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A proposed cloud-based billers hub using secured e-payments system

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ABSTRACT

Automation of several payment processes from start to end is a challenging task, particularly when multiple payments from online and offline billers are involved. In this paper, we introduced a new aggregator system to combine all billing system types, in which it is possible to pay invoices electronically. The proposed aggregator system was designed to be employed in a cloud-based billers hub (CBBH) developed by the central banks. Furthermore, many applications can be realized such as; deposit e-money, withdrawal e-money, and other applications. A Gateway translator is used to apply authentication rules, security, and privacy. The proposed system was employed in the Jordanian payment gateway and successfully fulfills its purpose.

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1. INTRODUCTION

E-payment applications are among the most promising innovations that shift consumers from using traditional bill payment to electronic alternatives [1, 2]. Electronic bill presentment and payment (EBPP) is the process by which companies present invoices through the internet and make payments to one another. Most of the Internet billing system is designed utilizing cloud computing technology. Several countries build their own cloud payment gateways to unify payment issues [3-8]. The two primary E-payment models are the biller-direct model and the aggregation model. In the aggregation model, the aggregator combines data from multiple billers and consolidates the information at a single destination. Several Internet-based billing systems models were suggested in the literature. As part of this proposal, several Internet-based billing systems models were suggested in the literature [6-16].

This paper represents a proposal to any Central Bank intend to establish a cloud-based billers hub (CBBH). It aims to define the technical requirements and the functional boundaries needed. It also depicts a high-level view of the envisioned architecture and presents the expected timeline and implementation approach. This paper serves as a reference for future analysis, design, and implementation activities.

The audiences targeted by this paper include the following:

- The sections on functional view, implementation approach, and paper timeline would be their primary focus.
- System Analysts from all involved parties. Their primary focus would be the sections on functional view and architectural overview.

– Architects from all parties. Their primary focus would be the section on the proposed solution.
– Technical team leads from all parties. Their primary focus would be the sections on the proposed solution, implementation approach, and timeline.

While the above points indicate which sections are most important for which audience, all other sections are somehow relevant to all. In such a case, it is advisable that the paper be reviewed in its entirety. Technical audiences that are not listed above (e.g. developers) are likely to base their work on the more elaborate papers that will be based on this proposal. The following list represents the papers and sources of information upon which the content of this paper was based:

– Relevant documentation from central Bank in particular:
– Through the analysis of the national payment gateway platform, and how it integrates with billers.

The scope of this paper is limited to the proposed biller hub solution. The proposed work will be integrated with various types of billers, and with national payment gateway (as the primary bank/PSP hub e-payments). The proposed cloud-based billers hub (CBBH) will provide all the facilities needed to enable both, direct and indirect billers on national payment gateway.

As illustrated in Figure 1, the national payment gateway facilitates payments between customers and billers. The proposed gateway provides a platform that integrates banks and other Payment Service Providers (PSP's) with the various types of billers [17-20]. In other words, it encompasses a national Bank/PSP hub as well as a biller hub.

The purpose of this paper is to implement a self-contained, reliable, and scalable biller hub that would decouple the billers from the national payment gateway platform. A direct consequence is that it would abstract all aspects concerning the integration with billers, as well as the details of how billing data are obtained from, and how payment notifications are delivered to billers. The proposed cloud-based billers hub (CBBH) will provide all the facilities needed to enable both, direct and indirect billers on national payment gateway.

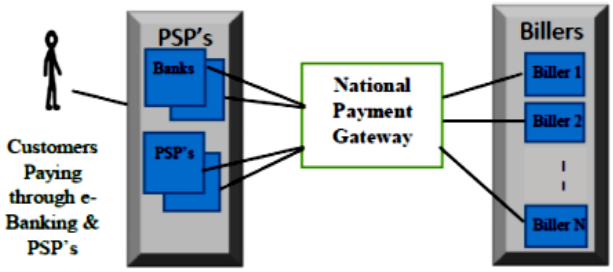

Figure 1. National payment gateway-the need for a biller hub

2. PROPOSED METHOD

This section introduces the main concepts and provides detailed necessary information to clarify the basic functions for the cloud-based billers hub (CBBH). Also, it illustrates how billers classified to small, mid and big, regarding to volume of daily transactions, from biller to the national payment gatway and vise versa. The provided subsections atarting from the functional view sub-section down to the costumer support sub-section are meant to clarifty the important role of each of them as part of the proposed scheme.

