



TECHNOLOGIES FOR  
DIGITAL FINANCIAL SERVICES



## About The Author

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*The views expressed in this document are those of the author and do not necessarily reflect the views and policies of Karandaaz Pakistan or the donors who have funded the study.*

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## Glossary

Acronym	Description
AD	Active Directory
ADC	Alternate Delivery Channel
AML	Anti-Money Laundering
API	Application Programming Interface
ATM	Automated Teller Machine
BCM	Business Continuity Management
CAPEX	Capital Expenditure
CBS	Core Banking Solution
COBIT	Control Objectives for Information and Related Technologies
COTS	Commercial Off-The-Shelf
CRM	Customer Relationship Management
CVV	Card Verification Value
DFS	Digital Financial Services
EOD	End of Day
EOM	End of Month
ERP	Enterprise Resource Planning
G2P	Government-to-Person
HSM	Hardware Security Module
ICT	Information and Communications Technology
ISO	International Organization for Standardization
IVR	Interactive Voice Response
KYC	Know Your Customer
MIS	Management Information System
NFC	Near Field Communication
NMS	Network Management System
P2G	Person-to-Government
PAN	Primary Account Number
PIN	Personal Identification Number
POS	Point-of-Sale
QR Code	Quick Response Code
SAF	Store and forward
SMS	Short Message Service
SMSC	Short Message Service Centre
UBPS	Utility Bill Payment System
USSD	Unstructured Supplementary Service Data

# The Company

Karandaaz Pakistan is a not-for-profit development finance company established in 2014 and registered with the Securities and Exchange Commission of Pakistan (SECP). The organization promotes access to finance for small businesses through commercially directed investments, and financial inclusion for individuals by employing technology-enabled digital solutions. It operates through three program verticals:



## **Karandaaz Digital**

Focuses on expanding access to digital financial services in Pakistan by working across the ecosystem with all stakeholders including regulators, policymakers, government departments, businesses, researchers and academics.



## **Karandaaz Capital**

Invests growth capital in small and medium size enterprises (SMEs) with the twin objectives of generating financial returns for Karandaaz Pakistan and supporting broad-based employment generation in Pakistan.



## **Karandaaz Knowledge Management and Communication**

Develops and disseminates evidence-based insights and solutions to inform the core themes of the organization, including innovation, women entrepreneurship and youth, and to influence the financial ecosystem to promote financial inclusion in Pakistan.

Karandaaz Pakistan has received funding from the United Kingdom Department for International Development (DFID) and Bill and Melinda Gates Foundation (BMGF).

# Introduction

The Financial Services industry in Pakistan is currently at varying degrees of digital maturity. While on one side we have organizations which are leading the digital transformation and innovation in the industry; on the far side of the spectrum we have organizations which are in the preliminary stages of their digital journeys. The telecoms are leading the digital front – benefitting from their technology reliant core business. The banks are following up with their digital strategies and tactical plans to transform the digital journey of their customers. These are followed by government institutions which have a far greater outreach to the unbanked and under-served population of the country.

At Karandaaz Pakistan, we are committed to uplifting the overall knowledge and abilities of the Digital Financial Services (DFS) industry. There is a need to quickly capitalize on new market opportunities. Players who want to jump on the DFS bandwagon have a lot of catching up to do. Karandaaz Pakistan sees this as a significant opportunity to improve service

delivery by providing a means to digitize a range of payment use cases. A considerable impact can be delivered by digitizing government payments alone. This is because digitization helps reduce the cost of a transaction. It also provides greater access to formal financial services by simplifying the procedural requirements of opening a digital transaction account and performing digital transactions. Such interventions hold the potential for increasing digital financial inclusion for the unbanked by collaboration between the regulator, various government institutions, commercial banks, and telecoms.

