



A modern view on the mainframe

When you think of the mainframe, you probably think it is where you write batch programs in Cobol on old green screen terminals. Not too exciting, right? Who would sign up for that? It's much more interesting to work on modern platforms and write web and mobile apps. But where do you think most of the processing of these apps happen?

The mainframe is often poorly understood by those who only know of it through rumor and myth. Ask anyone on the street to tell you what they think of when you say the word "car" and you will get descriptions of the latest model Audi, BMW or Porsche. You will never get a description of the first car by Carl Benz back in 1886. When you ask the same thing about the word "mainframe", you will get a description of a huge, room-filling computer from the 70s with spinning tapes in the background. In most cases you will not get the image of today's stealth-like designed, state-of-the-art super computer the IBM mainframe really is.

Companies that rushed to embrace distributed network farms and cloud computing during its hyped-up introduction have learned some hard lessons about its limitations, especially around security. The current move towards private clouds mitigates some of these risks, but when it comes to cybersecurity, "some" is never an acceptable answer.

In this paper we will try to show that the mainframe:

- Is one of the most valuable systems in the world and will be even more valuable in the future.
- Is a machine with 50 years of experience imbedded in its hardware and software.
- Is one of the most powerful systems today, and the best environment for large critical businesses.
- Is as modern as any other platform
- Is certainly no longer green screens, but provides a modern development environment
- Is a wanted skill to put on your CV

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What is a mainframe and what is it used for.


Today when we speak of the mainframe we mean the IBM Z mainframes. In the past many manufacturers existed, today few other than IBM remain.

The definition “large, high speed computer(s) that can support numerous workstations or peripherals.” Is correct but arguably Linux, Unix, and Windows servers also possess these qualities.

Although to replicate the strength of one mainframe we would need to create a distributed network of +1500 Linux, Unix and Windows servers, managed in a private datacenter or in the cloud. Within one box a z14 mainframe offers the same functionality with multiple layers of redundancy, to guarantee maximum safety and reliability.

An additional strength is in its history, the mainframe is a combination of both hardware and software which evolved over more than 50 years, and was specifically designed for the need of large business processing.

main·frame

/ˈmānˌfrām/ 

noun

1. a large high-speed computer, especially one supporting numerous workstations or peripherals.

In the hierarchy of computers, mainframes are right below supercomputers, the most powerful computers in the world. supercomputers are designed to execute one specific process at the highest speed. Commonly they are used for scientific problems. A supercomputer is tuned for maximum processing power and speed, and it excels at CPU-intensive tasks. The operative words for mainframes on the other hand are throughput, reliability, and rapid processing of extremely large data sets.

In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

Often it has been running in the corporation for many decades, the reason why this was possible is that the IBM Z family maintains full backward compatibility. In effect, current systems are the direct, lineal descendants of the “first IBM mainframe” (the System/360), announced in 1964. Most applications written for these systems can still run unmodified on the newest IBM Z system over five decades later.

This long history is often the reason why companies are keeping their mainframe. These companies grew into huge corporations with complex business rules and huge amounts of data process. Their programs equally evolved and are finetuned specifically for the company’s goal. Replacing or moving these programs is a huge undertaking and will seldomly lead to success.

The mainframe has long been a staple of healthcare and financial organizations.

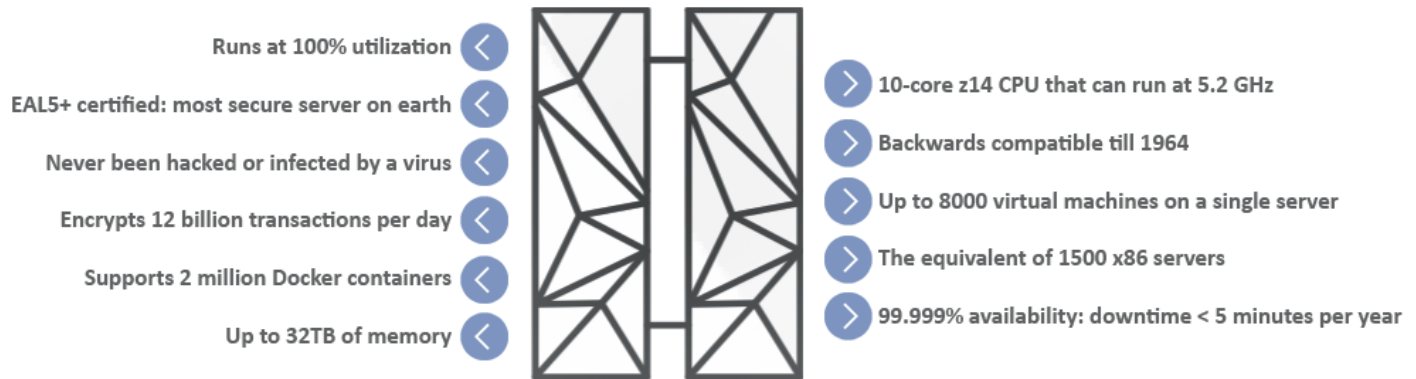
Large corporations which have a huge daily workload and handle critical data and processes often have no other alternative than the mainframe. These environments simply can’t afford downtime. Interruption of service can cost millions or even cost lives. To replace a mainframe often requires a huge network of servers. This can be done by a distributed network of Unix or Wintell servers. And in recent years even by the cloud. However, the reliability, availability and security features of the mainframe are not that easily replicated. Reliability features include the capability to automatically detect system faults, report problems and continue to operate using self-healing methods. Availability allows the system to continue operating even with the systems fault, while serviceability relates to the relative simplicity of how system faults can be reported and diagnosed, decreasing downtime.