2.1. Functional view

The CBBH is meant to provide a cloud-based service that enables billers to become integrated with national payment gateway in a standard and loosely-coupled manner, without direct technical involvement of national payment gateway. In other words, CBBH is meant to decouple the integration of billers from national payment gateway as shown Figure 2. depicts a high-level functional view of national payment gateway with CBBH. It also provides a Biller Portal, through which Small and Medium Billers (such as schools and universities who are typically technically-unready to integrate with national payment gateway) can manually upload billing data, view reports, and import payment data.

2.1.1. Types of billers

As will be explained throughout this paper, the proposed CBBH takes into consideration the various sizes of billers (i.e. small and medium).Their different levels of technical integration readiness, either online or offline, are also clarified. Finally, the business nature of billing data where also highlited for the completeness of the description.

a. Online billers

Online billers (also referred to as integrated billers) are mostly enterprise-level billers. Such a kind of billers are considered as technically capable of integrating with national payment gateway using either the pull or push integration model. They are enabled on national payment gateway via direct integration with CBBH integrated services.

b. Offline billers

Offline billers which may be concerned in all small or medium billers only. This type of billers have no IT infrastructure so it can not be integrated technically with the national payment gateway through the CBBH biller portal. Thus, it needs to be enabled and fully defined to clarify its operational criteria.

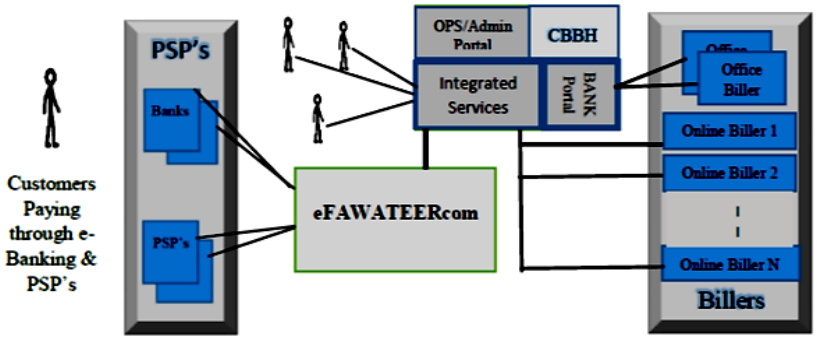

Figure 2. National payment gateway with CBBH - functional view

2.2. E-Commerce sites

In later stages, CBBH is planned to enable e-commerce sites to integrate with registered CBBH in a simple unified HTTP redirection model. This will enable customers to obtain an active billing number at national payment gateway. Once the payment is made, CBBH passes the payment notification back to the e-commerce biller, which in turn, delivers the services/goods to the customer. This will allow customers to select their preferred PSP from within the e-commerce site, which would result in the customer being dynamically redirected to the PSP payment facility. Once the payment is made, CBBH passes the payment notification back to the e-commerce biller, which in turn, delivers the services/goods to the customer. CBBH provides billers with the ability to integrate directly with its core platform (through Integrated Services), as well as a Biller portal and an Operations/Admin portal. The following sections describe the main functional use cases enabled through CBBH.

2.3. Integrated services

The two main use cases provided by the core component of CBBH (integrated services) are called as the inquiring of billing data and the delivery of payment notifications. Further details of these cases are deeply pronounced in the operational perspective section. Enabled billers to export payment notifications data will be in different formats (e.g. XML, CVS). Such notifications are to view and export operation reports, payment notifications, bills statuses, and etc.

2.4. Biller portal

It is known that one of the applications of the integrated services of CBBH is to enable automated retrieval of billing data from online billers and the delivery of payment notifications to online billers. In addition to that, the Biller portal enables offline billers to manually upload billing data, and download/receive payment notifications. Table 1 defines the main use cases of the biller portal.

2.5. Ops/admin portal

Away from the biller portal, the Ops/Admin portal provides operations and customer support personnel with monitoring and control facilities. Moreover, it will facilitate the generation/export of usage reports, and the handling of customer complaints and inquiries. It also provides administrators with facilities for administering user account, role-based permissions, and system parameter settings.