As part of its efforts to support the Digital Financial Services industry, Karandaaz Pakistan is providing an overview of the technology domains that are essential for setting up a DFS ecosystem. This study lists the product features and capabilities of various platforms to deliver solutions for clients. It is anticipated that these efforts would build the knowledge and capacity of our partners and stakeholders in the DFS space.

## Objective

The objective of this study is to act as a guide for the industry; enabling the practitioners of Digital Financial Services to make well-informed decisions when it comes to building, expanding, or upgrading their technology enterprise stacks.

While writing this document, a conscious effort has been made to ensure that it is written in a manner that even professionals without a technology background are able to comprehend and benefit from this information.

An enterprise stack is a collection of software applications and hardware, designed specifically for large organizations such as commercial banks and telecom operators.

## Technology Domains

In the scope of this study, we have discussed the following four domains – three of which are central to most DFS implementations. One of these, API Management, is a relatively new phenomenon that is rapidly becoming commonplace in digital implementations the world over. A brief description of these domains has been provided below, with detailed sections to follow.

### ◆ Core Banking System

- A software that enables the processing of financial transactions, manages the customer account and maintenance of other financial records.

### ◆ Financial Switch

- Enables the authorization and routing of financial transactions between a financial institution's internal platforms (such as Core Banking and Card Management systems) and external networks (such as the Interbank Fund Transfer network). It can be used to drive front-end devices such as ATMs and Point-of-Sale (POS) terminals.

### ◆ API Management

- Enables an enterprise to create, publish, analyze and manage APIs to external consumers in a secure and scalable environment.

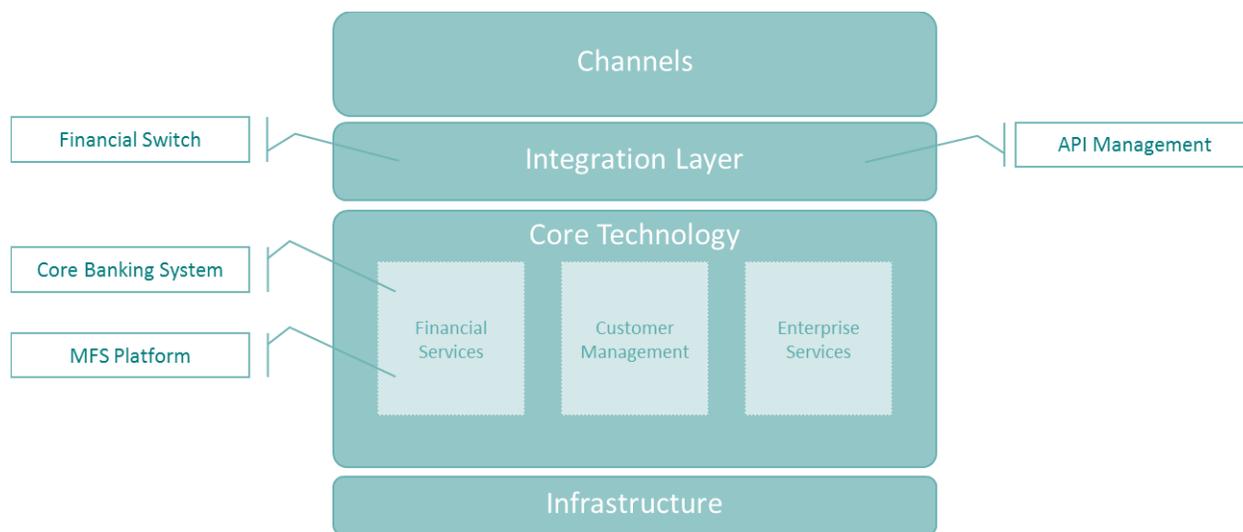
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*APIs, or Application Programming Interfaces, are a set of programming functions and procedures which allow one software application to access the features or data of another application exposing the APIs.*

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### ◆ Mobile Financial Services

- Similar to a Core Banking System, a Mobile Financial Services platform enables basic financial transactions such as bill payments and top-ups, disbursements and collections, cash deposits and withdrawals, fund transfers, and agent liquidity management.