A mainframe is the heart of the corporation, it is the central data repository, or hub, in a corporation’s processing center, it is where all data is preserved and maintained. And it is where most of the Critical business logic is stored.

A major part of the workload of a mainframe consists of batch processing. A large mainframe often will run up to 100,000 batch jobs a day. Simultaneously and at a high speed, treat millions of data records from all the company’s partners. Handle millions of transactions with the highest response time. And at the same time serve somewhere between 10,000 and 30,000 users.

What makes the mainframe unique.

The mainframe is a system developed specifically for the needs of big corporations. Centralized data storage and resource administration, high-demand mission-critical services, high security, high availability, robust hot-swap hardware, dynamic re-configuration of hardware and software with no downtime, massive transaction processing, backward-compatibility with older software, and massive throughput. There are multiple layers of redundancy for every component: power supplies, cooling, backup batteries, CPUs, I/O components, and cryptography modules. All in one box



The power of the mainframe

IBM z14 has 14 nanometer cores, 170 configurable processors, 6.8GB of cache memory, 32TB of main memory and 10 cores per chip to process up to 30 billion transactions daily. Which allows to Run up to 8,000 virtual machines on a single server with 160 I/O cards and 320 I/O channels. A single mainframe is equivalent to approximately 1500 x86 servers.

We can try to replicate this robust hardware in the x86/ARM server farm, but it's not the same. Commodity hardware is always under intense downward price pressure, and on lower-end machines a lot of functionality is offloaded to software, such as encryption and networking, which places the load on the host CPU. In contrast, the mainframe is a collection of specialized discrete components that supply their own resources. Networking interfaces, cryptographic processors, and device controllers have their own power supplies, redundant connectivity, self-diagnostics, reporting, and their own cooling systems.

Throughput is a distinct mainframe characteristic, as it supports large numbers of simultaneous transactions and massive I/O without slowing down. An x86/ARM server loses efficiency at >20% total load, and will slow down when any single component is overloaded; for example, when its CPU is running at 100%, or memory is exhausted, or the hard disk thrashes. This doesn't happen on a mainframe, which maintains peak performance up to 90% load.

Security

With increasing attention on security, it is important to note that the mainframe has the highest server security rating in the industry. The Evaluation Assurance Level (EAL) of an IT product or system is a grade assigned following the completion of a Common Criteria security evaluation. IBM mainframes are one of the few servers to have EAL5+ certification. What does EAL5+ mean? Security is built into every level of the mainframe's structure, including the processor, operating system, communications, storage and applications. Security is accomplished by a combination of software and built-in hardware functions, from identity authentication and access authorization to encryption and centralized key management.

IBM has reinforced its EAL level by building pervasive encryption into its latest model, the z14. Pervasive encryption is the ability to encrypt everything everywhere without interfering with the user experience and while being transparent to the programming. The new IBM Z14 mainframe can do real-time encryption of up to 12 billion encrypted transactions per day.



Despite the way Hollywood portrays the mainframe, in reality there has never been a reported incident of a mainframe being hacked or infected by a virus.

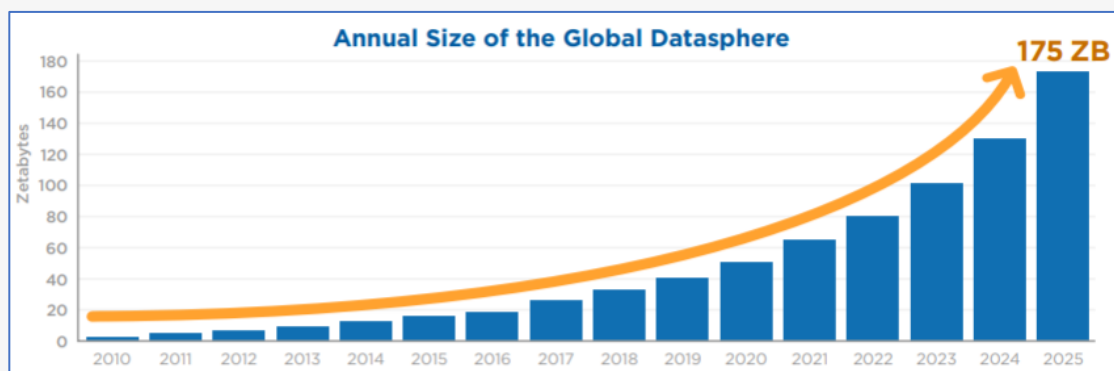
Reliability & availability

The mainframe has a high “Mean Time Between Failure” – in other words how long, on average, before it fails. For the mainframe, this is measured in decades. The mainframe has unmatched reliability, which contribute to its 99.999 percent availability. 99.999 percent availability means near continuous operation with unplanned downtime of only 5 minutes over the course of a year. Quick recovery and restoration of service after a fault greatly increase availability. Next time you are trying to get money out of an ATM, buy stocks, reserve an airline ticket, or pay a bill online, think about how important reliability really is. How much does an unplanned outage cost? It depends on the industry, but can certainly be millions of dollars per hour.



