



IBM AIX

*An executive guide to IBM's strategy and roadmap for the AIX
Operating System on Power Systems*

An IBM® White Paper

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Today's IT Environment and AIX

Today's IT organizations face challenges that are both immense and exciting. As more and more devices connect to the Internet, the demand for computing capability, storage, and 7x24 availability continues to increase at a rapid rate. It is no longer about how *many* systems are available but how *efficiently* they are being used and the *Quality of Service* they are delivering.

IBM Power Systems running AIX has been the choice of many organizations to run their Systems of Record, such as the databases for warehousing and OLTP, web application servers implementing business logic, and analysis tools such as Cognos. These systems have to step up to the demand as the client devices, the Systems of Engagement, proliferate and drive higher transaction volumes.

Power Systems with AIX are in a clear leadership position here to meet all these demands. The strategic direction of IBM is to keep innovating, stay ahead of the curve, and keep delivering the most reliable, flexible, high performing and secure IT environment to our customers.

Power and AIX Marketplace

The majority of the Fortune 500 companies run their most demanding mission-critical workloads on AIX, the UNIX operating system for Power Systems. Consider the following statistics - 10 out of the world's top 10 banks runs on Power, 10 out of the world's top 10 telecommunication companies runs on Power, 8 out of the top 10 retailers runs on Power, and 8 of the top 10 insurers runs on Power! The reason for this is simple, organizations generally choose server platforms based on *their* evaluation of application performance, reliability & security, and the support provided by the vendor, and AIX and Power Systems qualifies for these clients.

A recent ITIC survey¹ shows Power and AIX leading all other platforms in these areas. A major reason for this is that AIX and Power are *designed* for each other with the development teams working together right from the concept stage. For the last 15 years, successive generations of Power Systems with AIX have maintained per core performance leadership in the industry. AIX is uniquely positioned to take advantage of all the Power processor chip technology advances such as Simultaneous Multi-Threading (SMT), that increases system throughput; Active Memory Expansion (AME), that increases effective memory footprint; and Memory Protection Keys, that provides a deep level of security and reliability. These innovations and many others have driven IBM's leadership in the Unix market share.

¹ ITIC Reliability Survey - <http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=SA&subtype=WH&htmlfid=XSL03126USEN>

AIX Software Roadmap

AIX's 30-year history of innovation is described in the AIX Strength To Strength document². As AIX has matured, IBM's release strategy has focused on delivering enhancements with the least amount of disruption. The software and hardware roadmaps ensure a stable environment ready to run the most demanding workloads. Every major AIX release has new game-changing technology that helps IBM customers stay on top of new business requirements. Incremental technology enhancements, called Technology Levels (TLs) happen more frequently so customers can take advantage of new features without major disruption. Smaller iterations, called Service Packs (SPs) are issued 2 to 3 times a year. SPs package up accumulated bug fixes and may also include support for new Power Systems and I/O features so clients can move to new server and I/O technology with confidence and minimal disruption.

With the announcement of AIX 7.2 in October, IBM has made some changes in the support lifecycle for AIX versions currently in the market. The first change is an increase in the support lifecycle timeframe for major releases, which will now have a 10-year support lifecycle with extended support for the final TL now available for 3 to 5 years at additional cost. The standard support timeline for an individual TLs moves from 3 to 4 years. New TLs for *mature* releases will be delivered at 2-year intervals instead of the prior one-year release cycle. As an example, AIX 7.2 TL0 was just announced in October 2015. TL1 and TL2 are planned for 4Q2016 and 4Q2017, while TL3 is planned for 4Q2019. This allows IBM to deliver new functionality rapidly when a new AIX version is announced and then reduce churn as the innovation focus shifts to the next major release.

