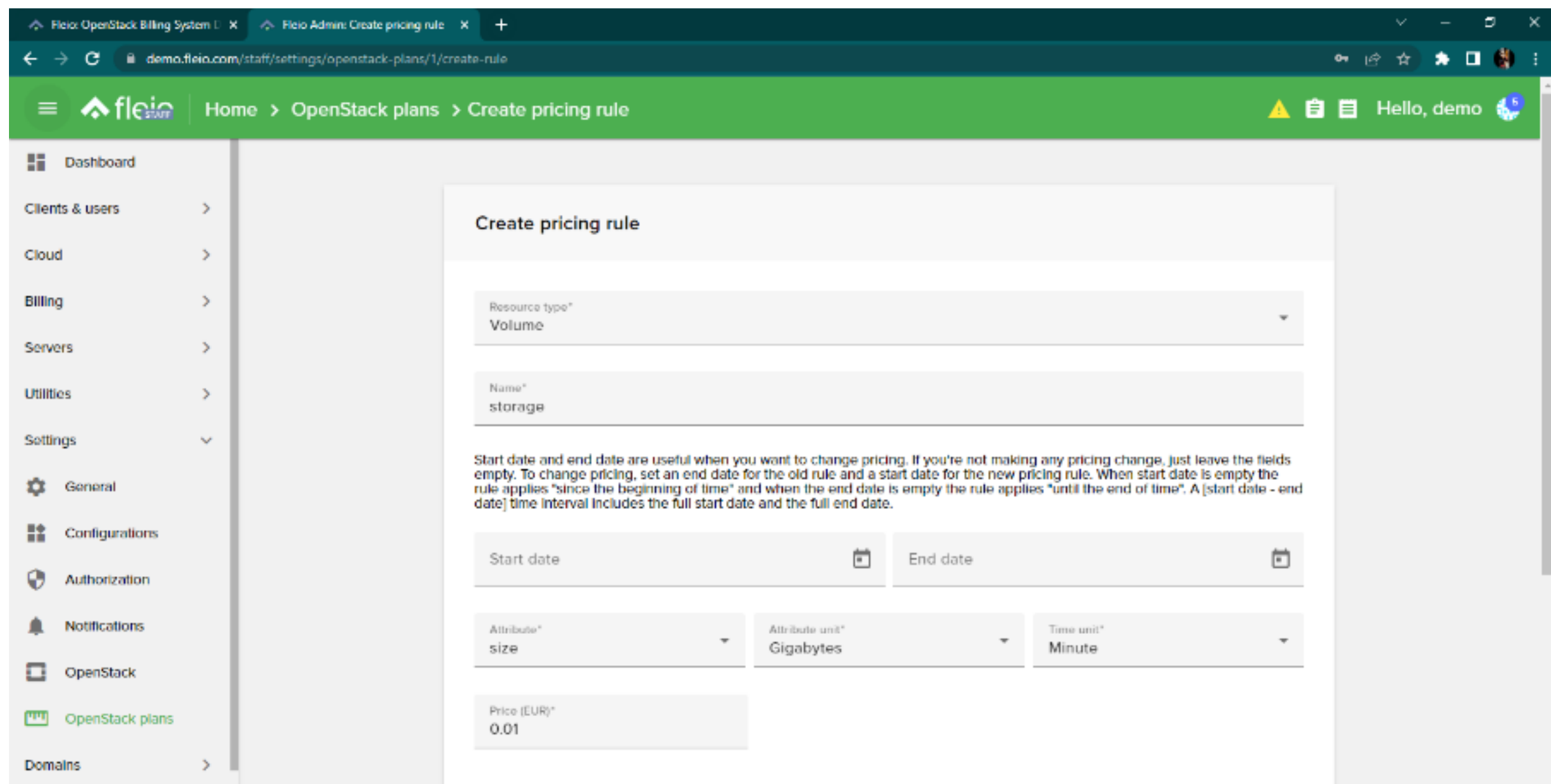
REFERENCES

- ☒ To know about Fleio Openstack:
<https://www.openstack.org/news/view/397/fleio-announces-openstack-billing-control-panel-software-enabling-companies-to-quickly-launch-public-cloud-services>
- ☒ <https://www.google.com/>
- ☒ For project based learning <https://fspcloud.bosschn.in:8443/index1.html>
- ☒ <https://www.geeksforgeeks.org/cloud-computing/>
- ☒ <https://www.goodsign.com/blog/the-future-of-billing-is-customer-centric>
- ☒ <https://fleio.com/blog/category/tutorials/>