The evolution of data

Today's economy relies on data, and this reliance will only increase in the future as companies capture, catalog, and cash in on data in every step of their supply chain; enterprises collect vast sums of customer data to provide greater levels of personalization; and consumers integrate social media, entertainment, cloud storage, and real-time personalized services into their streams of life. The consequence of this increasing reliance on data will be a never-ending expansion in the size of the Global Datasphere. Estimated to be 33 ZB in 2018, IDC forecasts the Global Datasphere to grow to 175 ZB by 2025.



In the 1990s the need for the expensive mainframe became arguable. For the price of one mainframe, you could afford to buy a hundred servers, grouped into a distributed network. But as the Internet took over, servers became more complex. Often, several servers had to work together to accomplish one specific task. Data centers grew to accommodate more and more servers, which demanded power and cooling resources. Even if mainframes are a tough sell, it is clear that a comeback is in the works. Large companies can even save money on IT infrastructure by replacing hundreds of servers with one huge mainframe computer. One secure place where all applications can access the data using API's and use machine learning to gain real-time insights.

80% of the world's corporate data
resides on or originates on the **mainframe**

The arrival of modern technologies itself, which brought with it the arrival of higher processing power needs, larger amounts of data than ever, and new security risks, has strengthened the need for enterprises to stick with their mainframe. The platform best suited for these types of challenges. The more mobile the Internet access, the greater the number of mainframe touch points. With the use of self-service applications rising, and with the Internet rapidly increasing the number of these mobile orders, the scalability and reliability of the mainframe is more important than ever and entrenches itself firmly as a mission-critical asset.

Where did the mainframe come from?

IBM's System/360, The "first" mainframe and the start of enterprise computing.

The UNIVAC was the first commercially produced enterprise computer. it was released in 1951 in small scale and started of the era of large enterprise computing. In the following years multiple companies jumped on the market with their own system, all following different development paths. Each used different peripherals, had its own OS and coding. In a word, they were incompatible. To change to a new system required buying new peripherals and rewriting all software, since the old software would not work on a different type of machine.



With the IBM 360, IBM decided to implement a wholly new architecture specifically designed for data processing. IBM invested \$5 Billion to develop a family of machines that ran the same OS and could use the same peripheral devices with the same architecture. Cobol code which has been written on the IBM 360 will still run today.

The introduction of the concept of compatibility proved a turning point in the

industry, and created a unified market that greatly stimulated the commercial use of computers. The IBM 360 forever changed the computer industry and revolutionized how businesses and governments worked, enhancing productivity and making countless new tasks possible.

In the past 50 years multiple technologies threatened the mainframe.

Up until the mid-80s centralized mainframe computing was practically the only option for big enterprise computing. But Since then we have seen the eras of personal computers, client/server computing, web-based enterprise computing, and we have advanced into to the cloud-based, server-less world we occupy today. But during this period the mainframe didn't stand still either. Likewise, it has advanced, adopted to the new technologies, even showed to be the best platform for them. Think mobile and blockchain for example, or virtualization which has been a mainframe hot topic since 1972.

- "I predict that the last mainframe will be unplugged on March 15, 1996."
— Stewart Alsop, March 1991
- "It's clear that corporate customers still like to have centrally controlled, very predictable, reliable computing systems – exactly the kind of systems that IBM specializes in."
— Stewart Alsop, February 2002



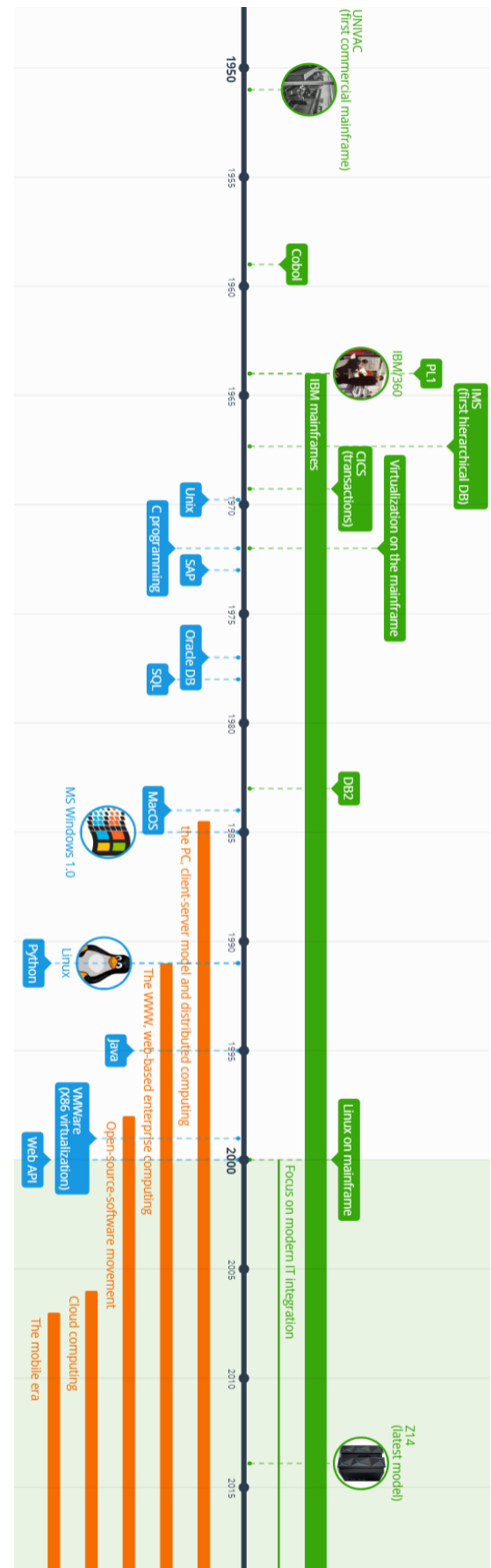
Takeaway from this:

- Developers should recognize that the roots of their profession lie on the mainframe.
- When looking at the timeline mainframe technology is not that much older than technologies as Unix, SAP or C.
- The mainframe is a machine with more than 50 years of experience in it.
- IBM has invested a lot in becoming the best platform for modern technologies, it has dominated enterprise computing for the last 50 years and there is little evidence that this will change in the future.



1969

Man on the moon
(Thanks in part to the IBM 360)



Mainframes are one of the most vital systems in the world.

If you encounter a massive company, chances are they use mainframes. If you go to a bank, it's really weird if they don't. The paychecks we cash, the health care we utilize, all depend on the mainframe. Mainframes are the cargo ships of the computing world.

World's leading businesses run on the mainframe

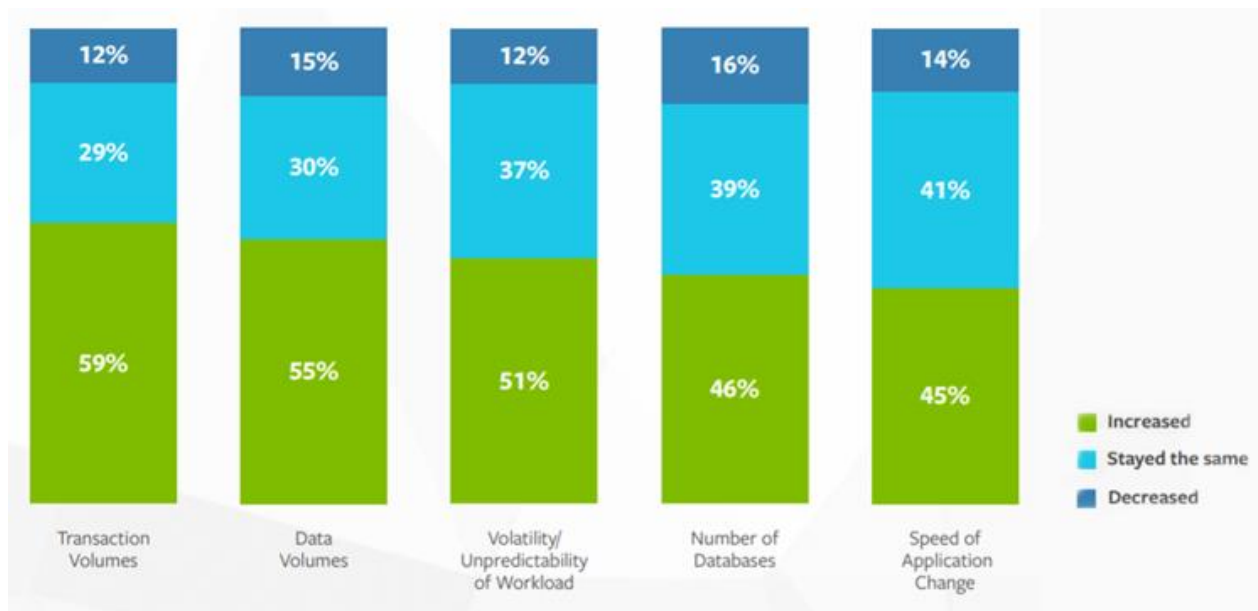
- 71% of global Fortune 500 companies.
- 92 of the top 100 banks worldwide
- 10 out of 10 of the world's largest insurers
- 18 out of 25 of the world's largest retailers
- 23 of the world's 25 largest airlines.
- Mainframes handle 68% of the world's production IT workloads, yet they account for only 6% of IT costs.
- 220+ billion lines of Cobol.

Processing the world's transactions and data

- 1.15 million transactions every second of every day, the equivalent of all Google searches, YouTube views, Facebook likes, and Twitter tweets combined. 80% of the world's corporate data resides or originates on mainframes.
- Mainframes handle 87% of all credit card transactions. Did you buy something with your Visa or Mastercard today? More likely than not, a mainframe made it possible.
- 55% of all enterprise application transactions occur on the mainframe.

Mainframes will remain as important in the future.

Although the number of mainframes being used has dropped over the past years, the amount of processing they do is increasing. A 2019 survey found that only 15% of mainframe sites have seen a decrease and over 50% saw an increase in consumption in the past year. Trends show a three-and-a-half time's growth in the capacity of mainframes over the last ten years, demonstrating that mainframe is a platform of revenue growth and innovation.



Most companies found that embracing a hybrid approach with the mainframe in the center is more strategic, keeping competitively differentiating mission-critical workloads on the mainframe and using XaaS resources from cloud providers for more basic business applications and a platform for distributed infrastructure.

While companies are losing essential mainframe staff

- Enterprises have lost an average 23% of specialized mainframe staff in the last five years.
- 63% of those positions have not been filled.

