

# OSA: COST AND SCHEDULE SAVER OR DRIVER?

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## Abstract

Open Systems Architecture (OSA) employs a modular design and utilized consensus based standards for its key interfaces with full design disclosures [Office of the Deputy Secretary of Defense, Systems Engineering, Initiatives]. OSA provides the ability to update and increase capabilities with seamless integration. A challenge with OSA is the ability to continuously design modular systems with obsolete technology and piece parts, evolving technological environment and emerging threats. OSA initiative began in 1994 and was extended for ten years, it is a key word still described in developing Capability Development Documents, but its general definition can lead to problems. Employed within the DoD, modular systems are growing in funded requirements, many times creating dependencies among multiple programs, which can lead to schedule, cost and technical risks on linked programs. Looking at past successes and failures, this study will analyze the effectiveness OSA and its impact on cost and schedule for programs.

A hospital is an example of open system, in that it is constantly interacting with its environment, resulting in change. Think of how a hospital operates, it is built upon guidelines including standards of care, procedures and protocols which create the foundation. However, hospitals change with patients and staff and evolve with developing vaccines, medications and techniques. Similarly, software is another example of an open system. By definition in the Department of Defense Open Systems Architecture Guidebook, an open architecture is a technical architecture that adopts open standards supporting a modular, loosely coupled and highly cohesive system structure that includes publishing of key interfaces within the system and full design disclosure<sup>1</sup>. With an overall goal of reducing cost and schedule while increasing competition and innovation, open systems architecture can provide an environment for development to thrive. Open systems architecture is appealing because when properly implemented, it leads to beneficial attributes such as flexibility, cost savings, and interoperability. For these reasons, open systems architecture are utilized in both industry and government. The challenge of open systems is successful implementation. Although industry and government have different goals and business structures, the lessons learned from industry can help government agencies succeed and successfully institute open architecture across multiple platforms.

The Department of Defense (DoD) open systems initiative began on November 29, 1994 when the Under Secretary of Defense for Acquisition, Technology and Logistics directed that all DoD components and agencies use open systems specifications and standards for the acquisition of weapon systems<sup>2</sup>. The goal of Open System Architecture (OSA) is to move away from proprietary and single contractor dependent solutions by creating an environment that will foster open competition and will reduce overall system costs and schedule. With declining military and defense spending as an overall trend since the 1950s<sup>5</sup>, OSA provides the DoD with the ability to leverage industry development and continue to utilize latest technology. Another key challenge that the DoD faces is that compared to industry the government product life of a system is over three times longer.<sup>3</sup> OSA is appealing because it

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would allow the flexibility for multiple contractors to be utilized over this life span, driving down system life cycle costs. Looking towards industry successes, the government can utilize lessons learned to implement OSA in future systems and development efforts.

The concept of open systems in industry began ten years earlier with the National Cooperative Research Act of 1984, which provided the foundation and ability for open architecture to thrive in industry. The act promoted research and development, encouraged innovation, stimulated trade, and made necessary and appropriate modifications in the operation of the antitrust laws<sup>4</sup>. Prior to this act, companies could be subject to federal prosecution for engaging in joint ventures in research and development (R&D). The potential of federal prosecution coupled with the high cost of research and development caused a decline in the investment of R&D efforts by companies within the United States due to the heavy financial burden<sup>5</sup>. Open Systems was a result of the National Cooperative Research Act of 1984, which allowed companies to work together and share the burden of costs. Since 1984, there have been multiple examples of successful open software including Linux, MySQL, Firefox, Apache and Wikipedia.<sup>6</sup> The appeal of open systems is its ability to adapt to changing environments quickly and efficiently.

While an obvious benefit of open systems is development cost sharing, many other characteristics have sustained and grown its appeal. In 1996, a study performed by EvansGroup Technology ranked the benefits of open systems among computer system buyers in the United States, United Kingdom and Europe<sup>7</sup>:

<b>Benefits of Open Systems</b>
Flexibility
Freedom to choose IT from different vendors
Products from different vendors work together
Access across multi-vendor environments
Protect investment in existing computer system
Ability to use/share information anywhere in the world
Cost savings
Interoperability/portability across various platforms
Organizational change not constrained by IT system

