The Evolution of Mainframe Transactional Processing Through Containerization and the Cloud

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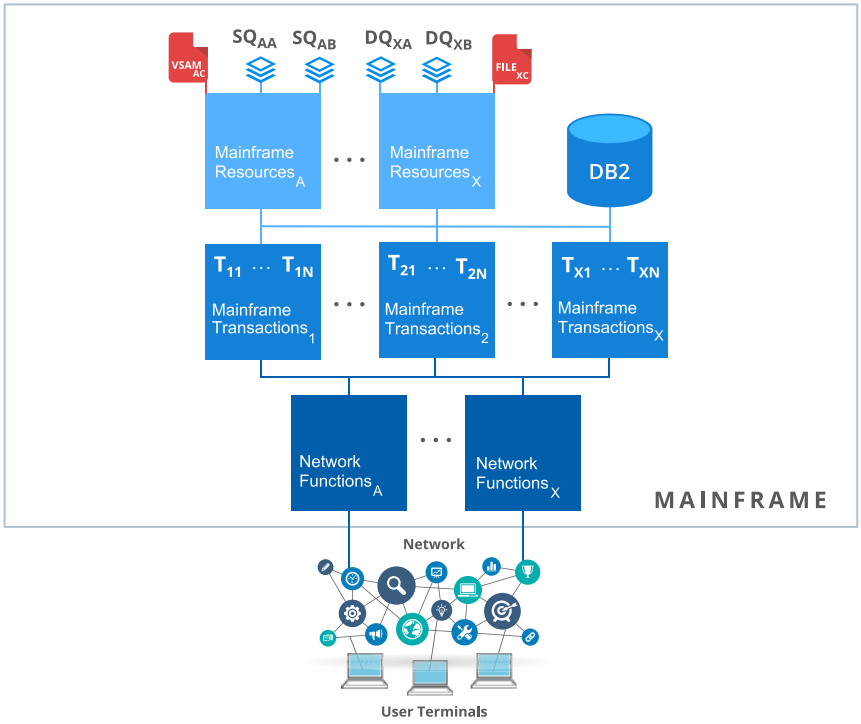
Overview

For decades mainframe customers have seen the evolution of single processing environments, from the earliest S/360 processors through to multi-processing environments of early S/370 platforms to the current logical partition (LPAR) and Parallel Sysplex architectures of mainframe platforms. Transactional processing has further scaled within these environments as both IMS™ and CICS® provided architectures for distributing workload across these multiprocessor/multi-platform hardware environments. By splitting a workload across multiple regions, organizations could leverage the growing distributed workload implementations of the Parallel Sysplex implementations.

This architecture, while initially specific to the IBM CICS mainframe transactional environment, has inspired many modern x86 or cloud environments for many kinds of distributed workload across a range of operating systems and platforms. The architectural evolution of the x86 processor towards multi-core environments underlies most modern servers and dominates the market with 10 million+ machines sold every year. In fact, mainframe and microprocessor technologies have converged to essentially one chip. While the mainframe still carries 60 years of compatibility challenges, Intel®, ARM® and others do not. This growth has affected the evolution of the software market: the trend toward "more of the same (only smaller)" on the hardware side drives state-of-the-art software architectures towards finer grain components in an application implementation.

This software trend is exemplified by the container and microservices architectures extensively used by all web-scale organizations such as Amazon®, Google®, Facebook® and others. Even if driven by the evolution of modern x86 hardware, it has intrinsic advantages from a software development perspective: small software pieces are simpler to understand and easier to test exhaustively. Each of them can therefore be upgraded independently, faster and with high reliability due to their limited and well-defined perimeter: impervious isolation across containers. This agility in software evolution serves the organization well: new releases at high speed are the fuel of innovation in the era of digital business. This blazingly fast innovation by new players makes incumbents nervous,

Standard Transactional / MRO Architecture



SQ – Storage Queue
DQ – Data Queue
MRO – Multi-Region Operation

as they are often hampered by the inertia of monolithic legacy architecture, with the mainframe at its heart.

In comparison to this growing scale-outwards architecture, the mainframe has rather followed a scale-up path with single machines of increasing power (in terms of MIPS) over the last several decades. However, users have come to realize the power of the granularity described above: mainframe architects created logical partitions (LPARs) to isolate subsystems using a portion of the available raw computing power on the platform. These LPARs operate fully independently of each other, and are therefore able to do very different things at the same time on the same machine without interference. This advantage of "isolated granularity" has been extended on the mainframe in many of its subsystems, as mentioned above.

This kind of architecture was devised on the mainframe for the same reasons as on x86 or other commodity hardware (ARM, etc.): high reliability, platform optimization and high performance. The LzLabs Software-Defined Mainframe® (SDM) has been architected to re-host legacy mainframe applications and data, unchanged, on those commodity machines (x86, ARM). This approach creates synergies between the old world of mainframe application architectures and the new world of distributed container and cloud architecture concepts.