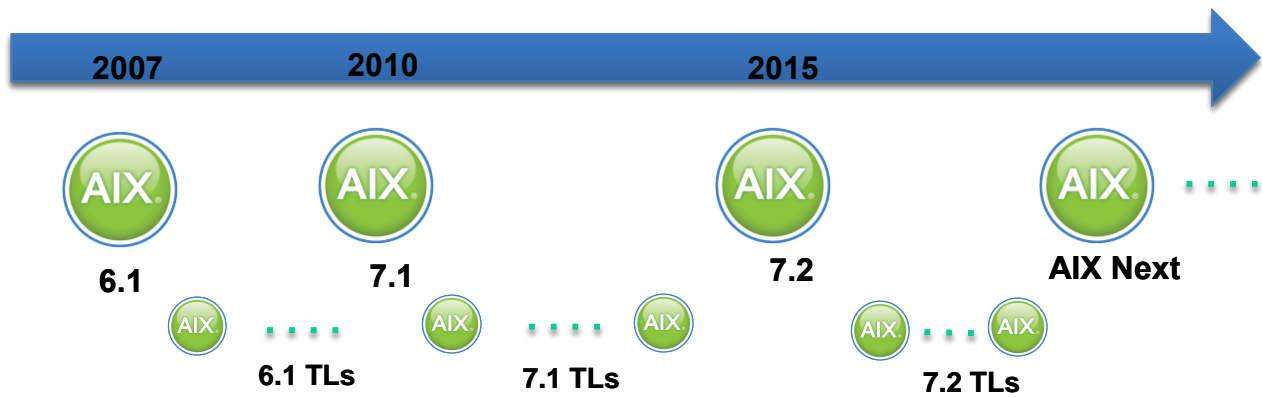
The support lifecycle updates do not change the AIX binary compatibility guarantee, which states that all well written applications adhering to the commonly practiced coding standards will run on newer versions of AIX without recompilation or modification. This means that when customers do move to a later version of AIX they can continue using their applications compiled on previous releases with confidence.

With the introduction of AIX 7.2 in December 2015, new features are available that further improve system reliability. The Live Update for iFixes feature allows a running AIX kernel to be patched and take effect without reboot. IBM plans to further develop this capability to get to the point where new Service Packs or TLs can be applied without a reboot.

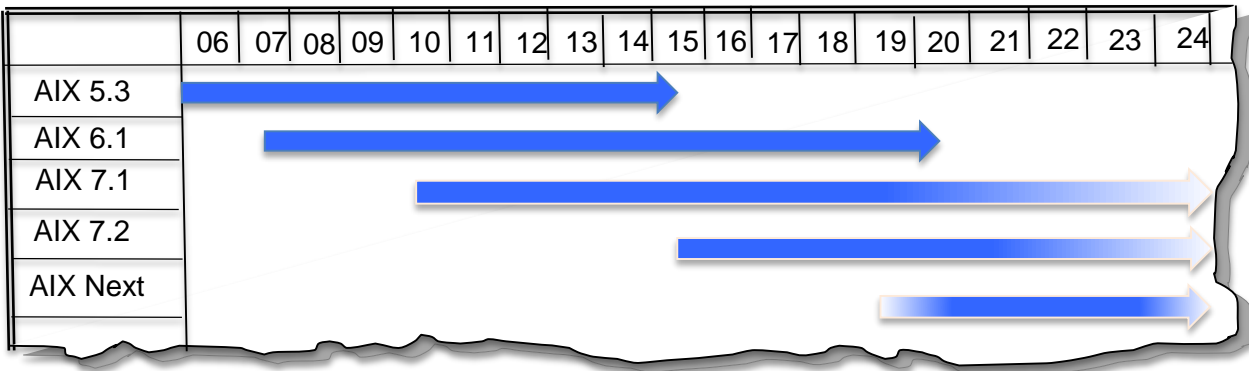
IBM will continue investing in AIX to deliver technical innovations and maximize performance, reliability, and security for the foreseeable future as the roadmap below demonstrates.