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Cost of ownership
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This demonstrates the expectations of companies and users investing in open systems, namely that flexibility, interoperability and cost savings must be apparent for a switch or change to be made. An important note is the significance placed on the ability to choose from multiple vendors, which provides another opportunity for cost savings. When companies are competing to provide the same services or product the competition drives prices down and helps to create different levels within the products. This concept is apparent in today's laptops – think of what is available today for laptops running on Linux, there are multiple providers: Dell, HP, Lenovo, and Microsoft just to name a few and the range of which one could be purchased. According to BestBuy, the current range of pricing in features ranges from a \$129.99 for a Dell Inspiron 11.6" Laptop with 2GB of Memory and 32GB Solid State Drive to a \$4,999.99 MSI 17.3" Ultra HD Laptop 32GB Memory and 256 GB Solid State Drive<sup>8</sup>. Even though both laptops operate on the same basic system, and can load similar applications, they have different hardware, computing capabilities and memory storage. The difference in features allows consumers to choose what is important. In addition, the competition between manufactures keeps the prices down within each tier. Not only does this allow the consumer to choose which laptop suits them best, it also allows them to change or upgrade their laptop and easily transfer over information and data because of the steady state of the operating system. This demonstrates the key attributes associated with open software systems, the flexibility, interoperability and potential cost savings available and exemplifies having an open stable software baseline with tradeoffs and capabilities provided through the different hardware alternatives.

Although the benefits of open systems are apparent, there are still many examples of successful closed systems. A current example of open versus closed system architecture is the software utilized in today's cell phones – iOS and Android<sup>TM</sup> represent the most widely utilized cell phone platforms and

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help to highlight the major differences between architecture approaches. There are many differences at first glance, such as the software construct the available hardware options and the number of manufacturers. Looking at these differences and their popularity in today's marketplace provides a good foundation for comparison.

From a software standpoint iOS and Android have a lot of similarities in how they operate and function. They represent the most popular software for cell phones today; overall Android represents the most popular operating system in today's market.

**Worldwide Smartphone Forecast by Region, Shipments, Market Share and 5-Year CAGR (units in millions)**

Operating System	2014 Shipment Volumes*	2014 Market Share	2018 Shipment Volumes*	2018 Market Share	2013-2018 CAGR
Android	997.7	80.2%	1,401.3	77.6%	12.0%
iOS	184.1	14.8%	247.4	13.7%	10.0%
Windows Phone	43.3	3.5%	115.3	6.4%	28.1%
BlackBerry	9.7	0.8%	4.6	0.3%	-25.0%
Others	9.3	0.7%	37.7	2.1%	31.5%
<b>Total</b>	<b>1,244.1</b>	<b>100%</b>	<b>1,806.3</b>	<b>100%</b>	<b>12.3%</b>

As the chart above shows<sup>9</sup>, Android has a large chunk of the market share and is forecasted to maintain a large portion through 2018. Android's large market share can be accredited to the multiple manufacturers who can provide hardware that is compatible with their software. The trend above is also seen in the U.S.

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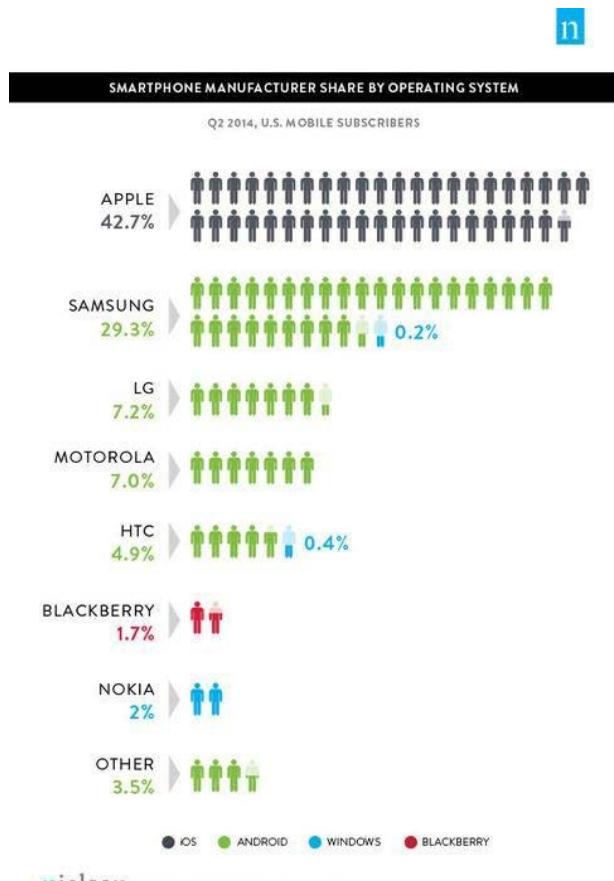
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only market, but the margin is not as large, as the chart shows below:

	iOS	Android
Northeast	43%	49%
Midwest	37%	55%
South	40%	52%
West	44%	49%
<b>Average US</b>	<b>41%</b>	<b>52%</b>

On average Android software is more popular, based on Q2 2014 data, by an eleven point margin.<sup>10</sup> From a software standpoint Android is clearly dominant today and is predicted to dominate in the future.

