BLACKDUCK

A RESOURCE GUIDE FOR OPEN SOURCE IN MOBILE FINANCIAL SERVICES

Insights, Trends and Models to Help Banks and Insurance Companies Navigate Technologies for Developing and Deploying Mobile Applications with Open Source

GUIDE BOOK

SUMMARY

This whitepaper examines the state of open source in mobile financial services and presents a guide of open source software (OSS) resources that are readily available to IT, application developers, integrators and ISVs. It presents industry trends and market statistics as well as links to OSS resources. It is meant to serve as a resource to help banks and insurance companies maintain a bridge to the OSS community, allowing them to reduce costs while accelerating the development of mobile financial services applications. It was developed as a companion document to the Black Duck whitepaper, *What You Need to Know About Open Source in Mobile Financial Services*, which discusses how banks and insurance companies can leverage OSS to accelerate development, control costs and remain competitive.

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INTRODUCTION

Open source software (OSS) is influencing almost every aspect of computing within a wide range of industries, ranging from small start-ups to global enterprises. The financial services industry is no exception and has proven especially receptive to the benefits of open source – including lower total cost of ownership (TCO), vendor independence, accelerated development cycles, superior performance and enhanced security. To date, inroads made by OSS have focused on developers and the data center, with the broad deployment of Linux, the LAMP stack, Eclipse and GNU-based development tools. There is also a range of specialized software that has been developed to meet the specific needs of banks and insurance companies. With the rising popularity of mobile financial services and the strong role that OSS serves in the application development and deployment process, it is inevitable that developers will leverage open source components to launch new projects. OSS allows developers to meet aggressive business growth goals without adding additional full time employees (FTEs) or resources.

MOBILE APPLICATIONS IN FINANCIAL SERVICES

Financial services mobile applications can be categorized into four distinct areas:

1. Mobile payments, while today a minority application, is poised for major growth.

2. Mobile banking provides consumers with access to account information and bank-based services via mobile devices (balance inquiries, account transfers, etc.) as opposed to using mobile devices to provide payment for goods or services at the point of purchase or remotely.

3. Equities trading, like mobile banking, brings services previously available by phone or on the desktop to device users.

4. Mobile financial services infrastructure builds on standard mobile client platforms and leverages a range of services in data centers and the cloud, all of which integrate substantial amounts of OSS.

According to Forrester, the mobile payments and mobile banking are likely to merge in coming years. Today, most major banking institutions offer mobile banking apps that run on Android and iOS, and smaller regional banks are following suit.

> For an overview of how to leverage OSS to accelerate development, control costs and remain competitive, download the companion Black Duck whitepaper, *What You Need to Know About Open Source in Mobile Financial Services*.

OPEN SOURCE IN FINANCIAL SERVICES

OSS pervades the stacks of all types of applications throughout financial services institutions. To understand its progress in mobile finance, it's instructive to start at the back-end in data center infrastructure and then proceed to mobile devices.

DATA CENTER DEPLOYMENT

Over the last fifteen years, OSS has made its way into financial services along the same path it followed in the broader sphere of enterprise computing. Starting in the mid-to-late 1990s, IT staff began deploying Linux and other OSS in non-critical utility computing roles, such as departmental file, print and Intranet servers. As Linux and Linux-hosted OSS proved to be increasingly reliable and cost-effective, deployment graduated into progressively more critical functions, such as company email and web servers, helpdesk systems and directory services. Today, OSS pervades enterprise data centers in general and financial services data centers in particular, hosting inward and outward-facing applications and powering a wide range of intelligent devices and appliances, including backup and storage equipment, routers, firewalls, printers and telephony equipment. Learn more about key data center OSS projects by visiting *Appendix A – OSS in the Financial Services Data Center*.
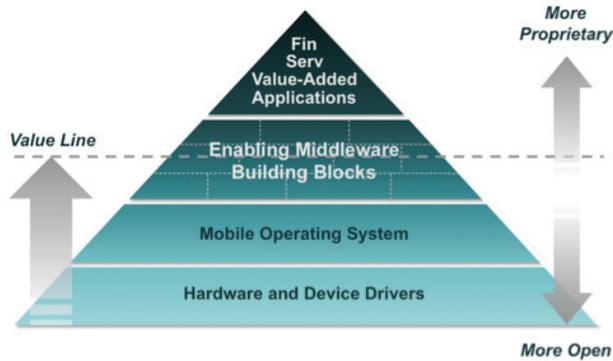
Figure 1: The Rising Value Line