It is highly unlikely that within 10 years organizations will no longer consider the mainframe as strategic, especially in the organizations with huge mainframe capacity. It's also difficult to believe that in 10 years over 90% of the organizations using mainframes today will no longer use them at all or only use them for a minor role. More likely the role of a mainframe developer will look different. Opening up to new technologies, the mobile world, the cloud and any other new technology on the horizon.



The mainframe is a modern development environment.

There was a time when the prospect of getting up to speed on mainframe development would have been daunting. Mainframe developers worked exclusively with arcane, “green screen” tools that required extensive, hard-won expertise in both the tools themselves and the understanding of the underlying IBM z/OS platform.

Because of these tooling and platform knowledge issues, the only way to become competent on the mainframe was to completely devote yourself to it, and this meant sacrificing any involvement at all with cloud, mobile, or any other technology that captured your interest. No more. A new generation of mainframe devops tools now provide the same graphical look and feel you’d expect from any other platform.



Open source on the mainframe

IBM has developed an Open Source Public Community for Linux on Z, and continues to add more and more open source products. In addition, there are over 4,000 IBM and ISV software products encompassing Cloud and Digital solutions.

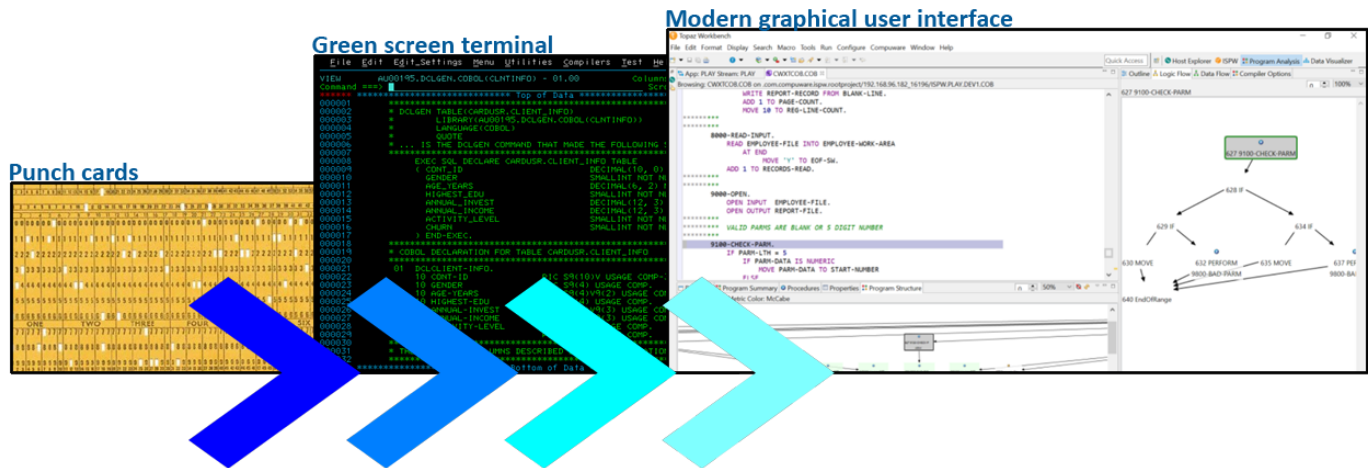
Besides Apache Spark and MongoDB, IBM said it will better enable other well-known open source software for the new systems, including Node.js, MariaDB, PostgreSQL and Chef.



Advanced Local development environment

Initially, data capture and programming were accomplished by means of punched cards or tape, which have long been replaced by the famous green screens or so-called dumb terminals in the late '70s. These green screens are today still a possibility to access the mainframe, but it is certainly no longer the preferred method.

Today interacting with mainframe feels no different than with any other platform. Developers can also use familiar, intuitive development tools like Eclipse on the mainframe.



Agile and Devops

In the past the mainframe was often siloed from other systems and further restricted by the archaic tooling surrounding it. What resulted in a bi-modal IT set-up, where one camp moves slowly whilst the other speeds ahead. This is simply unsustainable in a world where multi-platform development teams need to collaborate and deliver in ever shortening timeframes. Until recently, many IT leaders still believed they could allow their mainframe environments to languish in two-code-drops-a-year waterfall mode, while they embraced DevOps and Agile across their distributed and cloud environments. This is a common misconception. In this competitive digital economy, the mainframe can serve as a critical competitive differentiator, but only if it participates in the digital transformation of the enterprise. The business requires "on-demand" software delivery, which means mainframe teams are embracing the Agile/DevOps culture of change and continuous improvement. At this moment 48% of companies already use Agile and Devops within their mainframe teams, with many to follow in the coming years.

48% Use Agile/DevOps practices in their mainframe environment

Java and other modern languages

Cobol and PL1 are one of the oldest programming languages still used today. And despite their age, they remain the most used programming languages on mainframes. But mainframe developers are not only working with these 2 languages, they're using a mix of traditional mainframe languages, alongside more "modern" ones, such as Java and C++. And if your z/OS mainframe does not support your favorite programming language, you can always add a Linux environment to your mainframe, then use that environment to write in any language that Linux supports.