APPENDIX

SCREENSHOTS OF STAFF MANAGEMENT IN BILLING SYSTEM





Home > Invoices > 280835

Dashboard

Clients & users

Cloud

Billing

Journal

Gateways

Invoices

Services

Orders

Products

Config. options

Tax rules

Servers

Utilities

Settings

Domains

TODO

Proforma 280835

UNPAID

DETAILS

ADD PAYMENT

REFUND

Payment date

4/21/2023

Gateway*

Bank Transfer

Transaction ID

Amount*

100.00

Fee*

0

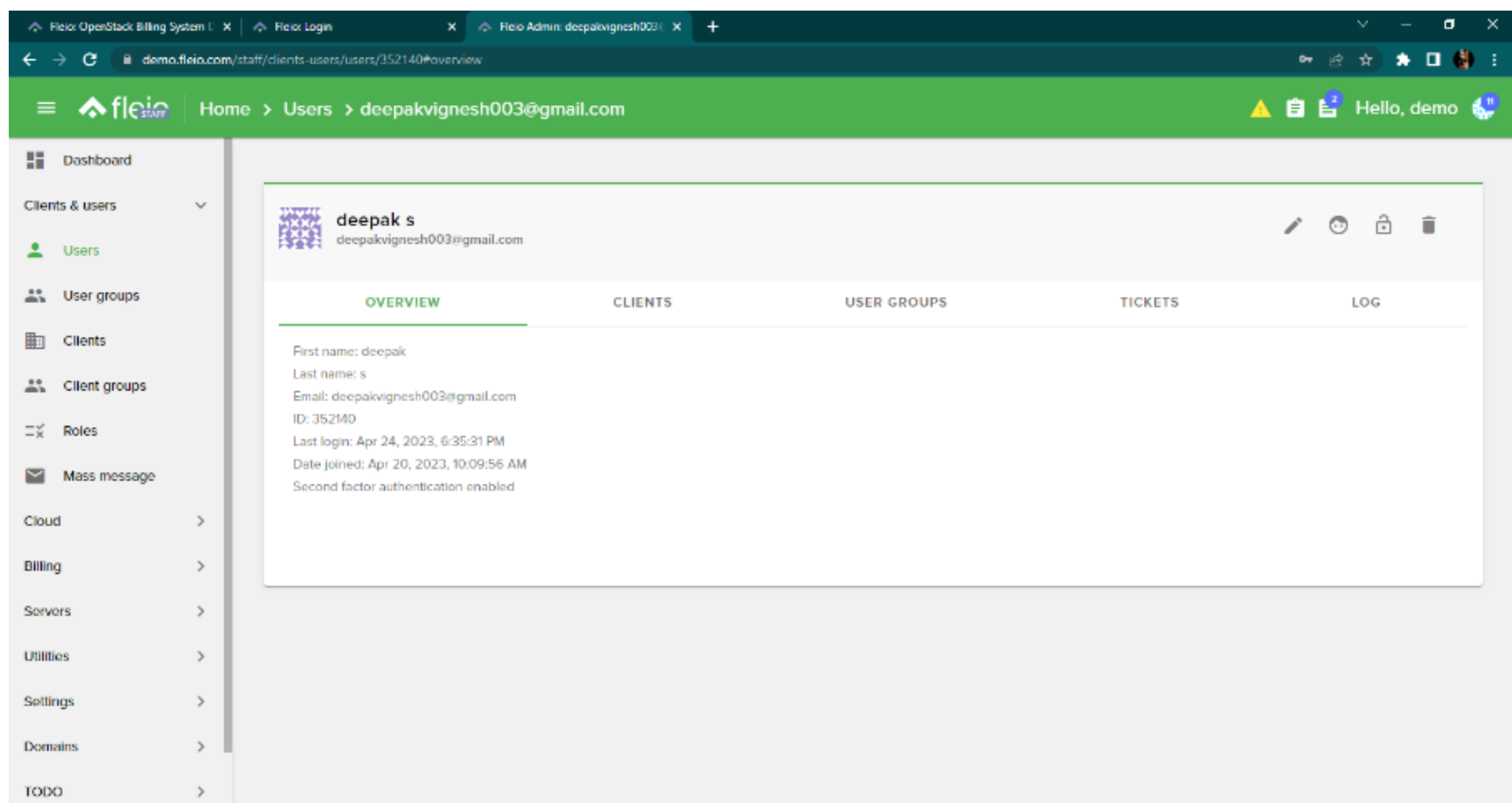
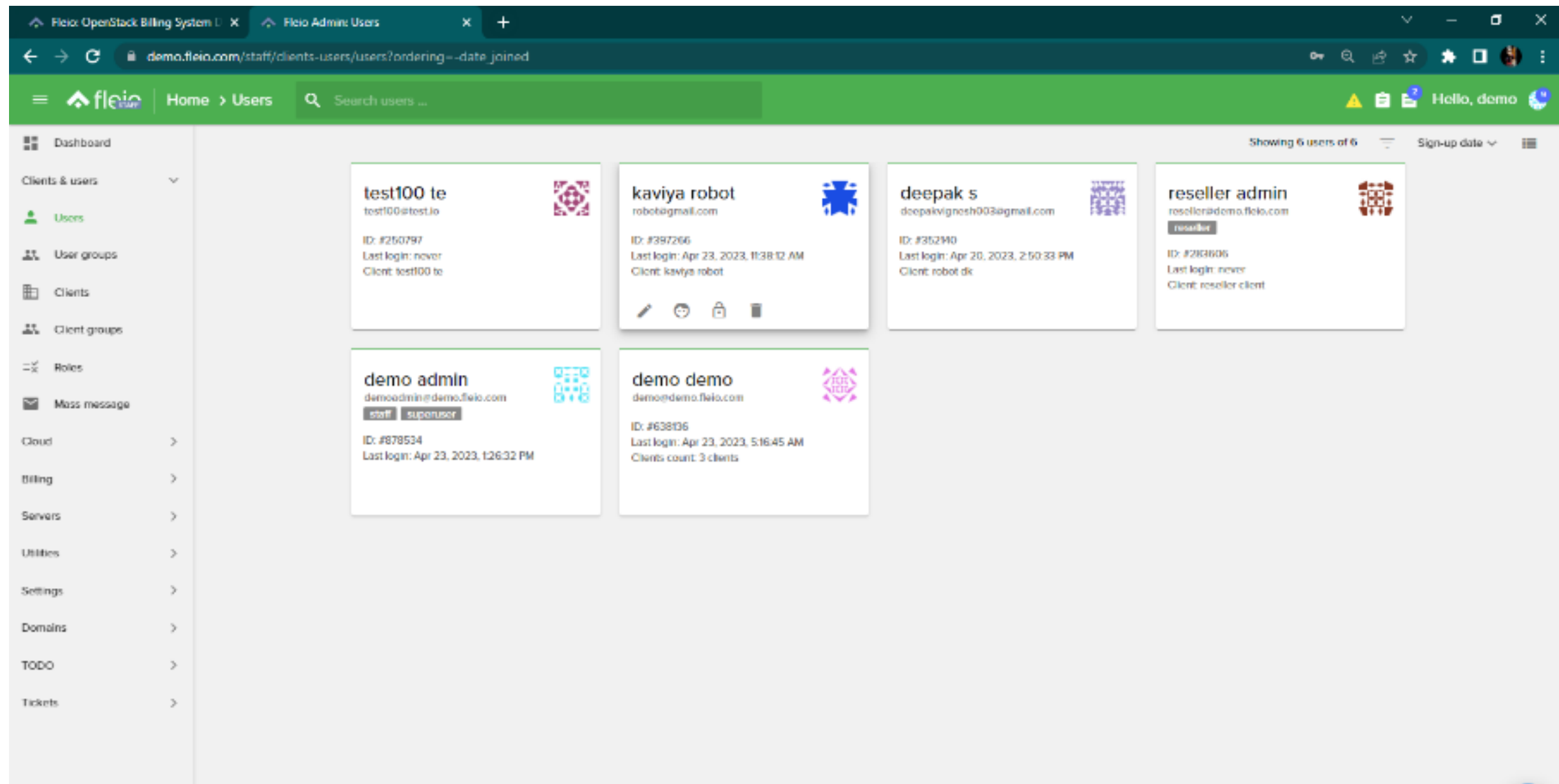
Currency*