MOBILE FINANCIAL SERVICES

While OSS enjoys visible success in the financial services data center, its presence in mobile finance is more muted, and its success more nuanced. Mobile operating system platforms, frameworks, browsers and other device software draw extensively from OSS. However, software that actually implements visible financial services applications for payments, banking, trading, etc. are almost entirely proprietary.

Open source enters ecosystems *"from the bottom"* as commodity infrastructure. Investments at-or-above the *"value line"* are by definition *"value-added"* and so they tend to lean towards closed/proprietary implementation – the rest is increasingly OSS.

UNDERSTANDING THE SUPPLY CHAIN AND ECOSYSTEM

Traditional enterprise sourcing of applications and other software technology followed two primary acquisition paths:

- Licensing from an ISV, sometimes also involving third party integration
- Internal development and integration

The addition of OSS to the traditional mix of proprietary software and services opens new opportunities for innovation and cost savings, but also requires the broadening of the definition of *"sourcing"* to include OSS projects, commercial OSS suppliers and other third parties. Delivery on, with and for mobile devices can also increase the number of technology sources. To comprehend this expanded sourcing paradigm, it is important to examine the actual supply chain that today's software follows, the roles of participants in the ecosystem that contribute to mobile OSS and the most important OSS technologies that traverse it.

MULTI-SOURCING OSS, PROPRIETARY AND INTERNALLY DEVELOPED CODE

Building software for mobile financial services mirrors the larger universe of all software development. To meet tight deadlines, hit narrow market windows and keep up with rapidly evolving mobile technologies, mobile financial service applications need to build on a mix of internal and external resources integrating and sourcing both open source and proprietary software.

Mobile financial services applications can integrate software from:

- Open source projects, communities and other ecosystem sources
- Commercial OSS suppliers
- Outsourced code development
- Traditional proprietary software suppliers
- Internal code development and integration

Legal, financial and procedural obligations accompany software comprised of both OSS and proprietary code, so being able to search the code base and understand the associated compliance issues is essential.
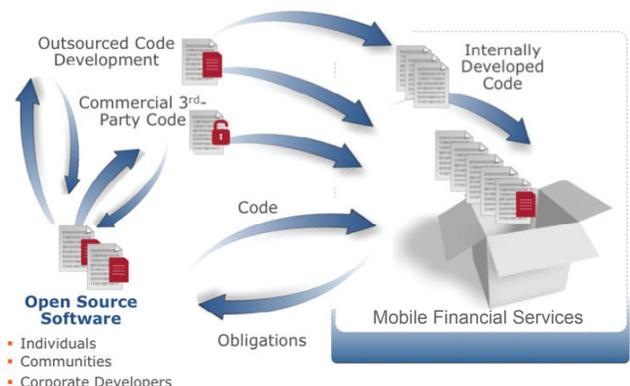

Figure 2: Ingesting Multi-Sourced Software Components

WORKING IN A MULTI-SOURCE ECOSYSTEM

Various suppliers for multi-sourced software do not exist in a vacuum. For mobile financial services, interdependent relationships exist among software components, the hardware they run on and the organizations that supply them. The supply chain applies to an ecosystem spanning multiple industries and product lifecycles. Figure 3 lays out the participant roles in the supply chain and ecosystem on two axes:

- Time on the horizontal axis
- Position in the technology stack vertical axis

By reviewing each of the functions in the supply chain and the interactions between them, the multi-source ecosystem becomes clearer.