2.6. Supplementary features

Billar portal use cases are an important course of applications to be mentioned, described and emphasized. The included cases of such an application are clarified briefly in Table 1. They include the upload billing data, download payment notifications export report notifications, and finally, the view activity logs. On

the other hand, the CBBH may constitute many different features as basic to the system. Following this context, the main supplementary features that may be assumed as fundamental and necessary by the CBBH are:

- Multi-lingual support
- Context-sensitive help
- Secure communication
- Logging and audit trail
- Notification delivery re-attempts
- Exception detection, handling, and reporting
- Responsive web interface, to support different sizes of screens
- High availability and fail over/disaster recovery site setup

Table 1. Biller portal use cases

Use Cases	Description
Upload Billing Data	Enables offline billers to upload batches of billing data. These data are made available for customers to view and pay for through supported electronic payment means (Banks and PSP's).
Download Payment Notifications	Enables billers to export payment notifications data in different formats (e.g. XML, CVS).
View/Export Operation Reports	Enables billers to view and export operation reports, concerning billing data, payment notifications, bills statuses, etc.
View Activity Logs	Keeps track of all activities performed on the portal.

2.7. Initial set of billers

CBBH will eventually support all types of billers, including online billers (in both "push" and "pull" mode) and offline billers. This phase of the paper will aim to launch a solution with pilot billers of each type. Through its biller portal, CBBH will allow for rapid onboarding of offline billers.

2.8. Architectural view

The cloud-based biller hub architecture will be discussed by two perspectives, the logical perspective and operational perspective. This will illustrate the major two modes of operation the pull mode and the push mode. The main features will be illustrated in the two following paragraphs.

2.8.1. Logical perspective

The logical perspective describes the integration operation between billers and the current payment gateway. Two modes, mainly the push mode and the pull mode, are used to describe such perspectives. Both of the modes are described in the next subsections.

a. Integration with biller

Figure 3 represents the current situation from an integration perspective. It shows a logical depiction of the direct integration between the national payment gateway and a given biller (Biller X). Online billers would be integrated with the national payment gateway either in a Push mode or in Pull mode. In push mode, the biller would be expected to upload billing data to national payment gateway using different means (such as FTP, or a web service exposed by national payment gateway). On the other hand, in pull mode, the national payment gateway would be expected to retrieve billing data on demand, by calling a web service exposed by the biller (billing service).

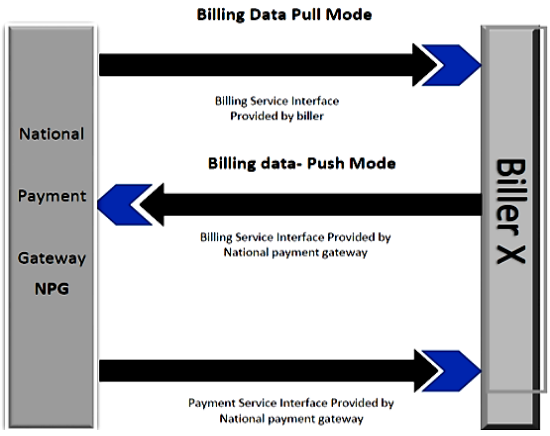

Figure 3. National payment gateway Integration with billers

b. Integration with national payment gateway

With CBBH, national payment gateway will continue to facilitate payments through various channels to the growing number of billers and small billers without causing any major disruption to the existing integration approach. CBBH will act as a biller aggregator, and will hence take care the technical onboarding of new billers (through a proposed set of management commands), as well as retrieving billing data and dispatching payment notifications (through the billing and payment notifications services) [21-25]. CBBH also enables small billers to upload billing data and export payment notification data through the Biller Portal. This is clarified pictorially as shown in Figure 4.