SDM – Leveraging the Power of Modern

The SDM *eliminates the need to modify and recompile mainframe application source code and preserves mainframe data in its native encoding format.* Our vision is to enable the power of modern computing infrastructures to liberate organizations from the limitations of legacy applications so they can achieve agility, flexibility and cost effectiveness from their computing platforms. LzLabs is therefore focused on three driving philosophies of product development:

- The power of modern x86 computing paradigms can be leveraged to run enterprise class workloads, including cloud infrastructure deployment models.
- Our Software Defined Mainframe approach ensures the lowest migration cost and risks. You move an existing workload, unchanged and "It just runs!"
- The SDM is designed to provide a container environment to run mainframe applications, but in all other ways is designed to leverage the power of Linux, open source and cloud environments.

The LzLabs philosophy – 'The Power of Modern' – represents the combination of open source, cloud deployments and x86 chip technologies. The SDM is the thinnest possible adaptation layer between mainframe application APIs and similar Linux® capabilities in order to stand "on the shoulders of giants" such as Linux and, more generally, open-source software (OSS). This OSS has been carefully crafted over the last few decades by tens of thousands of people around the world. Additionally, Linux has been optimized and stabilized by literally millions of installations around the world, handling workloads of all shapes and sizes. It has evolved to become lean and rock solid. The general objective

at LzLabs is to develop the SDM as the smallest possible software layer to map legacy mainframe applications, APIs and needs to the equivalent Linux APIs and features. This strategy extends to both software container and cloud deployment environments.

Why Containers?

One of the advantages of the mainframe operating system architecture is the ability to distribute different workloads across multi-processors, whilst maintaining the consistency and control of a single operating system. While virtual machine technology, introduced in the 1970s enabled a mainframe workload to run multiple operating systems on the same hardware, enabled multiple workloads to run under the control of a single operating system. Early distributed operating systems, such as Microsoft Windows®, UNIX® and, later, Linux were initially designed to run application workloads in support of smaller environments. As the demand for workload grew on these platforms, particularly Linux, the concept of application containers was created. Containers enable the deployment and operation of multiple application workloads, architected as small pieces of software, deployed at the same time on modern operating systems, such as Linux.

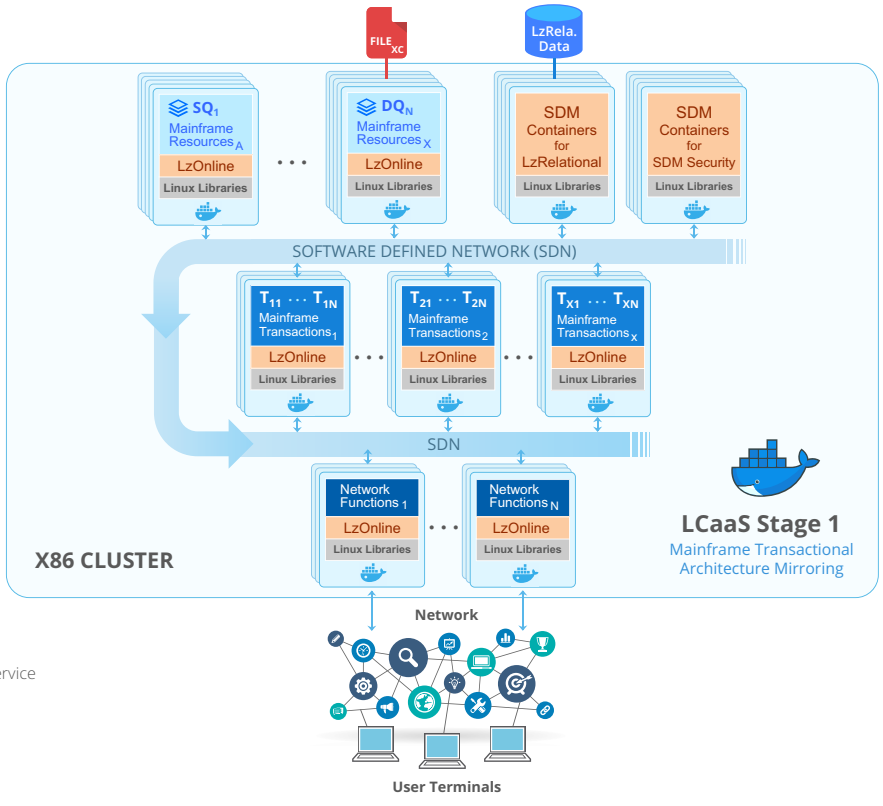
The Optimization of Infrastructure through Containers

One of the initial benefits of containers was to optimize computing infrastructure to provide greater use of existing hardware through a lightweight version of the standard virtual machine (no hypervisor but a similar isolation). By running multiple containers, each efficiently delivering different application workloads on a single multi-core platform, higher usage levels reduce the required compute capacity.