EUR

Extra information

ADD PAYMENT

The screenshot displays the Fleio Admin web application. The top navigation bar is green with the Fleio logo and a breadcrumb trail: Home > Invoices > INV 8. A user profile dropdown shows "Hello, demo". The left sidebar contains various menu items like Dashboard, Clients & users, Cloud, Billing, Journal, Gateways, Invoices, Services, Orders, Products, Config. options, Tax rules, Servers, Utilities, Settings, Domains, and TODO. The main content area shows details for "Invoice INV 8 PAID". It includes metadata such as "Fiscal invoice issue date: 2023-04-21" and "Fiscal invoice due date: 2023-04-21". Below this is a table with columns "Items", "Name", "Quantity", "Unit price", and "Sub total". The table lists an item "Add 100.00 EUR to credit balance" with a quantity of 1 and a unit price of €100.00. At the bottom right, there are buttons for "DOWNLOAD PDF" and a toast notification saying "Payment added" with a "CLOSE" button.



Fleio OpenStack Billing System

Fleio: Home

demo.fleio.com

fleio

Home

Hello, deepak

Home

Clients & users

Cloud

Domains

Tickets

Billing

Utilities

Billing

Unpaid invoices

Summary

Services

Up to date credit

€100.00

ADD CREDIT

All invoices are paid. Thank you.