Banks and insurance companies operate within a multi-source ecosystem to deliver mobile financial services applications. By understanding the roles and contributions of each member of this ecosystem, they can best assess their own requirements and allocate resources to optimize development resources in order to accelerate the delivery of mobile applications while efficiently managing IT budgets.
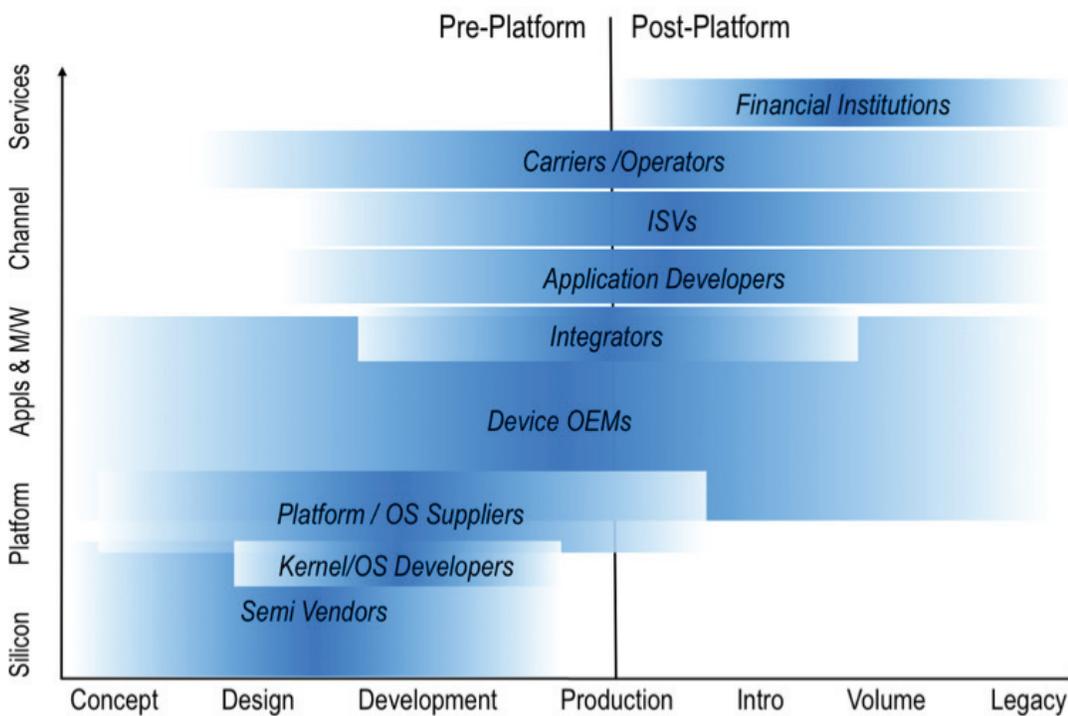

Figure 3: Financial Services and the Mobile Ecosystem

PARTICIPANT	ROLE IN THE SUPPLY CHAIN
Financial Institutions	Financial services institutions are ultimately responsible for delivering the mobile applications and presenting the brand to the customer. Larger institutions can field their own teams of application developers, while smaller ones typically contract mobile application development projects to ISVs.
Carriers/ Network Operators	In the US, network operators constitute the primary retail channel for mobile phones and select tablets, while in Europe and other developing markets devices often move through other channels. For applications, operators have been engaging with developers and setting up their own app stores for almost two decades. The most famous operator-generated ecosystem came from Japan's NTT DoCoMo, but European and North American equivalents have also enjoyed success in promoting branded apps and services. With the rise of platform-dominated ecosystems (Android and iOS), operators are looking for new means to differentiate, including partnering with financial institutions to build mobile payments and other mobile offerings.