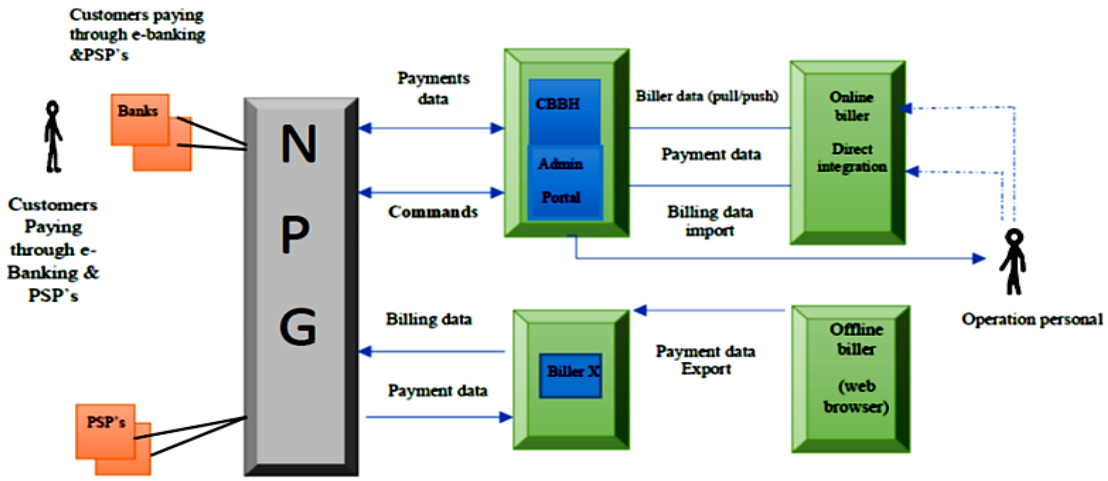

Figure 4. Integration with Billers through CBBH

2.8.2. Operational perspective

CBBH is concerned with a number of processes. As an example, the technical on-boarding of billers, inquiry/retrieval of billing data from billers, and the delivery of payment notification data to billers, are considered as part of the most important processes. None the less, generating and exporting both transactional and statistical reports is also considered under the main duties of CBBH. The following sections describe the main focal processes.

a. Inquiring of billing data

CBBH facilitates the retrieval of billing data so that customers can pay their due payments through the various payment channels provided by national payment gateway. Figure 5 illustrates the billing data inquiry process.

- The operations/sales personnel complete the registration and onboarding of the biller through the CBBH's operations portal.
- The new biller is activated for national payment gateway. Consequently, the biller becomes visible (and its billing data becomes accessible) although the various payment channels supported by national payment gateway .
- When attempting to pay, the customer inquiries about the bills and due payments by entering relevant data retrieval keys (e.g. phone or meter number and billing period) .
- National payment gateway sends a bill inquiry request to CBBH. The request would embed the biller Id along with the data retrieval keys.
- Based on the biller's integration mode (pull or push), CBBH would either dispatch the request to the concerned biller or return the billing data directly from within CBBH's secure data store.
- In case the biller is integrated with CBBH according to the pull mode, CBBH would submit the billing data inquiry to the billing service exposed by the concerned biller .
- CBBH returns corresponding biller data to national payment gateway, which in turn delivers it to the customer through the payment channel.

b. Delivery of payment notifications

Once billing data is retrieved through CBBH, and the due amount is paid through one of the PSP's supported by national payment gateway, the biller is eventually notified. Consequently, the biller would reflect the payment data onto their financial records and would deliver the service or commodity that has been paid for. Figure 6 illustrates the payment notification delivery process. Notice that small billers are typically not

ready for direct technical integration, and therefore access payment notification data through CBBH's Biller Portal or through other provisioned means such as a merchant's mobile payment app. CBBH can also be optionally set to send payment notifications through conventional electronic means, such as email and SMS.