INVOICES LIST

No instances

CREATE INSTANCE

No images

CREATE IMAGE

No volumes

CREATE VOLUME

2 SSH keys

ADD SSH KEY

1 invoice

1 service

No domains

ORDER NEW SERVICE

REGISTER NEW DOMAIN

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Fleio OpenStack Billing System

Fleio: Login

Fleio: Billing history

demo.fleio.com/113253/billing/billing-history

fleio

Home > Billing history

Hello, deepak

Home

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Billing

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Invoices

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Utilities

<

Period: Apr 20, 2023 - May 19, 2023

>

Service

Default OpenStack Product - c0772c31a43441888c3dc80836d4c71d

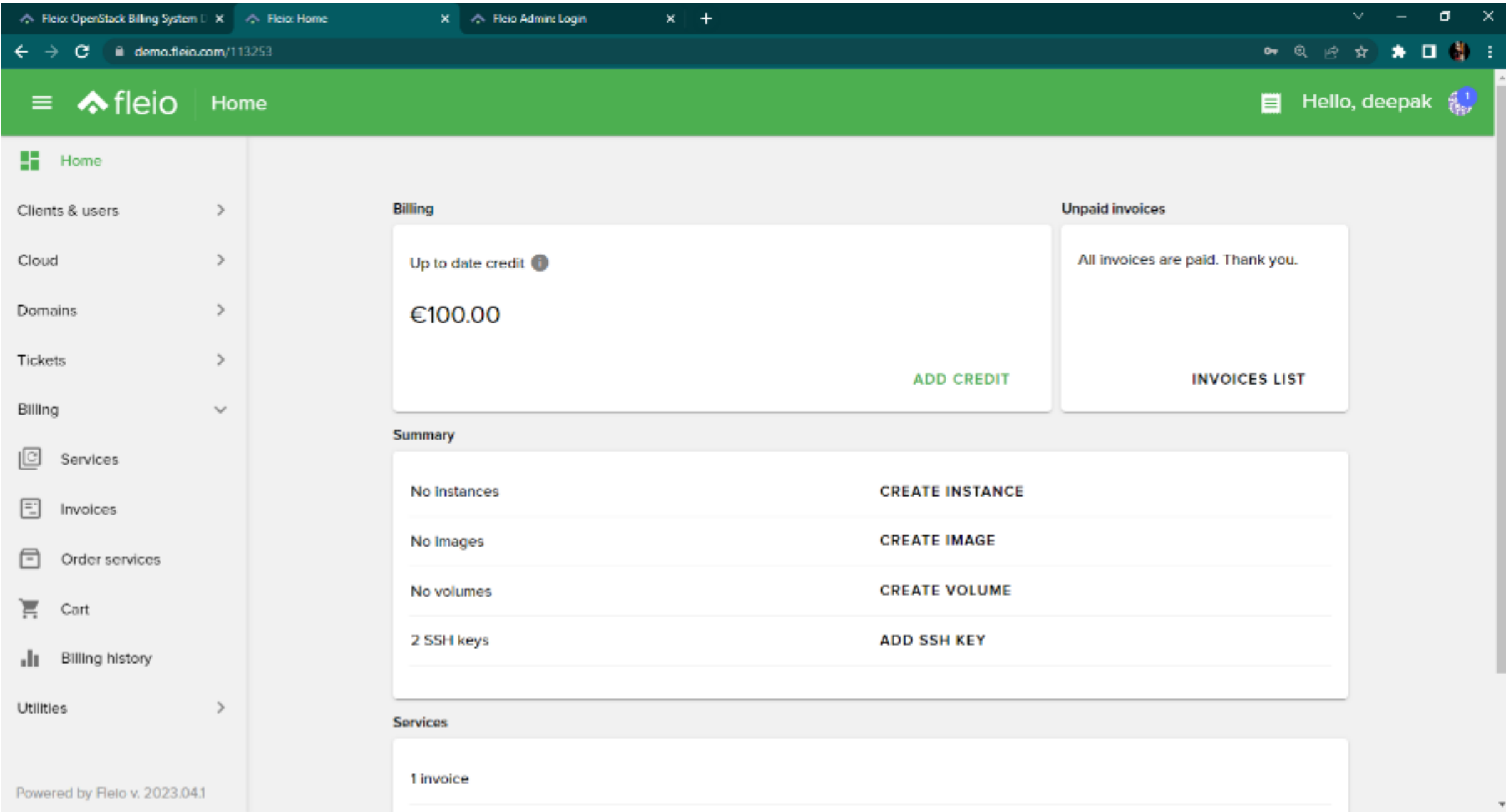
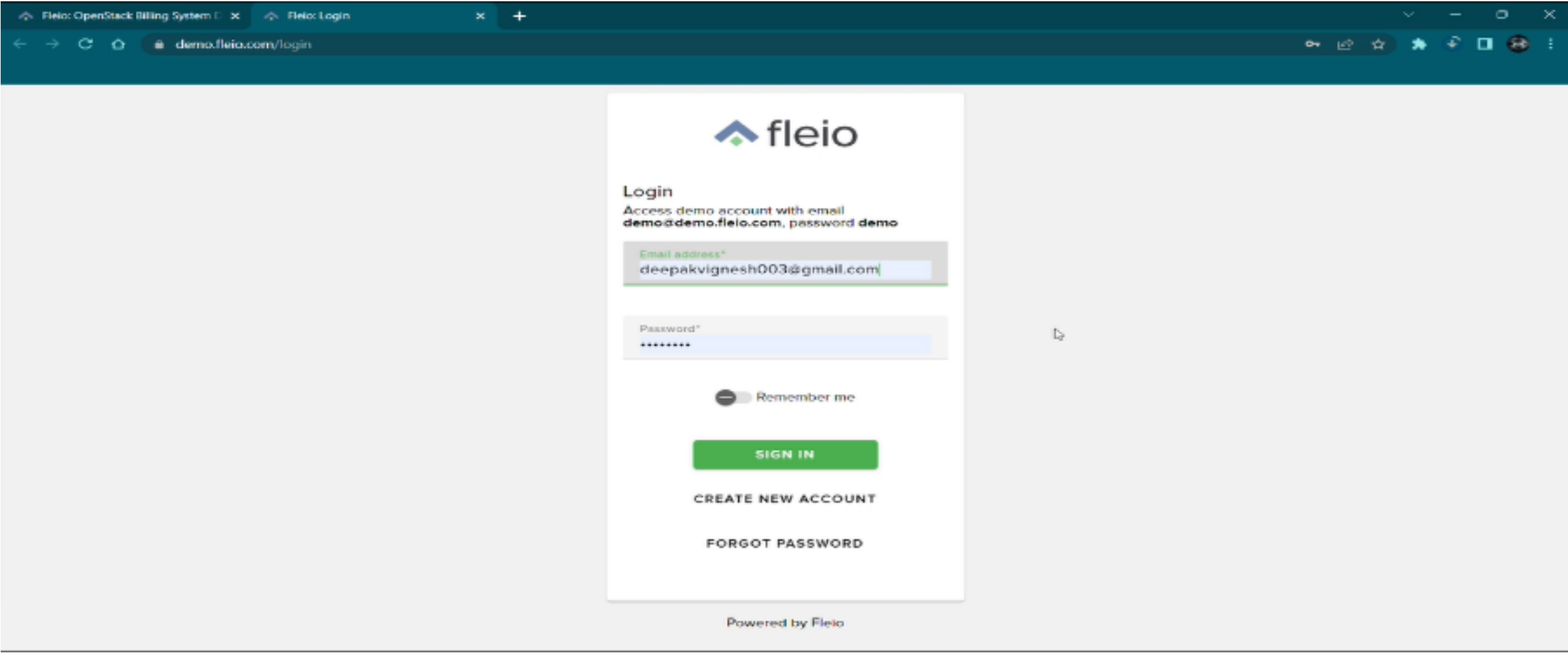
INSTANCE	€0.00
IMAGE	€0.00
VOLUME	€0.00
VOLUME SNAPSHOT	€0.00
VOLUME BACKUP	€0.00
FLOATING IPS	€0.00
DNS DOMAINS	€0.00
LOAD BALANCER	€0.00
METRICS	€0.00