PARTICIPANT	ROLE IN THE SUPPLY CHAIN
Application Developers/ ISVs	Originally, intelligent devices included applications crafted and loaded as part of the manufacturing process by OEMs themselves, or contracted to third parties. In contrast to those closed legacy devices, today's mobile phones and tablets leverage a universe of hundreds-of-thousands of applications for each platform, created by small developer shops and also by larger ISVs. Mobile financial services applications occupy about 4-5[1] percent of the output of these developers, with about half of these apps tied to a particular institution, such as mobile banking or stock trading apps. While these developers utilize volumes of OSS, and many contribute to key OSS projects, relatively little of their output is actually licensed as open source.
Integrators	Integrators play several different roles in the mobile/wireless ecosystem. For smaller OEMs, especially in Asia, integrators help bring together chipsets, reference designs and software stacks to fast-track the creation of a particular device (pre-platform). For operators and financial services providers, integrators help bring together platform and application software (post-platform) to enable branded and value-added services. Experienced integrators are likely participants in the projects whose code they use, but many are strictly OSS consumers and redistributors.
Device OEMs	Device manufacturers such as Apple, HTC, Huawei, Samsung and Sony Mobile primarily target end-users and not applications, but in response to needs for securing mobile transactions, they are increasingly designing-in technologies that include near-field communication (NFC) and encryption, and integrating secure chipsets into their devices for all audiences. OEMs have a mixed record of OSS participation. Striving to avoid commoditization of their devices, they customize OSS as a means to differentiate, with the result that OEMs often fork OSS projects away from mainstream distributions (e.g., HTC Sense and Motorola BLUR for Android) and disclose as little of their source code and patches as possible.
Platform/OS Suppliers	Suppliers of the leading mobile platforms — Google Android and Apple iOS — are increasingly integrating key mobile financial services functionality into their software stacks. Google offers Google Wallet and Apple is expanding the scope of purchasing options through iTunes. Both of these companies have departed from the traditional model of OS suppliers as only OS-focused ISVs.
Kernel/OS Developers	The communities that develop the Linux kernel and the BSD operating system (at the core of Android and iOS respectively) operate mostly independently of the rest of the ecosystem, in that Linux and BSD find deployment in devices, on the desktop, in data centers and in the cloud. Linux code is integrated into Android by Google, by the Open Handset Alliance (OHA) members and by third parties (e.g. semiconductor vendors and OEMs) on an ongoing basis. The trajectory of BSD into iOS is quite different. iOS (and also Marcos) come from that code base with minimal ongoing interplay with the BSD community.
Semiconductor Vendors	Semiconductor vendors (FreeScale, Intel, TI, etc.) and IP suppliers (especially ARM Ltd.) are increasingly investing in vertical markets, including financial services. Their response to RFPs from device OEMs includes building systems on a chip (SoCs) that integrate mobile financial services technologies like NFC, encryption and other types of security. From a supply-chain perspective, semiconductor vendors are often the immediate suppliers of Linux and Android stacks to OEMs, together with board support and device drivers for the peripherals, cache, memory management units (MMUs), etc. that are particular to the SoCs they manufacture. Today, they are also substantial contributors to the Linux and Android source trees, primarily to guarantee ongoing support of their silicon wares.

For an overview of how to leverage OSS to accelerate development, control costs and remain competitive, download the companion Black Duck whitepaper, *What You Need to Know About Open Source in Mobile Financial Services*.

1 AppBrain and Statistica, business and finance categories

KEY TECHNOLOGIES FOR MOBILE FINANCIAL SERVICES

The mobile financial services ecosystem relies on a handful of technologies to enable collaboration and secure mobile financial transactions from smartphones and tablets. The following is a brief review of the most salient of these technologies.

MOBILE PLATFORMS

Today's mobile marketplace is vast and dynamic. The Global Mobile Suppliers Association reports there are almost 6 billion mobile subscribers worldwide, with the smartphone segment shipping hundreds of millions of units each quarter. Beyond just market share considerations, smartphones, as rich applications platforms, make the best first targets for financial services applications. Within the smartphone segment, mobile platform shares are clearly dominated by the two leading platforms, Android and iOS. Android is an open source platform and Apple's iOS is based on OSS components.

OPEN SOURCE APPLICATION FRAMEWORKS

Mobile financial services applications – whether open or proprietary – benefit from a rich toolbox of OSS components, including complete application frameworks. Frameworks come in three basic flavors: native SDKs directed at a particular platform; cross-platform software development kits (SDKs) designed to let developers target two-or-more mobile operating systems with a single application; and frameworks that are usually built around a particular programming language and either targeted at mobile applications or usable with many types of client and server environments. Today's financial services developers can choose from a rich menu of open source programming frameworks to simplify the task of building and maintaining mobile apps, for both server and client-side deployment, supporting Java, JavaScript, PHP, Python and Ruby.