The LzLabs SDM can be used to easily distribute existing CICS transactional workload across containers implemented on physical servers or cloud deployment Infrastructure-as-a-Service (IaaS) environments. The **LzOnline**™ architecture has been carefully designed to fully leverage modern distributed computing advances, such as containers. All services in support of a transactional workload are implemented so they can be replicated and deployed across multi-container environments. This enables organizations to maximize their server use and increase their business agility in line with their current container strategies. Much as CICS provides a multi-region operations model (MRO), as described earlier, LzOnline leverages containers to provide functionally equivalent behavior in a containerized platform environment.

The combination of the SDM, orchestrated containers and cloud deployment models, such as **Microsoft Azure**, enables organizations to re-host transactional workloads, leveraging their current MRO model, on modern, open and scalable technologies. Application workloads can be transitioned from mainframe transactional environments to the SDM in an incremental

Transactional / MRO Architecture in Containers



LCaaS – Legacy Container as a Service
MRO – Multi-Region Operation
SQ – **Storage** Queue
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fashion. LzOnline is architected to support complete integration with existing CICS MRO implementation, while at the same time providing a modern environment to migrate as much application workload as necessary to distributed server or cloud environments.

The Optimization of Applications through Micro-Services

The LzLabs container approach is designed to enable companies with legacy mainframe applications to take further advantage of the scale and agility of containers on modern Linux or cloud environments, exposing existing business logic as services or micro-services. Modern web scale giants roll out new or updated services rapidly, many of which are 'Micro-services' – small pieces of software specializing on a small number of (or even just one) business functions. The boundaries and dependencies of these micro-services are explicit and clear; they are defined by their communications with other micro-services over the network.

Containers – One Path to Agility?

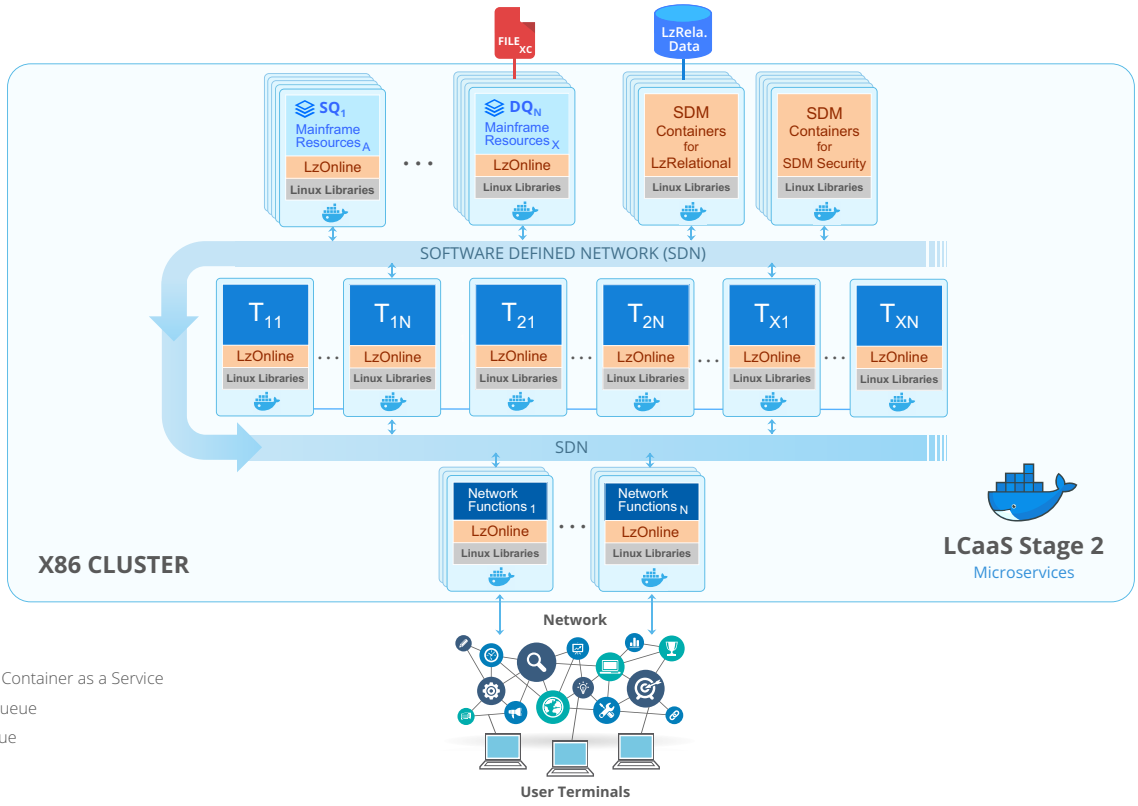
These explicit and clear boundaries dramatically reduce the scale of testing – it becomes much quicker and easier. More straightforward functionality enables automated testing to yield dramatic improvements in productivity. How else could anyone achieve the scale of these born-on-the-web companies? The usual 'go to production' fear associated with legacy systems is often a result of organizations' caution over testing. Many mainframe shops are challenged when testing their entire infrastructure because these systems are so monolithic and complex. With a simpler piece of software, with more straightforward functionality and supported completely by automated testing solutions, companies are able to roll out changes in a continuous delivery mode, incurring limited risk due to the smaller footprint of these micro-services. Legacy mainframe applications are quite different. These large, complex monolithic systems, with lots of programs, each highly dependent on one another must be tested in their entirety over many weeks in order to find the "bug in the haystack."