It is important to look at this from a hardware standpoint as well. In 2014 a study was performed comparing the most popular hardware in the U.S.<sup>10</sup>:



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The above chart shows that although Android is clearly the most popular software operating system; however, Apple® is still the most popular hardware by approximately a thirteen point margin. This highlights the differences in open vs. closed, specifically that open systems provide the opportunity for many Original Equipment Manufacturers (OEMs) to utilize software and provide their own hardware. The OEMs compete on the slight differences between the hardware, while iOS has only a single OEM. Although iOS still has to innovate their hardware to entice people to update and buy new phones they still reap the benefit of maintaining and supporting that hardware forever since they are the only providers.

Looking at the overall popularity in the market of the Android versus iOS software indicates how competitive the market is, and that it is not only dominated by open systems. While we have looked at the positives associated with open systems, it is also important to look at the software itself in comparison to closed systems. The main four areas of concern as they relate back to government use are customizability, software upgrades, security and cost. Going back to the cell phone industry example, a comparison of these features will highlight the differences and tradeoffs that the government must analyze before choosing an open system.

By definition customization allows the ability to change characteristics to adhere to different circumstances or preferences. By virtue of being an open system, Android provides greater ability to customize. Android allows the consumer to customize the home screen not just by adding and organizing the applications, but also gives the ability to add widgets to allow the user to stay informed and connected<sup>11</sup>. On the other hand, iOS leaves little room for customization because the interface is locked down. Android provides the flexibility for users to change and adapt their phones to meet their needs,

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while with iOS the user must adapt to the phone's standards. In customizability, the open system provides the greatest options and latitude.

Software upgrades are used to fix software bugs, update security and introduce new technology; they are very useful and help to ensure the system is running most efficiently. While Google does update Android frequently, some users find that they do not receive the latest upgrades, or they purchase new phones with out of date software. This issue arises because of the multiple platforms the software is hosted on not all updates are compatible with the various hardware. Furthermore, the phone manufacturer decides when to offer software upgrades, therefore it can sometimes take months to receive an update after released by Android<sup>11</sup>. This is where iOS has a clear advantage, with only a couple hardware variations and a single OEM, iOS upgrades are generally offered to all iOS devices. The only potential issue is older technology where Apple® cites hardware capability as the reason some older devices may not receive new features in upgrade.<sup>11</sup> In the case of software upgrades, the closed system is the winner, exploiting the advantage of a single OEM that allows full control and oversight.

Security is a concern with technology, especially as phones store more personal data and credit card information. iOS is the operating system for Apple® phones, it is a fairly closed system, where Apple® controls all updates and the baseline software. They allow applications to be developed to work with the phone but limit what the applications are able to access within the phone. iOS is associated with security, because of the locked and guarded software baseline code. While, in contrast Android is led by Google, but the basis is an open source software operating system. As described on the Android Source Code overview “the primary purposes of Android are to create an open software platform available for

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carriers, Original Equipment Manufacturers (OEMs) and developers...wanted to make sure there was no central point of failure, where one industry player could restrict or control the innovations of any other<sup>12</sup>.” There are some guidelines that allow Android to operate smoothly and prevent uncontrolled optimization, thus the Open Source Project maintains the Android Compatibility Program to prevent incompatible implementations<sup>12</sup>. With iOS having a more controlled and locked baseline, and limiting application access to personal information, iOS has historically had stronger security. Also, with Android being the more popular software system, it falls prey to larger security hack attempts and with the software being open, applications can access almost all data within the device. The closed system by virtue of design provides greater security.

An important factor in any purchase is cost. Cost can be a driving force for choosing which option to buy. With the newest model of the iPhone 6S 32GB starting at \$649, and the 128GB iPhone 6S Plus costing \$949, Apple® hardware is clearly expensive and carries a premium. Although, the main competitor for iPhone is Samsung and the 32GB Galaxy S6 starting at \$548.99 is not much cheaper. The difference lies in the wide variety of hardware available with the Android platform, and multiple OEMs offering differing models including LG, Motorola and HTC. Another difference is that the Android hardware manufacturers will run specials and sales, which is usually only limited to Black Friday for Apple®. It is not unheard of for Samsung to run a buy one get one free on their latest model to entice shoppers. Therefore, Android is the more cost effective choice, with the wide variety of hardware options and overall lower cost. Even though Android offers more options and hardware manufacturers, Apple® still represents the most widely purchased hardware provider in the U.S., which demonstrates that cost is not always the number one driver to consumers, and the tradeoffs consumers make daily does not always represent the most cost effective solution.