NATIVE SDKS

Each of the leading mobile platforms accommodates app developers with an SDK. Of the leading SDKs, only Android SDK is open source but many competing SDKs build substantially on OSS projects:

- Practically all mobile SDKs use the GNU toolchain

- Apple uses OSS and make available substantial portions of iOS, the iOS SDK and other software available as Apple Open Source

- Samsung does the same for its Bada platform and for key pieces of the company's Android-based software stacks at the Samsung Open Source Resource Center

- The nascent Tizen platform (evolved from code formerly in Moblin) is completely open source

- The new OS kernel for Research in Motion (RIM) is based on QNX Neutrino and it provides source code under a free-access license

- Key pieces of the Windows Phone 7 stack and SDK are available on the CodePlex portal

CROSS-PLATFORM FRAMEWORKS

Supporting multiple platforms can be expensive. Large ISVs can spend $1-2 million USD annually in incremental hosting for enterprise applications, and porting and support costs for smaller mobile app developers and enterprise IT shops are not far behind. Luckily, developers of today's mobile applications have a range of open source options to ease multi-platform support across Android, iOS, RIM Blackberry and other types of devices, with options for community and commercial support for each.

OPEN SOURCE FRAMEWORKS FOR POPULAR LANGUAGES

FRAMEWORK	DESCRIPTION	LANGUAGE	LICENSE	COMMERCIAL SUPPORT
Cake	PHP Applications Framework	PHP	MIT, OGTSL	Cake Development Corporation
Chef	Systems-integration / Cloud automation framework	Multiple/ Any	Apache 2.0	Opscode, Inc.
Django	High-level Python Web framework	Python	BSD License	Revolution Systems, LLC; JetBrains s.r.o.
Nodejs	JavaScript applications framework	JavaScript	MIT License	Joyent, Inc.
Pylons	Web applications framework	Python	BSD License	Various individuals
Rails	A full-stack framework for database-backed web apps	Ruby	MIT License	37 Signals, LLC
Spring	Java-based applications framework	Java	Apache 2.0	VMware, Inc. SpringSource
Struts	Java web applications framework	Java	Apache 2.0	Most Java support organizations
Symfony	PHP web applications framework	PHP	MIT License	SensioLabs International
Zend	PHP web applications framework	PHP	BSD License	Zend Inc.

The following table lists the most popular cross platform mobile frameworks and their key attributes:

MOBILE CROSS-PLATFORM FRAMEWORKS

PROJECT	ANDROID	APPLE IOS	RIM OS	WIN PHONE	OTHER	LANGUAGE	LICENSE	COMMERCIAL SUPPORT
Appcelerator	√	√			HTML5	JavaScript, HTML, CSS	Apache 2.0	Appcelerator Inc.
Enyo	√	√	√		webOS	JavaScript	Apache 2.0	HP / Gram
MoSync	√	√	√	√	JavaME, Symbian	JavaScript, C/C++, HTML	Dual GPLv2, commercial	MoSync AB
PhoneGap	√	√	√	√	Bada, webOS Symbian,	JavaScript, HTML, CSS	Apache 2.0	PhoneGap (Adobe)
Rhodes	√	√	√	√	HTML5	Ruby	MIT License	RhoMobile / Motorola

WIRELESS

Mobile financial services applications developers can treat most wireless interfaces as part of the *"landscape."* Support for 3G/4G telephony, WiFi, Bluetooth, etc. comes with the underlying platform (open source or proprietary), and only the APIs are relevant for most applications (e.g., the sockets library). Mobile payments stand out as a clear exception. In select markets, mobile device users can carry digital *"wallets"* on their phones and tablets, and make payments at point-of-sales devices in physical proximity over WiFi and/or Bluetooth. These types of wireless payments require some level of access to interface APIs beyond mere transport. In these cases, open source WiFi drivers and interface management software is a must (as found in Linux and Android) as is access to projects like BlueZ.