² <http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=RG&htmlfid=POO03022USEN>

AIX Roadmap



AIX Support



AIX 6.1, AIX 7.1, and AIX 7.2 are currently supported releases

AIX Standard and Enterprise Editions

AIX 7.2 is available in Standard Edition and the Enterprise Edition. The Enterprise Edition consists of the Standard Edition plus several other management solutions for enterprise customers such as PowerVC (Virtualization Control/private cloud), PowerSC™ (Security Compliance), Tivoli Monitoring, and IBM BigFix® Lifecycle. Enterprise Edition is less costly than the combination of Standard Edition plus all of the individual components so enterprise customers can implement advanced private cloud, security compliance, monitoring, and fix management at a bundled price

AIX and Open Source Software

Open Source technology has been an important part of AIX for many years. AIX uses open source technology within its core functionality and in AIX based Power Systems facilities such as the PowerVM® Virtual IO Server (VIOS). AIX also ships open source packages such as Perl, OpenSSL, and OpenSSH as part of the AIX base distribution since they have become mainstream tools and functions used by AIX administrators. Most recently, CloudInit was ported to AIX, enabling a uniform means to customized VM deployment by setting the VM's personality (hostname, IP address, etc.). Additional open source packages are included in the AIX expansion pack and can be downloaded from the AIX Linux toolbox download sites.

IBM is strongly committed to open source technology and open standards. IBM provides support for timely resolution of issues with both AIX and the Open Source software distributed with it. IBM support personnel work closely with the open source community to quickly resolve issues, with particular focus on security issues