Micro-services – The Path to Modern

LzLabs' solution enables these legacy systems to participate in a more modern and agile world. We achieve this by providing the restructuring technology for automated transformation of monoliths into a myriad of independent micro-services, without changes to the source code.

This approach allows existing COBOL COMMAREA programs (to use a legacy term) to become a micro-service that is hyper-connected with new applications written for mobile and social networks. This means that innovation can occur on top of the cornerstones of the current business. To put this in terms of Gartner's Bimodal IT vision, it means that Mode 2 applications can more easily leverage Mode 1 services. Exposing these legacy

Containerized Transactions



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"crown jewels" as micro-services enables them to be reused for modern digital business solutions. For example, a bank with tens of thousands or even millions of lines of COBOL that are used to determine the value of their banking customers can reuse these functions "as-is" and doesn't have to spend time and money re-writing them in Java or another modern computing language. The LzLabs solution enables organizations to isolate the legacy programs providing this "customer valuation" function as a separate micro-service, that can be readily reused by the evolving application portfolio. In essence, our solution is designed to:

1. Leverage automatic application analysis techniques to unambiguously understand all programs required to provide the business function, and expose them as a micro-service..
2. Package these required components, still in their mainframe binary form, within an optimized version of the LzLabs SDM.

When combined with the necessary Linux packages and Docker® technology, these components are bundled as an independent micro-service, ready to be deployed in our "Legacy Container-as-a-Service". (LCaaS) The number of micro-services extracted from legacy applications using this new approach can yield hundreds of controlled functions, requiring modern processes to build and maintain them. The LzLabs solution is being designed to automate the build, delivery and update engine in DevOps mode to support these legacy-based micro-services by:

1. Running application analysis automatically each time application program changes are committed to the source code repository. This recurring analysis detects if dependencies have changed (new copybook, different call tree, etc.) and redefines, if needed, the set of components to be packaged together for the next version of the micro-service.
2. Constructing Docker images automatically to populate the container image registry with the latest version following the update of the COBOL application program. The LCaaS platform will then transparently take care of the automated deployment of this new version, leveraging Kubernetes – a key component of the RedHat Docker Enterprise Edition or OpenShift initiatives.

SDM – Just Enough Mainframe and No More

The strategic direction of the LzLabs Software Defined Mainframe is to continue to evolve the legacy application workload of mainframe transactional environments to leverage containers and cloud deployment models, using contemporary hardware. The core differentiation of the SDM is the migration of mainframe application load modules through an export process that produces a mainframe object module, with new APIs which provide equivalent behavior to the legacy mainframe variants they replace. This functional compatibility ensures that the re-hosted program will produce the exact same results it did when running in the legacy application environment. This unique approach provides the ideal architecture to quickly leverage readily-available container deployment and orchestration technologies.

Providing functionally equivalent behavior is necessary to support the migration of any mainframe workload to alternative platforms. The SDM provides, not only this support today, but enables the distribution of workload across multiple processing environments, including existing mainframes. Continued evolution of the SDM will leverage cloud deployment and container models to strengthen this capability across these growing compute architectures. Continuing to utilize these legacy business processes in a modern world is greatly enhanced by the transition to a micro-services model. LzLabs and the SDM will continue to evolve to support this modern approach to application architecture.

LzLabs continues to invest in innovative approaches that enable organizations to leverage their investment in legacy mainframe applications while at the same time evolving to more modern technology alternatives. This unique approach is unparalleled in the industry and provides a much lower risk approach to moving mainframe workloads.

To learn more please visit: http://www.lzlabs.com/our-solution/

About LzLabs

LzLabs GmbH is a software company that develops innovative solutions for enterprise computing customers including the **LzLabs Software Defined Mainframe®**. The LzLabs managed software container provides enterprises with a viable way to migrate applications from mainframes onto Red Hat Linux computers or into cloud environments such as Microsoft Azure. The company was founded in 2011 and is headquartered in Zürich, Switzerland. Learn more at **LzLabs.com**

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