Of special interest to mobile payments is the OpenNFC project, an open source hardware-independent implementation of an NFC stack. There also exist a number of application-level projects to enable NFC programming:

- libNFC – low level NFC SDK and API released under the GNU Lesser General Public License (LGPL)
- NFC-tools – NFC tools based on libnfc, the Open Source NFC Library
- Tenderlove NFC – a Ruby wrapper for libNFC
- PyNFC – Python bindings for libNFC

There are about a dozen more similar open source projects. Conduct an NFC search on Ohloh or on GitHub to discover additional projects.

ENCRYPTION

Most mobile platform SDKs offer developers a native encryption library implementing standard algorithms with moderate to high-grade security (e.g., open source Android javax.crypto). For mobile financial services applications demanding either stronger encryption or the ability to encrypt specific content, there exist a range of open source projects, including:

- SQLcipher – an open source extension to SQLite that provides transparent 256-bit AES encryption of database files
- Braintree Android Encryption – a library is for use with Braintree's payment gateway to encrypt payment information using the public key of an asymmetric key pair
- StrongSwan – an open source IPsec-based VPN solution

DOMAIN-SPECIFIC SOFTWARE

While most application-level mobile financial services software is proprietary, there are interesting middleware components and prototype implementations that are available as OSS, including:

- AqBanking – an open source library implementing HBCI, a bank-independent online banking standard developed by the German Central Banking Committee ZKA (Zentraler Kredit-Ausschuss) defining communication between banking applications and credit institution servers
- Cyclos – a complete open source on-line payment system with additional modules such as e-commerce and communication tools
- Financisto – an open-source personal finance manager for Android
- MyBanco – an open source core banking solution, splits into easy to manage separate applications which can be installed on separate machines to scale high loads

BLACK DUCK RESOURCES FOR FINANCIAL SERVICES

Black Duck provides software and consulting to deliver end-to-end solutions for open source adoption, management, governance and compliance while connecting development teams to critically important community resources. The Black Duck® Suite is a comprehensive set of governance and compliance automation tools that enable development organizations to harness the power of open source technologies and methods:

- The Black Duck® KnowledgeBase™ continuously searches the Internet for open source and downloadable code, resulting in the industry's most comprehensive database of open source software and associated license and other information

- Black Duck® Code Center™ automates open source governance and compliance, and boosts developer productivity by streamlining the search, selection, approval and tracking of open source and other externally produced software

- Black Duck® Protex™ automates open source compliance, and can automatically scan, discover and identify software origins, an integral step in the development process and essential for enforcing license compliance and corporate policy requirements.

- Black Duck® Export™ automates encryption export compliance, and identifies cryptographic elements in source code and automates the regulatory approval process helping organizations to comply with Bureau of Industry and Security (BIS) regulations

- Black Duck® Code Sight™ is a source code search engine that brings transparency and easy access to an enterprise's vast and often distributed source code resources

Olliance Consulting, a division of Black Duck, offers open source governance, policy and strategy consulting services to help financial services achieve their business objectives. Ohloh, a free community resource, is the most comprehensive public directory of OSS and the contributors who create and maintain it. Ohloh Code is a publicly available, free code search engine indexing more than 18 billion lines of code. Black Duck also offers the following whitepapers tailored for the information needs of the financial services community:

- What You Need to Know About Open Source in Mobile Financial Services

- Open Source Drives Innovation in Financial Services

- How to Increase Velocity and Value with Agile Development using Open Source

- The Impact of Open Source in Financial Services: A Chief Architect's Perspective

CONCLUSION

The previous sections in the whitepaper have illustrated that resources exist at many levels for building and deploying mobile financial services applications. But in order to benefit from OSS, you must address a range of challenges that include:

- Following new developments in OSS technology and methods

- Finding the right OSS project code to meet mobile application needs

- Gauging the quality and maturity of candidate OSS code

- Tracking the provenance of candidate code, for both IP management and security purposes

- Meeting the obligations of different OSS licenses across a substantial body of source code