**Figure 1**

Figure 1 illustrates the placement of these technology domains in a layered architecture.

In the end of this study (Annex 01), we have provided a high-level representation of a Reference Architecture for Digital Financial Services which expands the layered architecture shown in Figure 1.

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*The Reference Architecture can also be considered as a Service Landscape that depicts the various business domains, products, and services provided by an organization.*

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We have not detailed the various components depicted in Annex 01. Please note that that illustration is for reference purpose only – actual implementations may differ depending upon the need and purpose of the business.

# Core Banking System

A core banking system is at the heart of any banking institution's technology enterprise application stack. "Gartner defines a core banking system as a back-end system that processes daily banking transactions and posts updates to accounts and other financial records. Core banking systems typically include deposit, loan and credit processing capabilities, with interfaces to general ledger systems and reporting tools."<sup>1</sup>

A Core Banking Application is generally the most capex-intensive platform in a financial enterprise stack.

A Core Banking System generally comprises of the following features:

- ◆ **Customer Account and KYC Management:**  
This includes account opening, capturing KYC information and documents, manage the process flow of registration, maintain account statuses, manage updates in customer's KYC and account information, Closure of Account, Customer Profile, Level of Account, etc.
- ◆ **Multiple Account Options:**  
The system should enable opening of multiple account types such as Current Account, Deposit Account, Corporate Current Account, and Savings Account.
- ◆ **Loans, Leasing, Credit Management:**  
Ability to manage both Consumer as well as Corporate loans and leasing products.
- ◆ **Cards Management:**  
This includes linking of Debit, Credit, and ATM Cards to customer's account; as well as processing of Card Transactions, Card Billing and Payments.
- ◆ **Transaction Management:**  
The financial transaction processing engine manages all the debit and credit transactions.
- ◆ **General Ledger and Accounting Management:**  
Integration with the General Ledger system for reporting of accrual transactions and closing entries, and consolidation of financial statements.
- ◆ **Core Operations:**  
This includes the back office functions such as managing authorizations based on Maker-Checker concept; execution of End of Day (EOD) and End of Month (EOM) batch processes; cash management; teller operations; configuration of interest, commission, fees and taxes; configuring products and defining product rules; etc.
- ◆ **AML, Fraud and Risk Management:**  
This is catered either as a sub-module of Core Banking or via integration with a separate dedicated AML, Fraud and Risks Management module for validation and verification of accounts and transaction patterns.

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<sup>1</sup> Gartner, <http://www.gartner.com/it-glossary/core-banking-systems/>

◆ **Reporting and MIS:**

Regulatory reports, Analytical reports, Operational and Monitoring reports, Product-based reports.

◆ **Access Control and User Management:**

The system allows limited access to confidential information by authorized users only. These users can be assigned to configurable roles with defined access levels.

According to a Gartner Industry Research Note<sup>2</sup>, following are some of the key evaluation criteria to focus on during the selection process of a Core Banking System:

1. Functionality
2. Flexibility
3. Cost
4. Viability
5. Operational performance
6. Program management
7. Partner management
8. Customer references

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<sup>2</sup> Gartner, [Core Banking System Selection: Criteria That Matter](#), 27 April 2011

# Financial Switch

A financial switch is a platform that allows various financial platforms and applications to communicate and perform financial transactions. A financial switch is also sometimes referred to as a Payment Switch, an Enterprise Switch or a Financial Gateway.

Financial switches are typically used by financial institutions such as banks, Digital Financial Services Providers, and interbank network operators. As the number of participating members in a network increases, the total number of integrations required increases exponentially. This is where a financial switch plays its role. A financial switch typically performs the following functionalities:

- ◆ Provide a routing mechanism for participating systems
- ◆ Translate the messages as participating systems may use different protocols
- ◆ Provide a secure and robust communication channel for financial transactions

There are various types of financial switches used in the global financial industry. These can be segregated by the following functions:

- ◆ Online or Batch Processing
- ◆ Real-time or Net Settlement
- ◆ Instrument Type (Debit Card, Credit Card, or Card-less)

A financial switch may be used as an enterprise middleware to integrate internal systems in an organization; as a gateway to integrate with external entities; or as an industry switch to provide communication between business entities.