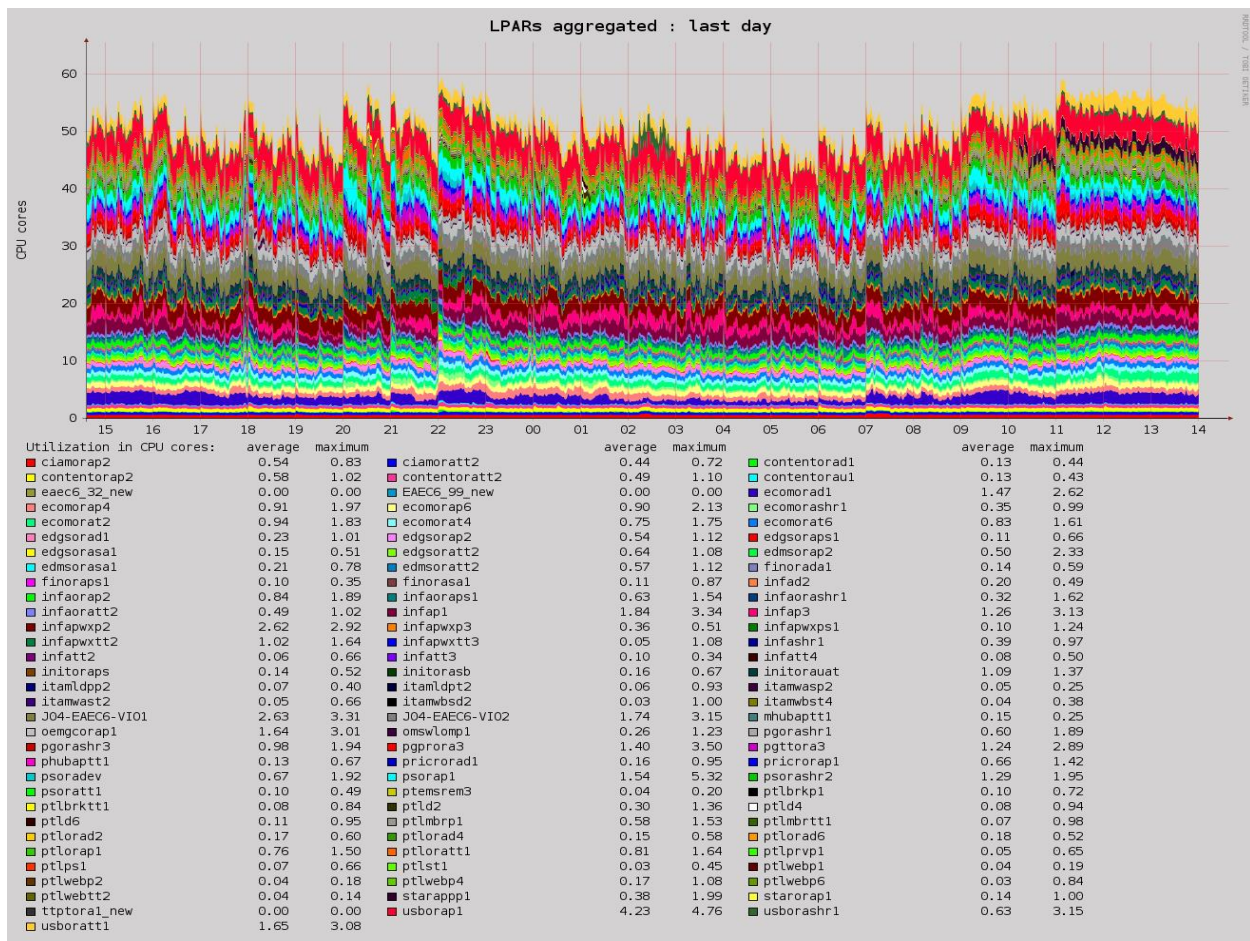
AIX Supporting Technologies

Server Virtualization and Cloud Technologies

Power Systems servers are designed with virtualization in mind. The PowerVM® hypervisor is implemented in system firmware and runs natively on the Power cores. The native implementation of the hypervisor enables very efficient and granular allocation of CPU, memory and I/O to the various Logical Partitions while providing the greatest possible security. In fact, as of the writing of this paper the National Institute of Standards and Technology (NIST) reports that the PowerVM hypervisor has never been hacked.

PowerVM supports LPARs with small and large CPU allocations; as little as 1/20th of a core or as many as 192 cores on the largest POWER8 E880 server. Whatever the CPU allocation, LPARs designated as "uncapped" compete for CPU cycles that are not being used. Dynamic allocation of these CPU cycles allows the busy LPARs to get more than 100% of their CPU allotment on a given dispatch cycle and do more work. The uncapped LPARs get more cycles so workloads can run faster. Stacking many LPARs onto a server allows higher utilization on the Power Systems compared to other server technologies.

The figure below is from a customer machine showing average CPU busy of about 80% across a business day on a 64-core system with 100 LPARs.



AIX takes advantage of another POWER technology called Active Memory Expansion (AME). AME allows a portion of an LPAR’s memory to be stored as compressed using a special compression unit on the POWER processor chip, making the effective memory larger than it is. For example, 16 GB of memory can be made to look like 20 GB by applying an AME compression factor of 25%. AME along with the POWER8® hardware uses the on-chip accelerator to speed compression and save main compute resources transparently.

AIX also supports a lightweight partitioning technology called Workload Partitions (WPARs). WPARs divide up the resources allocated to an LPAR into work units that usually run a single application. One use of WPARs might be to provide each developer with his/her own environment with a consistent image. Customers can choose between the higher isolation of LPARs and the lower isolation of WPARs based on their needs.