- Mobile financial services application lifecycle management in a multi-sourced marketplace

For an overview of how to leverage OSS to accelerate development, control costs and remain competitive, download the companion Black Duck whitepaper, *What You Need to Know About Open Source in Mobile Financial Services.*

Mobile financial services holds tremendous potential for end-users and financial services institutions looking to deploy new products and services via mobile devices, as well as for application developers and ISVs looking to fill the market need with innovative offerings. OSS is a valuable resource for all players in this rich ecosystem, however it may not provide all the necessary code components, requiring a complex multi-sourced supply chain. Black Duck and its Olliance Consulting division can help your organization tame the complexity of multi-source development of mobile financial services applications by providing:

- Advice on creating a mobile financial services multi-sourcing strategy
- Training on working with open source software and working with and building open source communities
- Tools and services for managing and controlling open source
- Licensing and audit tools and services to help your organization ensure compliance

For more information, visit www.blackducksoftware.com.

APPENDIX A – OSS IN THE FINANCIAL SERVICES DATA CENTER

This whitepaper primarily addresses mobile open source in financial services. The following section calls out key OSS design wins *"on the other end of the wire."*

LINUX OS

The Linux operating system – the Swiss Army knife of open source – has had the greatest impact on financial services. Banks and equities traders have adopted Linux for its security and performance, and also for the ability to customize the OSS platform to meet particular organizational needs:

- Charles Schwab and other trading firms have adopted Linux and participated in its development to help reduce trade round-trip times and transaction latencies across trading centers and global markets
- On-line payments giant PayPal as well as up-and-coming payments firms commit to Linux for scalability and to ensure a cost-effective upgrade path
- Eighty percent of global stock and commodities marketplaces – from the London Stock Exchange to the Tokyo Stock Exchange to the Chicago Mercantile Exchange to the London Stock Exchange – all deploy Linux to manage billions of transactions per year and to scale to meet short and long-term trading trends[2]

LAMP STACK

While Linux by itself has proven to be a reliable and flexible operating system, the actual application platform for enterprise applications comprised four sets of open source components.

- Linux OS (L)
- Apache Web Server (A) – the open source software that delivers almost two-thirds of all web content and is key to delivering financial services applications

- MySQL (M) – the open source relational data base used not only with web apps but also in myriad enterprise, embedded and now cloud applications
- Perl/PHP/Python (P) – the open source scripting languages that provide the *"glue"* for applications with web interfaces

TIMEKEEPING

Banks, traders and other financial services providers need to track transactions and timestamp trades with millisecond accuracy to meet regulatory requirements. Implementations of the Network Time Protocol (NTP) allow clocks to drift. To meet the need for microsecond-accurate network time, scientists, enterprise IT developers and financial services houses look to the Precision Time Protocol (PTP) and have created an OSS PTP implementation.

LODESTONE FOUNDATION

The goal of the Loadstone Foundation is to quickly and convincingly build the go-to non-profit open source foundation for financial markets.

OPENMAMA

Open Middleware Agnostic Messaging API (OpenMAMA) is an open source project and a super-community working to provide a lightweight vendor-neutral integration layer for financial services applications. OpenMAMA brings together some of the biggest names in financial services, including NYSE Technologies, Bank of America, J.P. Morgan and IBM

ABOUT BLACK DUCK

Offering award-winning software and consulting, Black Duck is the partner of choice for open source software adoption, governance and management. Enterprises of every size depend on Black Duck to harness the power of open source technologies and methods. As part of the greater OSS community, Black Duck connects developers to comprehensive OSS resources through Ohloh.net, and to the latest commentary from industry experts through the Open Source Delivers blog. Black Duck also hosts the Open Source Think Tank, an international event where thought leaders collaborate on the future of open source. Black Duck is headquartered near Boston and has offices in San Mateo, St. Louis, London, Paris, Frankfurt, Hong Kong, Tokyo, Seoul and Beijing. For more information about how to leverage open source to deliver faster innovation, greater creativity and improved efficiency, visit www.blackducksoftware.com and follow us at @black_duck_sw.

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