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The comparisons above show that the choice between open and closed systems is not clear cut, and there is not a one size fits all answer. The appeals of open system is its flexibility, customization, and overall lower cost to procure. While a closed system offers better security and more consistent software upgrades. It is important to note that while the overall cost of a production unit with open system hardware tends to be less expensive, that does not imply that the same is true for the development of an open system. Recall that Open Systems was implemented in industry in order to share the burden of R&D costs, this cost sharing would not occur in government. If the government decided to hire multiple industry partners to create a set of open standards and build open source code, the government would have to pay all industry partners, most likely at a higher cost then hiring only one. Furthermore, an issue would develop of who controls the baseline and dictates the standards. Android is effective because it is led by Google, Google has the expertise within that can manage and update the code as necessary. If the government simply contracts all the work out an issue will arise of who has control within the industry partners. Open systems architecture, as a software approach, can be an effective solution for government. It must be recognized that it might come with a higher price during development, but the overall goal would be to recuperate the costs over the life cycle of the program. The other important feature to ensure success is to have the standards and baseline to be controlled by the government which would entail having the expertise within.

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**References:**

1. United States of America. Department of Defense. Open Systems Architecture Data Rights Team. DoD Open Systems Architecture Contract Guidebook for Program Managers. 1st ed. Vol. 1. N.p.: n.p., 2013. Print
2. "Initiatives: Open Systems Architecture." Office of the Deputy Assistant Secretary of Defense (ODASD): Systems Engineering. DoD Inspector General, n.d. Web. 22 Feb. 2016. <[http://www.acq.osd.mil/se/initiatives/init\\_osa.html](http://www.acq.osd.mil/se/initiatives/init_osa.html)>.
3. Logan, Glen T. "The Modular Open Systems Approach (MOSA) to Defense Acquisition: OS vis-à-vis OA" NAVAIR Open Architecture Industry Day sponsored by AFCEA, 7 August 2007, Solomons Island. <[http://somd-afcea.org/downloads/Logan\\_ModularOpenSystemsApproach.pdf](http://somd-afcea.org/downloads/Logan_ModularOpenSystemsApproach.pdf)>
4. "S.1841 - National Cooperative Research Act of 1984." Congress.gov. Library of Congress, n.d. Web. 01 Mar. 2016. <<https://www.congress.gov/bill/98th-congress/senate-bill/1841/titles>>.
5. Wright, Christopher O.B. "The National Cooperative Research Act of 1984: A New Antitrust Regime for Joint Research and Development Ventures." Berkeley Technology Law Journal Spring 1.1 (1986): 133-93. Web. 4 Mar. 2016. <<http://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=1045&context=btlj>>
6. "The 8 Most Successful Open Source Products Ever." *Tech Blog*. Pingdom, 29 May 2009. Web. 4 Mar. 2016. <<http://royal.pingdom.com/2009/05/29/the-8-most-successful-open-source-products-ever/>>
7. "The Business Case for Open Systems: Expectations for Open Systems in a Changing Marketplace." A White Paper from the Open Group, n.d. Web. 01 Mar. 2016. <[http://www.unix.org/market\\_information/buscase.html](http://www.unix.org/market_information/buscase.html)>
8. All Laptops. Best Buy, n.d. Web. 6 Mar. 2016. <[http://www.bestbuy.com/site/searchpage.jsp?cp=1&searchType=search&\\_ks=960&sc=Global&list=y&usc>All%20Categories&type=page&id=pcat17071&iht=n&seeAll=&browsedCategory=pcmcat13](http://www.bestbuy.com/site/searchpage.jsp?cp=1&searchType=search&_ks=960&sc=Global&list=y&usc>All%20Categories&type=page&id=pcat17071&iht=n&seeAll=&browsedCategory=pcmcat13)>

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9. Edwards, Jim. "The iPhone 6 Had Better Be Amazing And Cheap, Because Apple Is Losing The War To Android." *Business Insider*. N.p., 31 May 2014. Web. 4 Mar. 2016.  
<<http://www.businessinsider.com/iphone-v-android-market-share-2014-5>>
10. Chan, Vera H-C. "By the Numbers: iPhone vs. Android." *Yahoo! Tech*. Yahoo!, 19 Sept. 2014. Web. 4 Mar. 2016. <<https://www.yahoo.com/tech/by-the-numbers-iphone-vs-android-97842025474.html>>
11. "Android vs IOS." *Difference and Comparison*. Diffen, n.d. Web. 6 Mar. 2016.  
<[http://www.diffen.com/difference/Android\\_vs\\_iOS](http://www.diffen.com/difference/Android_vs_iOS)>
12. "Android Overview." Open Handset Alliance, n.d. Web. 7 Mar. 2016.  
<[http://www.openhandsetalliance.com/android\\_overview.html](http://www.openhandsetalliance.com/android_overview.html)>