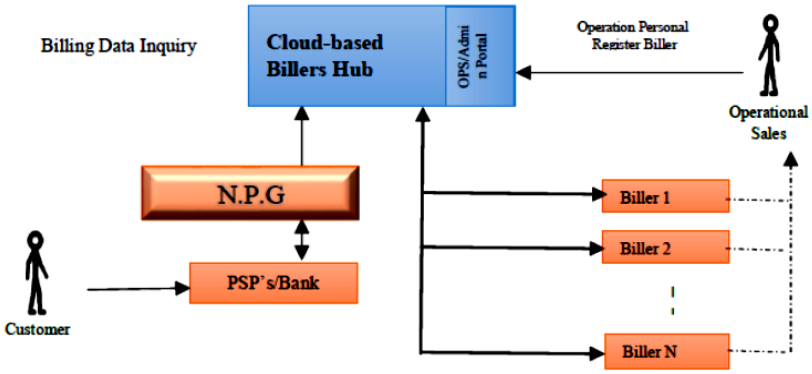

Figure 5. Billing data inquiry – flow

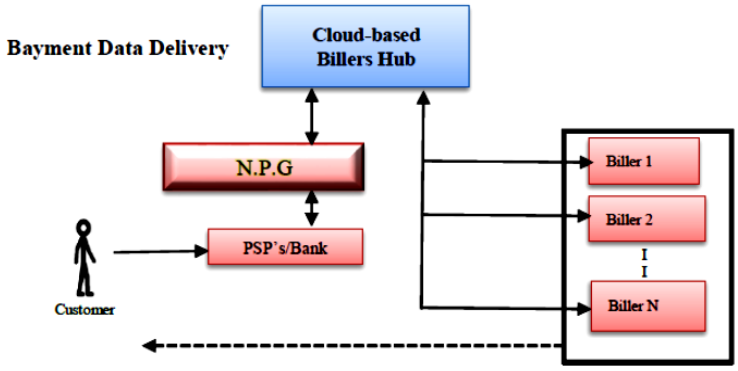

Figure 6. Payment notification data delivery – flow

2.8.3. Physical perspective

Physical perspective in this context means two major critical issues. These two issues are the deployment and high availability with disaster recovery. The later issue is used in case a service framework is designed to meet the demands of enterprises to bring resiliency to business models. Such resiliency act would deliver uninterrupted services, or a non-stop service to the CBBH system.

a. Deployment

We are willing to accommodate any regulations that may favor or restrict the deployment of CBBH in a given environment, as long as the scalability and reliability requirements are met. Nevertheless, the hosting of CBBH during the early stages of operations will be at a local cloud-based data center that provides on-demand infrastructure as a service (IaaS) such as VTEL. It is worthwhile considering moving the virtual setup to data centers as the number of billers increase.

b. High availability and disaster recovery

Technically speaking, CBBH can be deployed in any reliable and scalable environment. To ensure business continuity, the deployment setup must also account for disaster recovery (DR), which could be cloud-based. Data should be replicated in near real-time so that failover can happen within a matter of minutes. DR will be active/standby during implementation Phase I. It will be transformed to Active/Active in Phase II. As depicted in Figure 7, CBBH will be connected with national payment gateway over redundant connections (main and backup) through two different providers. To increase the reliability and scalability of the connections, they shall support multi-protocol label switching (MPLS).

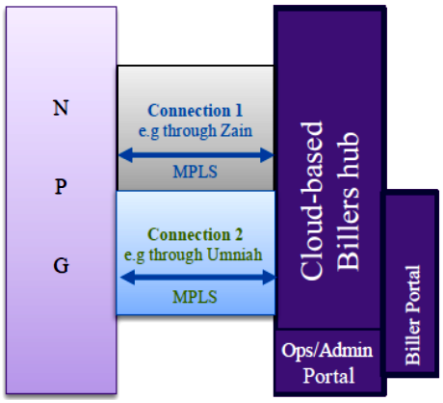

Figure 7. Redundant backup connections

2.8.4. Other quality attributes

Many attributes are worth of clarifying and explaining. The most important to illustrate are related to security, performance and audit trail. The audit trail must be supported by sufficient documentation to follow a transaction from beginning to end. The user should maintain an adequate audit trail of all transactions.

a. Security

Secure electronic transaction was an early communications protocol used by e-commerce websites to secure electronic payments. Secure electronic transaction was used to facilitate the secure transmission of consumer card information via electronic portals on the Internet. This will prevent hackers, and electronic thieves from accessing consumer information. The Cloud base biller hub communication with national payment gateway and billers will be secured to ensure the privacy of confidential data, authentication, non-repudiation and, data integrity.

1) CBBH and national payment gateway

Toughened requirements to banks on protection of means of clients against cybercriminals, follows from new provision of the Central Bank. The Central Bank introduces new requirements to cyber security of brokers. Cloud biller base hub solution will comply with the security requirements imposed by the Central Bank for Cloud Service Providers.

2) CBBH and Billers

The following security methods will be applied to secure the communication between CBBH and billers:

- Securing connections using TLS. This will involve exchanging certificates with billers as part of the official biller onboarding process.
- Applying additional end-to-end message-level encryption for sensitive data as needed.
- Applying non-repudiation mechanisms using message digest algorithms such as SHA 256.