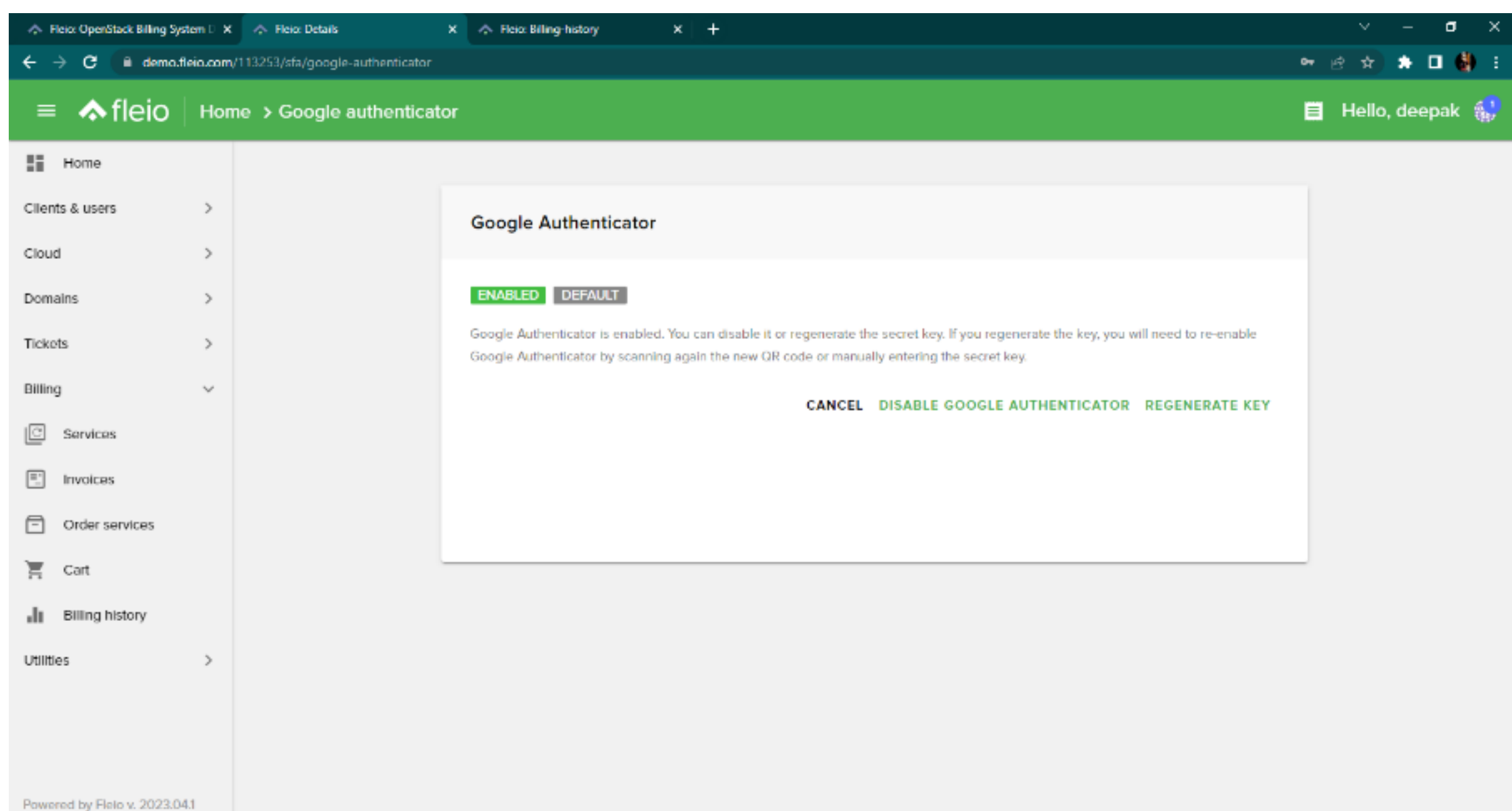
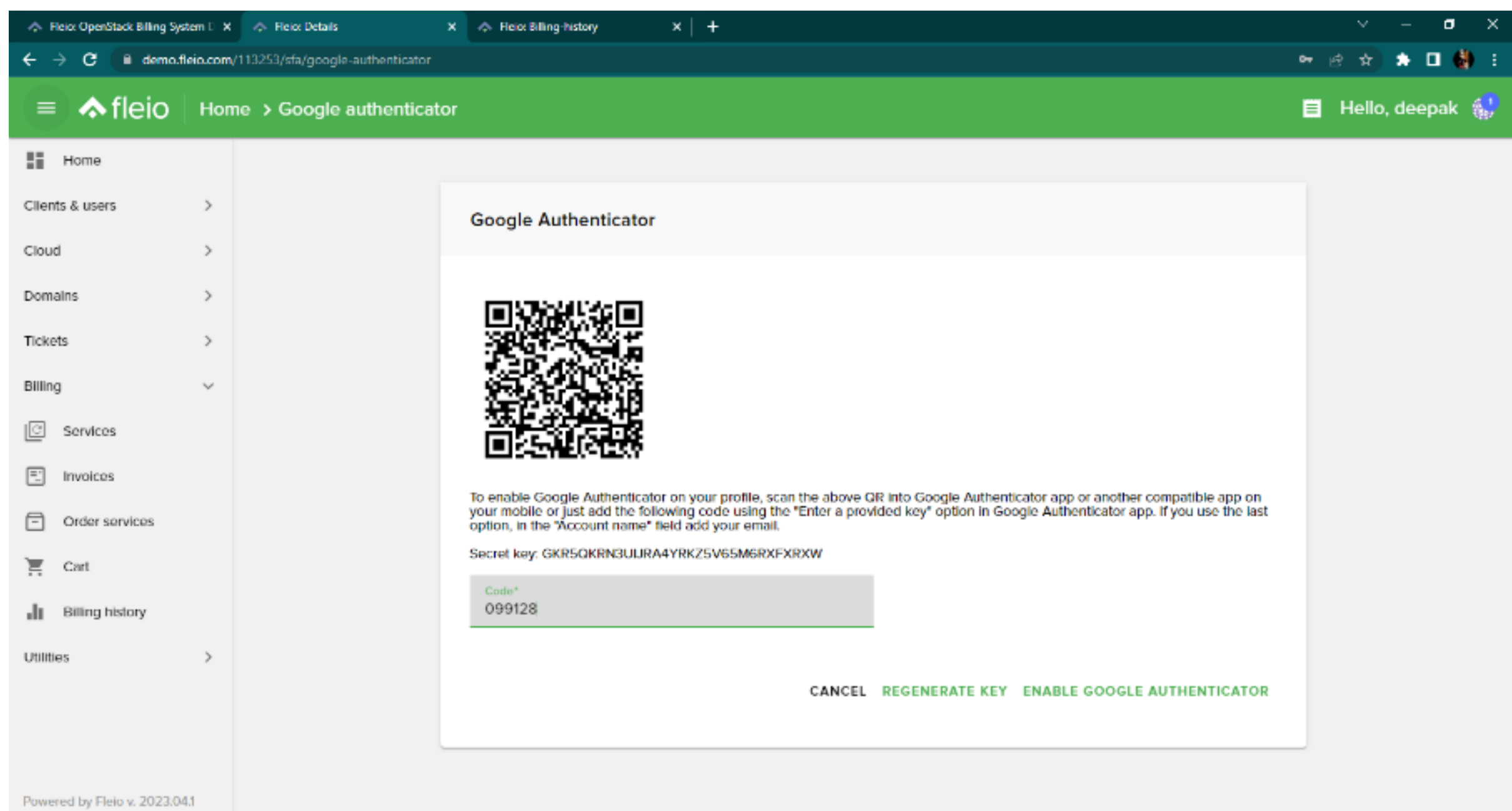
Total price: €0.00