PowerVM virtualization provides the foundation for private clouds. Implementing a private cloud in an enterprise can reduce the time to deploy new LPARs and provide a self-service menu for authorized users to automatically provision short term LPARs within established limits. PowerVC creates, destroys, and manipulates PowerVM LPARs with an easy to use GUI, even incorporating non-IBM resources (SAN disk, for example) that can be managed with OpenStack management tools. PowerVC improves compliance and reduces errors by standardizing deployments and configurations while leveraging approval policies for oversight and optimal

performance. A private cloud built with PowerVM and PowerVC enables organizations to reduce IT costs, improve service delivery and accelerate business innovation

Resiliency and High Availability

This is the area that IBM platforms have historically excelled in. IBM Power Systems made the decision many years ago to bring IBM Mainframe reliability features to the Power servers. Key innovations like First Failure Data Capture (FFDC), processor instruction retry, CPU de-allocation, chipkill memory, and memory protection keys have consistently given Power and AIX the best reliability record in the Unix/Linux/Windows marketplace. Annual customer surveys by Information Technology Intelligence Consulting (ITIC) have shown Power and AIX having the least amount of downtime and the shortest recovery time among the surveyed platforms³.

The well-known high availability and disaster recovery (HA/DR) capabilities of Power servers are delivered through PowerHA® SystemMirror software. This technology is deeply integrated with AIX for reliably orchestrating the acquisition and release of cluster resources from one system to another. As an example, PowerHA version 7.2 integrates with the new AIX 7.2 Live Update feature in AIX 7.2 that allows the AIX kernel to be patched without application downtime.

Another technology that improve reliability are PowerVM Live Partition Mobility (LPM), which moves a running partition from one physical server to another while the applications continue to run. This helps in eliminating downtime when production systems need to be updated.

Systems Management

Power Systems has embraced the open source community to deliver enterprise solutions for systems management based on open technologies like OpenStack. IBM's PowerVC product can manage the offerings of other OpenStack members in addition to our own. OpenStack membership provides the greatest speed for innovation and allows each vendor to contribute to the support of the devices they know best.

AIX has been extended to fit into this new OpenStack systems management model, to allow flexible and fast deployment of workloads in a private or hybrid cloud. AIX workloads can be captured and redeployed within a cloud within seconds using PowerVC or IBM Cloud Manager with OpenStack (both are based on OpenStack).

Systems Security

The key for the IT security of an enterprise is to use a variety of security and cryptographic mechanisms to determine and maintain the trusted state of the systems and to ensure a safe and

³ <http://itic-corp.com/blog/2014/04/itic-2014-reliability-survey-ibm-servers-most-reliable-for-sixth-straight-year-cisco-ucs-comes-on-strong-hp-reliability-rebounds/comment-page-1/#comment-802510>

trusted execution environment. The operating system provides the foundation around which the rest of the software stack can build its security structure. AIX historically has had an exceptionally strong security foundation addressing a variety of different types of threats. An example is the Trusted Execution. This ensures that known binaries are not altered in any way that would allow malicious code to execute. When this is combined with the PowerSC Trusted Boot capability the “root of trust” is ensured from the AIX kernel load process through the execution of each AIX executable. This can be extended to the actual applications themselves if that is so desired. This is truly unique in the industry.

Several options exist in AIX for customers to implement mechanisms to prevent unauthorized access. AIX Security Expert is an AIX tool that standardizes security settings across a group of servers or even throughout an entire enterprise.

AIX automatically takes advantage of the cryptographic hardware accelerators in POWER8® based servers. The various AIX security libraries automatically detect hardware facilities and then use them without any additional configuration.

Conclusion

AIX has supported mission critical workloads in a high performance, reliable, and secure manner for decades, and is expected to continue doing so for the foreseeable future. The deep integration of the Power Systems with AIX gives the platform an edge that is hard to match. This paper highlights the keys areas of differentiation and innovation for our customers.

Some links to the reference pages on Power Systems and AIX are listed below.

AIX Resources

There is a wide range of on-line resources available to the AIX community. A short sampling is listed here

- IBM AIX
<http://www-03.ibm.com/systems/power/software/aix/>
- IBM AIX service and support best practices
<http://www14.software.ibm.com/webapp/set2/sas/f/best/home.html>
- “IBM AIX Technology Forum” on LinkedIn
https://www.linkedin.com/grp/home?gid=8413155&trk=my_groups-tile-flipgrp