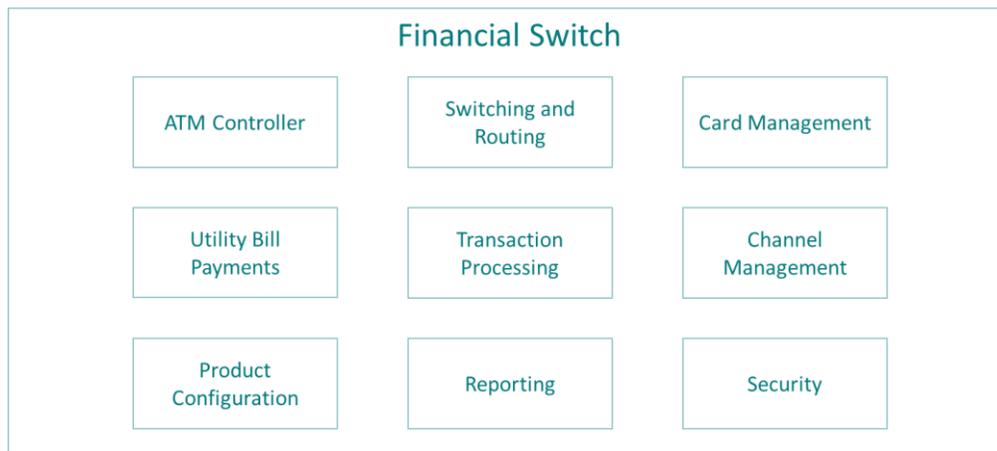


Figure 2

As illustrated in Figure 2, a Financial Switch usually comprises of the following features:

- ◆ **Switching and Routing:** This component maintains the communication connection over the network layer. It manages the routing of messages of between internal and external platforms by utilizing message translation between protocols. Business logic rules are implemented to make routing decisions

based on PIN translation. Store-and-forward (SAF) queue mechanism and timers are used to manage the flow of messages between two systems.

◆ **Transaction Processing:**

This comprises of the authorization of financial transactions, clearing and settlement.

◆ **Channel Management:**

This is used to integrate, manage configurations and monitor the financial operations of various channels. The integration protocols used by financial switches are ISO 8583, ISO 20022, or Open APIs.

◆ **Card Management:**

This is used to manage multiple card products. It includes card production, PAN provisioning, generation of CVV/CVV2, Card linking to customer's accounts, card status management, etc.

◆ **Utility Bill Payments:**

A Financial Switch can be integrated with a UBPS module to allow online and offline mechanisms of bill presentment and bill payment.

◆ **ATM Controller:**

Allows to manage and monitor the operations of ATMs. ATM functionalities, statuses and screen flows can be configured with the help of this feature.

◆ **Product Configuration and Reporting:**

This allows to implement basic product customizations and reporting requirements.

◆ **Security:**

The switch is responsible to authorize the PINs of all financial transactions via a hardware security module (HSM).

# API Management

API Management is a relatively new phenomenon in the world of digital enterprises. “Full life cycle API management is about the planning, design, implementation, publication, operation, consumption, maintenance and retirement of APIs.”<sup>3</sup> As various organizations are evolving their technology capabilities, the focus is increasingly shifting towards implementing API-based applications to achieve the objectives of their digital strategies.

Such organizations have realized the financial value of exposing APIs to the outside world as service building blocks for third party applications.

By possessing the capability of API Management, an organization may successfully accomplish digital innovation by allowing easy access to the developer community at large. Moreover, such a capability allows it to monetize the use of its APIs by provisioning them as new products or access channels for customers and business partners.