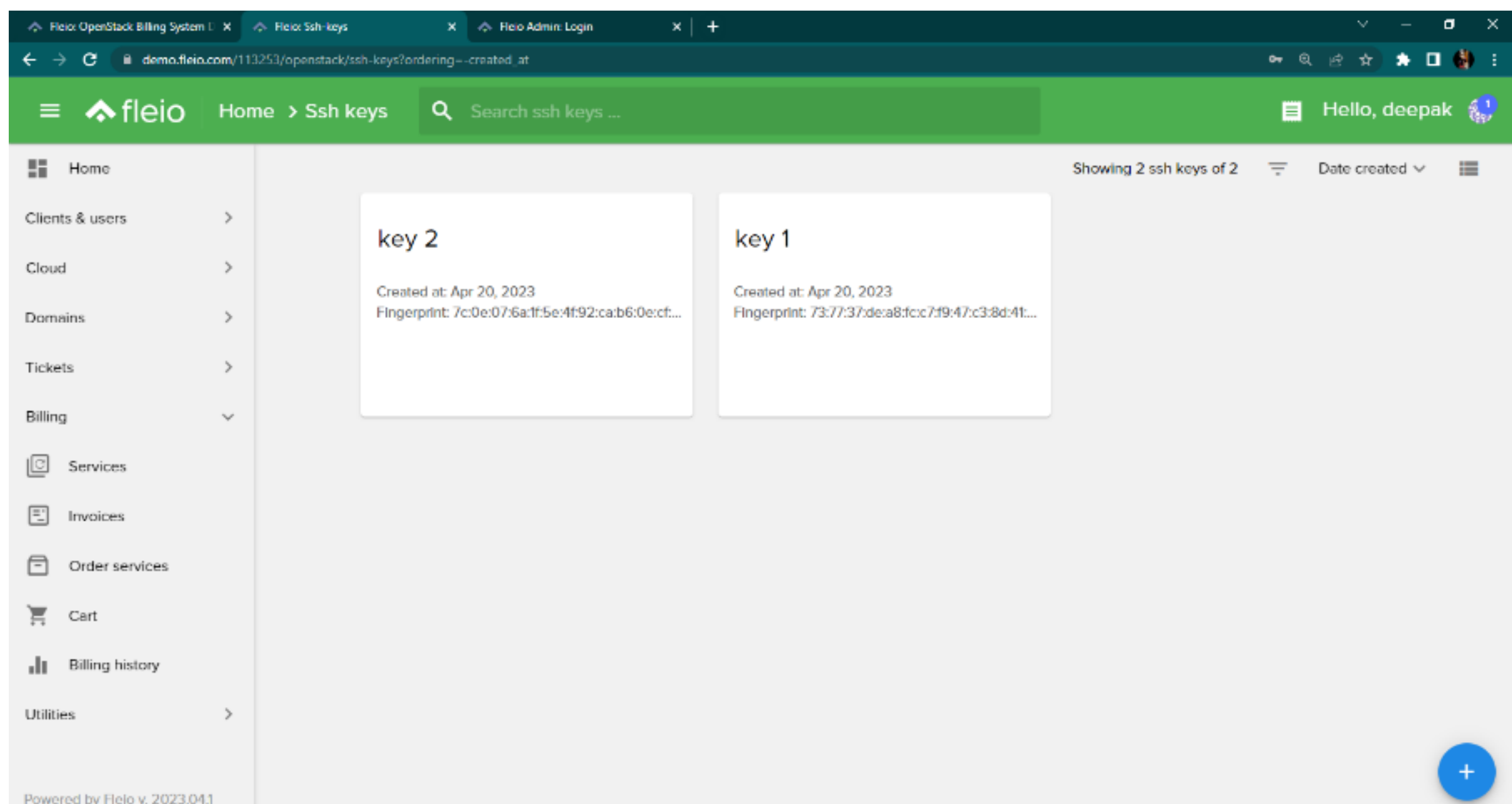
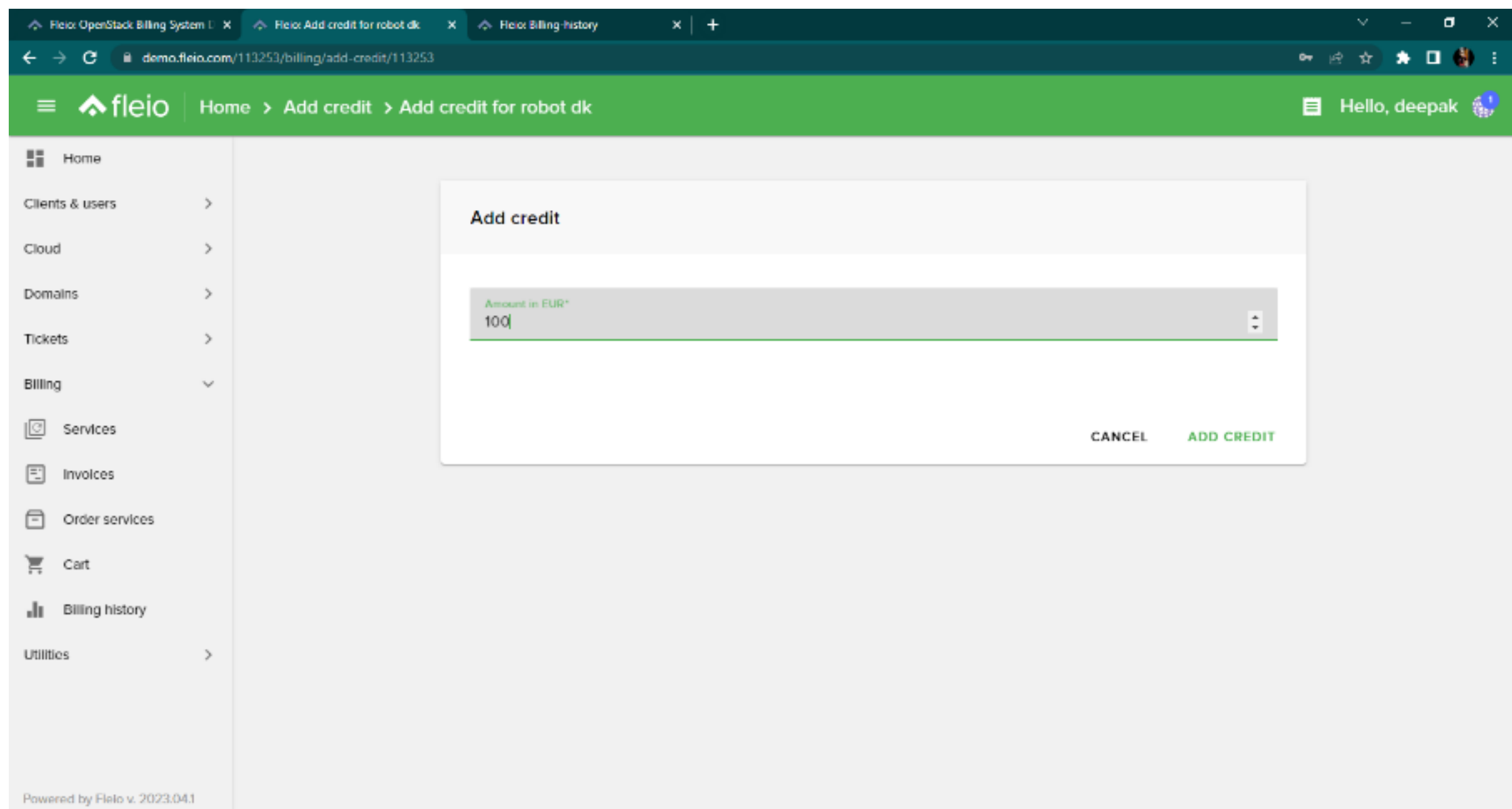
Updated 4 minutes ago