Dedicated links between all sites are recommended to achieve max security. However, it has an impact on operations cost to maintain high availability. Site-to-site VPN is an alternative way for connectivity.

b. Performance

In the case of electronic payment (Transactions), more complex performance monitoring is needed., the continuous monitoring and the scalable nature of the virtualized cloud-based environment will be deployed to offer timely, adaptability and consistent performance. Further evaluation and refinement will be performed and will mostly focus on resolving issues and optimizing biller on boarding and operations. Eventually, after conducting operations and administration training, CBBH will go live at full scale, supported by close monitoring and customer support

c. Logging and audit trail

CBBH will log and keep track of all actions performed on or through it. This includes all transactions data (and in particular, financial records pertaining to payment notifications), as well as administrative action performed through the sales/admin portal, and data import and export actions performed by small billers through the biller portal. Logging and archiving will be implemented in accordance with the regulations and durations specified by CBJ in the referenced papers.

2.9. Maintenance & Support

Full responsibility for all required maintenance & support activities, including:

- Continuous monitoring of overall system performance to identify possible bottlenecks and intervene when needed.

- Regular reviews of system logs to identify possible issues and intervene as needed.
- Analysis of issues and bugs that may be observed or reported by operation personnel, and resolving them in a timely manner, based on their level of severity as in Table 2.

Table 2. Maintenance and support issues

Severity Level	Description	SLA
Critical	Issues that suspend business operation, or endangers data integrity. For example: A system-wide failure (Software, Hardware or Network)	Intervention within 2 hours Resolution within 24 hours
High	Issues that highly impede business operations. For example: Network or Hardware failure affecting multiple service/participants	Intervention within 24 hours Resolution within 48 hours
Intermediate	Issues that intermittently impede business operations. For example: Network or Hardware failure affecting single service/participant	Intervention within 48 hours Resolution within 3 days
Low	Issues that have no impact on business continuity and data integrity. For example: Issues with Bills Reports, Customer Profile, System Logs and Transaction logs Reports	Intervention within 1 week Resolution within 3 weeks

3. IMPLEMENTATION APPROACH

The implementation of CBBH will follow an iterative incremental approach that will involve multiple parallel work streams. Upon paper start, requirements will be revisited, further analyzed, and detailed/refined as needed. After the sign-off of the requirements, detailed blueprints will be produced, followed by the kick off of main work streams; CBBH Core, Ops/Admin Portal, and Biller Portal. During this time, We will work with pilot billers of different types (i.e. “pull” and “push” integrated billers, as well as small billers). After thorough testing, CBBH will be soft-launched with the pilot billers only.

4. WORK BREAKDOWN STRUCTURE

Table 3 illustrates the work breakdown structure that provides a high-level view of the Work breakdown structure. They were subdivided into three main levels level one, two and three. Each one of them were described by their relevance and importance according to the context of operation. The main paramters of level 1 are given as inspection, elaboration, construction, and transition, respectively. The other levels are as described in Table 3.

Table 3. Work Breakdown Structure (WBS)

High-Level CBBH Implementation WBH		
Level 1	Level 2	Level 3
Inspection	Requirements Analysis	
	Agreement with Pilot Billers	
	Specification of Software requirements	
Elaboration	Baseline Architecture Blueprints	Specification of Software Architecture Integration specifications.
	CBBH Core	CBBH Platform Integration with e-Fawateerkum - Billing data inquiry - Payment notifications Integration with Pilot Billers - Pull - Push Managements Commands
	Refined Architecture Blueprints	
Construction	CBBH Core Use Cases	
	Ops/Admin Portal	Biller Management Administration Settlements Reports
	Biller Portal	Basic Biller support Support for Micro Billers
Transition	UAT	
	Training	
	Rollout Planning	
	Pilot/ Soft launch	
	Operations Optimization	
	Full Scale Production (Live)	

5. CONCLUSION

In this paper, we developed an aggregator system that can be integrated into an Internet billing system developed by central banks. The proposed method defined the technical requirements and the functional boundaries needed. It also depicted a high-level view of the envisioned architecture and presented the expected timeline and implementation approach. The proposed method was successfully implemented in the cloud-based Billers Hub developed by the central bank in Jordan.

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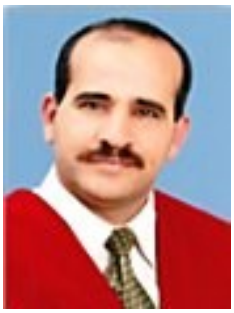

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