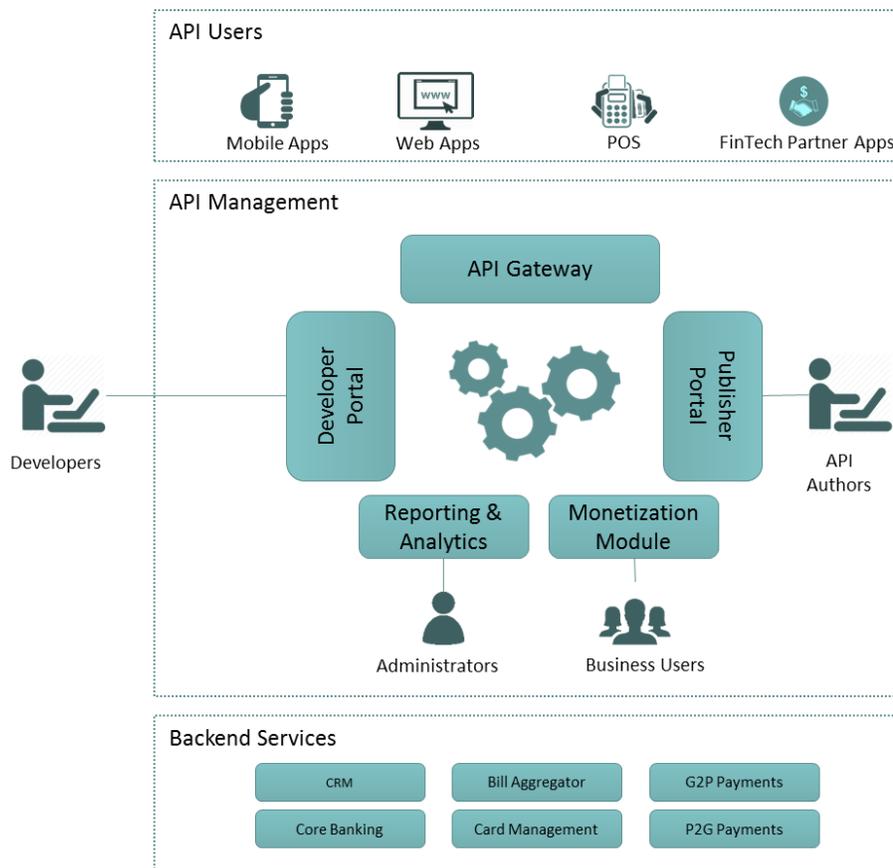


Figure 3

<sup>3</sup> Gartner, Magic Quadrant for Full Life Cycle API Management, 27 October 2016.

As depicted in Figure 3, an API Management platform typically consists of the following components:

- ◆ **API Gateway:**  
This component acts as the mediator between the internal and external domains. API requests are received at the front-end from third-party integrators, modified and orchestrated, and passed on to the back-end services. API Gateways also ensure the implementation of performance throttling and security policies.
- ◆ **API Creation and Publishing Tools:**  
This component is used by API providers to expose the internal APIs by defining the parameters, usage policies and access rules. This component primarily manages the API Lifecycle.
- ◆ **Developer Portal:**  
This portal is available to the API subscribers for consumption of the exposed APIs.
- ◆ **Reporting and Analytics:**  
This component provides insights into the usage of the APIs along with their performance to identify the business impacting trends.
- ◆ **Monetization Module:**  
<sup>45</sup>This is used to configure the pricing of commercial APIs for monetization purposes.