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SCREENSHOTS OF END-USER MANAGEMENT IN BILLING SYSTEM







Fleio: OpenStack Billing System

Fleio: INV 3

Fleio Admin: deepakvignesh003

demo.fleio.com/113253/billing/invoices/839382

fleio

Home > Invoices > INV 3

Hello, deepak

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Invoice INV 3

PAID

Fiscal Invoice issue date: 2023-04-20

Fiscal Invoice due date: 2023-04-20

Proforma issue date: 2023-04-20

Proforma due date: 2023-04-20

abc private ltd,

robot clk

3, Mathan Street,Tindivanam

My Company

Items	Name	Quantity	Unit price	Sub total
	Add 100.00 EUR to credit balance	1	€100.00	€100.00
				Sub total: €100.00
				Total: €100.00

Journal

4/20/23, 10:22 AM	Invoice	Client Credit	€100.00
4/20/23, 10:22 AM	Bank Transfer	Invoice	€100.00
			Balance €0.00

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Fleio: OpenStack Billing System

Fleio: Billing history

Fleio: Billing history

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Home > Billing history

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Service

Default OpenStack Product - c0772c31a43441888c3dc80836d4c71d

INSTANCE	€0.00
IMAGE	€0.00
VOLUME	€0.00
VOLUME SNAPSHOT	€0.00
VOLUME BACKUP	€0.00
FLOATING IPS	€0.00
DNS DOMAINS	€0.00
LOAD BALANCER	€0.00
METRICS	€0.00

Total price: €0.00

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Updated 8 minutes ago

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