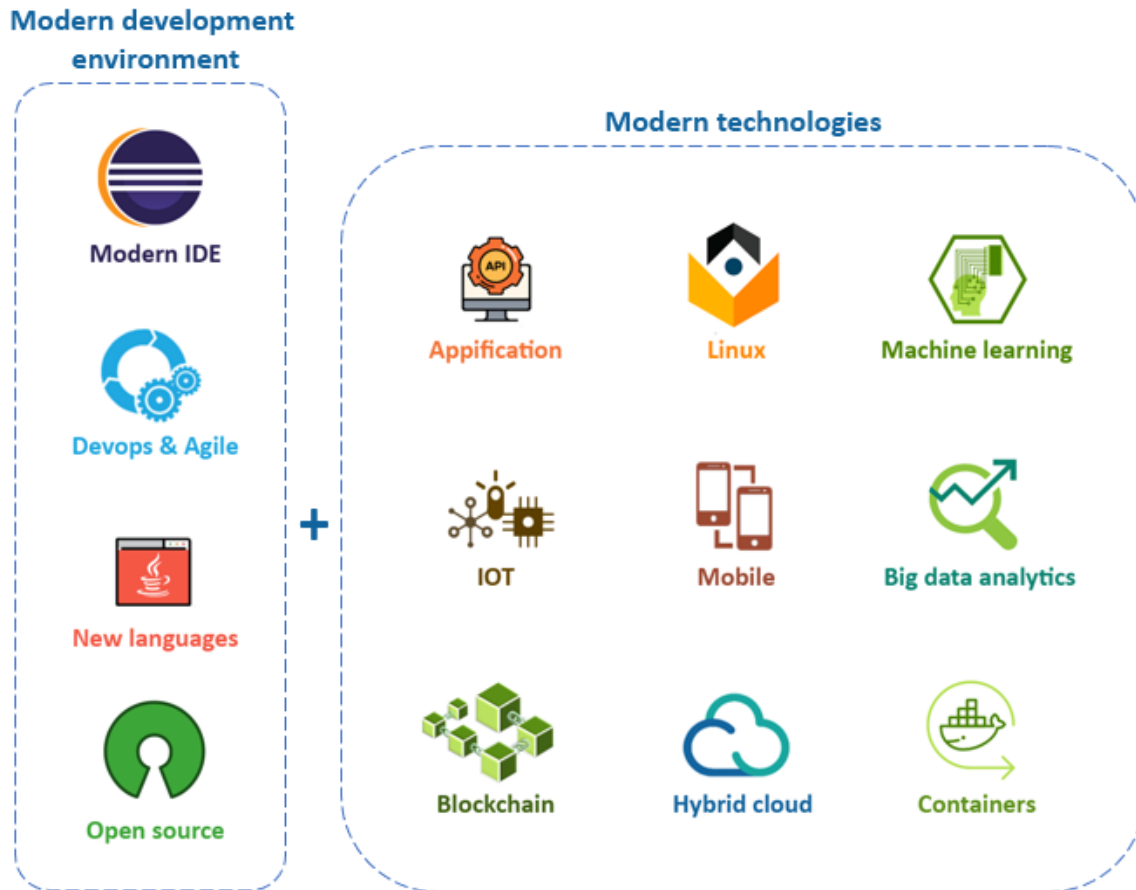
COBOL vendors continue to add new features, such as Microsoft .NET and Java functionality, which provides a means to integrate COBOL with Windows' .NET framework and allow Java programs to call COBOL as well as allow COBOL to invoke Java objects.

82% Use Java in their mainframe environment

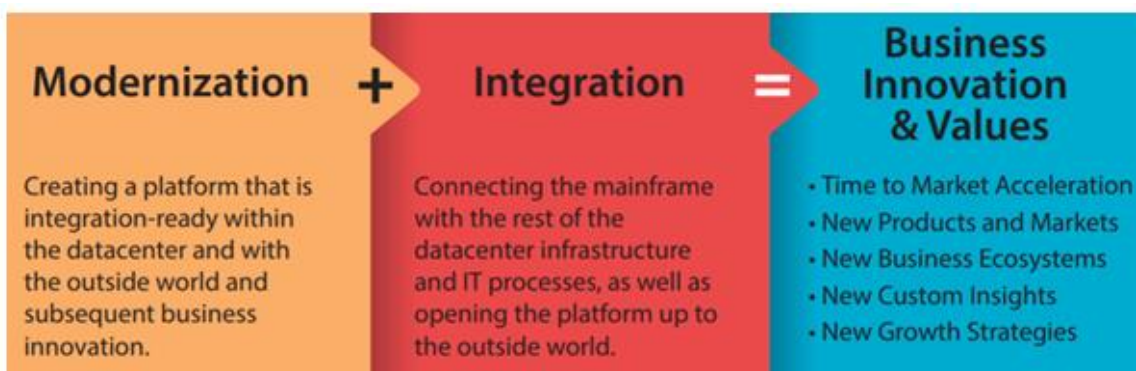
Modern technologies on the mainframe.

One of the biggest worries you could have to join the mainframe team is to lose contact with modern technologies and forget the skills you already gathered, but that is not the case. You will use modern languages and tools similar to anyone who works in distributed computing, including Java, SQL, SVN, Jenkins, Eclipse based interfaces and other web technologies.

Most mainframe sites today run multiple platforms, and all these platforms connect to the mainframe, so it's likely that new recruits will develop cross-platform skills. After all, the mobile apps and other new tools will be written in modern languages and these will have to work seamlessly with underlying mainframe systems.



IBM also understood that it is at a crossroad of being replaced or becoming the central point of this modern ecosystem. The latest generation mainframes have opened up too many other technologies. Instead of being a competitor to it, it is trying to be the best host for it. Mainframes today support Java, can run Linux, and are one of the best platforms for applying enterprise grade blockchain, building cloud-based applications or big data analytics and machine learning.