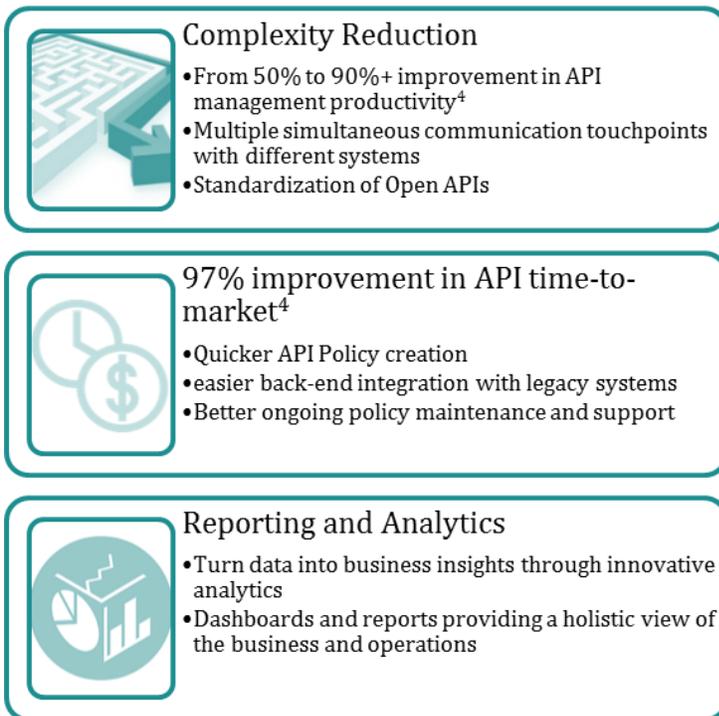


Figure 4

## WHY API MANAGEMENT?

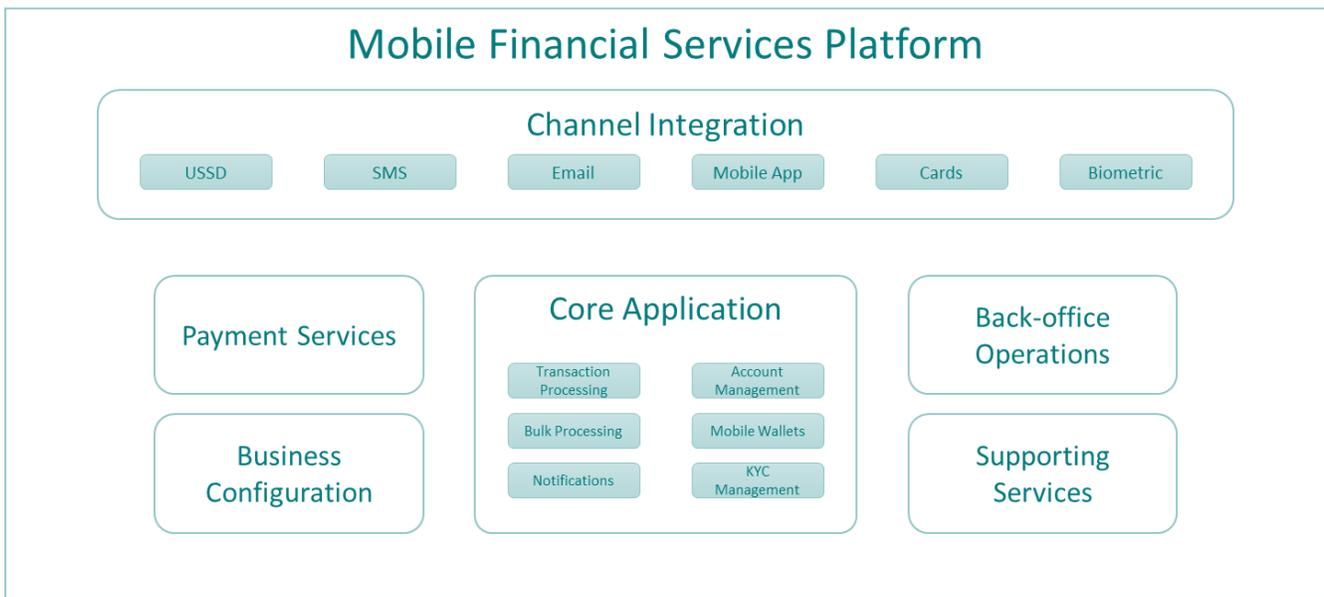
There are many advantages of implementing an API Management platform in an organization. Besides promoting digital innovation and providing new revenue streams, API Management is also useful for streamlining existing and new API integrations. Moreover, it provides an improved developer experience and a centralized mechanism for operational visibility and control.