Linux has been running on z Systems since the beginning of the millennium, and the installation rate only continues to grow. In fact, the Linux installation rate is the fastest-growing part of IBM's mainframe business.

There's also another type of mainframe Linux customer: one who's bought a mainframe specifically to run Linux applications. Originally launched in 2015, LinuxOne enables customers to purchase Linux-only Z System mainframes.

Linux on the mainframe gives us the best of both worlds: the dependability and resilience of over 50 years of hardware innovation and a flexible, reliable open source operating system. Virtually any application that runs on Linux on Wintel computers will run on System z. This provides a unique opportunity for young professionals who have grown to love the Linux operating system and want to leverage that skill while developing on the world's most powerful hardware.



Big data analytics



Machine learning

Most customers do their operational analytics separate from their transactional systems, which introduces latency challenges. When the data is taken off the mainframe system of record, different groups will see snapshots of data that are not fresh. Multiple copies of the data need to be supported. Analyzing z/OS transaction and business data in place avoids costs that are associated with data extract, transform, and load (ETL) and data breach situations by eliminating unreliable and less secure environments. Companies can analyze every transaction they process in near real-time to detect instances of fraud and provide real time marketing.

Data scientists can take days, or even weeks developing and retooling one analytic model, doing so step by step in an overly tedious process. To solve this, IBM announces IBM Machine Learning for z/OS—the first cognitive platform that can continuously create, train and deploy a substantial volume of analytic models at the source of corporate data stores. This can happen in any language, using any transactional data type, from various machine learning framework, all without the risk of moving data off premises.



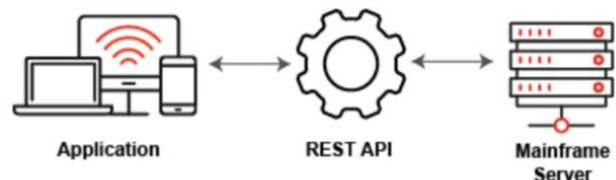
Appification

API's have made it possible for companies that run on a mainframe to make use of its processing power also from web and mobile platforms. Using APIs is the key to giving countless users and applications access to the same data, at the same time, and on any device. The mainframe's security, reliability and scalability can be transferred to these new device platforms thanks to the APIs that allow for the sharing of data to build fresh, innovative mobile applications.

The implementation on mainframe is the idea that mainframe has a mature set of programs, which have been optimized and tested for decades. Instead of having to rewrite these programs you can create API's to access these programs and data, without having to modify them. To be successful, the mainframe must be connected to the rest of the data centre infrastructure and IT processes and the outside world. There's a need to expose services and capabilities on the mainframe

Mainframes have great potential for Web services and cloud computing – enabling IT departments to make legacy mainframe applications available to the entire internal organization, as well as customers and partners around the world. Web services inherent functionality including security, business compliance and personalization make the mainframe application much more feature-rich. And, information stored in a repository, gives administrators a common database for easy monitoring, troubleshooting and enhanced legacy applications.

Enabling the mainframe to communicate with other parts of the infrastructure using web services and service-oriented architectures (SOAs) to deliver new revenue-generating services. Web services can deliver the trove of data and functionalities within the mainframe to other applications seamlessly and securely while leveraging the platform's inherent reliability and scalability.





Hybrid cloud

The marriage of mainframes and cloud networks in hybrid systems empowers the scalability of the cloud while providing a rock-solid foundation for performance. Modernizing the mainframe in this way will help to bring it into the fold of mainstream IT, enabling businesses to maximize the benefits it has to offer by allowing it to run seamlessly alongside the cloud in a two-platform IT model. This new operating model will enable businesses to continue running mission-critical applications and high-volume transaction processing on the mainframe, which is best suited to those requirements, whilst the cloud is used for systems of engagement and more basic business services, such as payroll and CRM.

I/O in the cloud uses a massive amount of bandwidth, it is one of its performance-limiting factors, while a good I/O throughput is something which an average mainframe environment has actually most need of. This need and the need for high security makes a hybrid cloud solution almost the only viable cloud approach for most mainframe shops which run mission critical workloads.

Cloud systems can potentially be used to fulfil tasks that mainframes are less suited for, such as number crunching tasks which may not use a lot of data. Indeed, businesses are increasingly choosing to use the two systems in tandem, rather than depending on one service over the other for their digital operations.



Mobile

Companies who could once get by with running mainframe applications only accessible by employees with dumb terminals, know they must not only have web versions, but apps as well. If you are using a mobile application today that runs a transaction to check your bank balance, transfer money or book a flight, there is a four in five chance that there is a mainframe behind that transaction.

All of the underlying systems that support mobile banking are powered by mainframes, but they are being asked to do far more than they were originally designed to do. This requires more than simply skinning an old app – it involves building entirely new functionality on top of an existing infrastructure with zero disruptions or system failures. And if this sounds like a pipe dream, consider that just about every bank in the world has successfully done this! They didn't replace their mainframes...they created completely new functionality to support mobile deployments.

The workload these tons of mobile transactions are generating, require exactly what the mainframe does best.