<sup>4</sup> A Forrester Total Economic Impact™ Study, April 2015

# Mobile Financial Services

Mobile Financial Services (also referred to as Mobile Banking or Branchless Banking) is defined as providing financial services using an agent network and communications technologies, resulting in minimum dependency on conventional bank branches.

Most of the solutions currently offered for this domain are a reduced amalgamation of Core Banking Systems (CBS) and Alternate Delivery Channels (ADC) found in a conventional bank.



**Figure 5**

As can be seen in Figure 5, a Mobile Financial Services solution typically comprises of the following features:

- ◆ **Channel Integration:**  
This layer is responsible for all external integrations with the telecom services and other 3<sup>rd</sup> party integrations, e.g. USSD Gateway, SMSC, IVR, internet banking, mobile application, cards (ATM and POS), Biometric Verification, email exchange, etc.
- ◆ **Core Application:**  
This comprises of transaction processing, bulk processing, notifications handling, account management, mobile wallets, KYC management, etc.
- ◆ **Business Configuration:**  
This includes configuration of products, services, pricing, transaction rules, notifications messages, USSD menu, etc.

◆ **Payment Services:**

This comprises of services such as bill payments, airtime top-ups, e-commerce payments, domestic remittances (money transfers), card payments, international remittances, cash deposits and cash withdrawals.

◆ **Back-office Operations:**

This includes User Management, Role Management, maker-checker authorization, agent hierarchy management, definition of transaction limits, cash management, etc.

◆ **Supporting Services:**

This involves services which are utilized for service monitoring, alarm generation, reporting, event logging, etc.

## Conclusion

In this study, we have touched upon the features and functions of only a select few platforms that play a vital role in the Digital Financial Services Technology Landscape. It should be noted that this domain has evolved considerably over the past two decades; and that it will continue to evolve as technological enhancements become more accessible.

The recent advancements in technology have encouraged DFS players to experiment with new payment mechanisms using NFC and QR Codes. It is crucial for technology suppliers and FinTech start-ups to continue exploring the possibilities and expand the horizons of the existing DFS space.

When setting up a DFS Enterprise ecosystem, it is important for DFS Providers to maintain the right balance between Commercial off-the-shelf (COTS) platforms and in-house developed products and services. A good strategy is to acquire products for mature domains such as Core Banking Applications and Financial Switches from established technology suppliers; but rely on local in-house development for newer experimental products.

Another aspect that DFS players need to be cautious of is whether to opt for a multi-vendor (best-of-breed) ecosystem, or a single vendor enterprise suite. This is important when setting up or upgrading a technology stack as it has a

direct impact on your financial expenditure and vendor management strategy.

As new services and technologies are being introduced in the industry, it is of utmost importance for regulators to play their due role. New technologies always bring with them a new set of vulnerabilities and challenges for the customers. By providing guidance policies and a robust framework on security and controls, a regulator can ensure that the DFS providers and technology suppliers can launch products and services that would have a minimum negative impact on the well-being of customers. Though, care has to be taken to avoid overregulation as it limits experimentation and innovation.

Last but not least, DFS Providers should have a firm focus on Enterprise Governance of IT. This is an area often neglected even by technologically advanced and established organizations. There are quite a few frameworks available for reference that can be employed in this regard, e.g. COBIT (Control Objectives for Information and Related Technologies).

It is well established that Information and Communications Technology (ICT) plays a vital role in promoting Financial Inclusion. By implementing a DFS technology ecosystem in an effective manner, we can ensure additional impact on the lives of the underprivileged.

# Annex 01: Reference Architecture