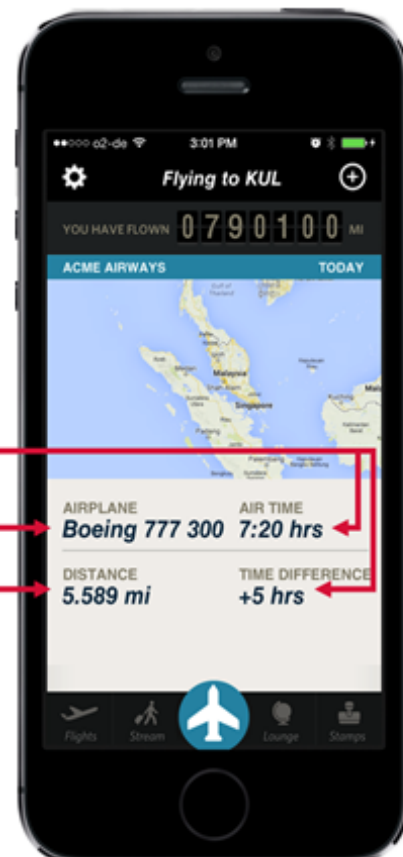
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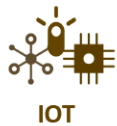
Attributes Input fields
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A	Flight ID	Aircraft	Distance	Airtime	Time D. Type
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999	Airbus A380	7.985 -mi	9:45	0	I
6	Airbus A330-200	4.100 -mi	5:46	+1	
513	Boeing 777 300	6.501 -mi	8:17	0	I
5	Airbus A340-500	4.297 -mi	5:59	0	G
9	Airbus A340-500	3.992 -mi	5:41	+5	I
101	Airbus A340-500	4.005 -mi	5:50	+3	I

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The total number of connected IoT (Internet of Things) sensors and devices is set to exceed 50 billion by 2022, up from an estimated 21 billion in 2018. This growth, equivalent to 140% over the next 4 years, will be driven by edge computing services.

With the IOT foundation IBM is staking out its role in the IoT market. The IoT Foundation service is part of IBM's Bluemix, an open, do-it-yourself cloud-based application platform that enables easy access to and from IoT device data coming from Internet-connected sensors, controllers and devices. As part of the IoT Foundation announcement, IBM began identifying IoT use cases, many of which will have a mainframe at the core. For example, equipment manufacturers can use IoT to provide remote service and monitoring to residential and commercial customers. Oil and gas companies can remotely monitor and provide predictive maintenance to critical equipment. Logistics companies can track and monitor the condition of goods in transit. These are natural tasks for mainframe shops.



IBM mainframes do not only support traditional Docker containers, but also expands the concepts of isolation and safety into another type of containerization technology called IBM Secure Service Container. For companies running Linux on an IBM Z, Secure Service Container brings a new dimension of security to mainframe computing.

Secure Service Container combines hardware virtualization, applications and data into a secure, encrypted "container" (partition). The encryption keys are protected in the Secure Service Container partition. Should a key become compromised or attempts are made to tamper with the keys, the Secure Service Container will invalidate the key and the encrypted contents will become inaccessible. Once the Secure Service Container is deployed (via the physically secure hardware and firmware), everything inside it is fully encrypted. The boot sector becomes tamper-proof and memory access is disabled.

What this means for mainframes is that you can use the platform to integrate them more seamlessly into your infrastructure. If a company's infrastructure is built using a mix of x86 servers, cloud environments, and a mainframe, Docker containers allow to stop worrying about which apps are supported where. Once you containerize your apps, you can run them anywhere.



Blockchains certainly have a big potential, but making the business world trust and implement it will take a lot more. This is where IBM and Hyperledger comes into the picture. Hyperledger Fabric is the first distributed operating system for permissioned blockchains built specifically for business. By pairing the blockchain with mainframes, organizations can double-down on data reliability. Mainframes have a reputation as one of the most reliable types of infrastructure available today. At the same time, blockchains can increase data reliability because they distribute data across a wide network of hosts.

When IBM decided to open source Hyperledger, they partnered up with the organization which is best at maintaining open source projects, "Linux Foundation". Today, both IBM and Linux Foundation are maintaining the project that will be used by millions in the coming years. An interesting fact is that this is the fastest growing Linux Foundation Project ever.

Why become a mainframe developer?

The demographics are clear. The baby boomers who have been manning the mainframe for 30, even 40 years, are retiring in droves. With young developers being primed for newer technologies like mobile, Hadoop or distributed Linux, precious little new blood has been circulating back into the mainframe ecosystem. With only 7% of the current mainframe developer workforce under 30, organizations are looking to pierce the outdated perceptions surrounding mainframe application development.

Young developers should be pointed out that there are incredible career opportunities on the horizon as the more senior professionals retire. And even if the mainframe would disappear, the skills and knowledge of a mainframe developer will not become obsolete. In most cases when migrating of mainframe, the main language (Cobol or PL1) is preserved, the mainframe principles and techniques used to create and maintain big data processing batch flows will still be needed. When a mainframe is migrated to a more modern platform, it does not make the job of the mainframer obsolete, it only makes it more modern.

Mainframe experience is a marketable skill.

Keeping pace with shifting industry standards is a priority, but so is having marketable skills. Ambitious developers probably tend to follow industry buzz wherever it leads, whether that's Docker, Spark, or Kendo. But with new technologies disappearing as fast as they arrive, and companies being reluctant to implement these new technologies it will always be a safe haven to have mainframe experience on the resume. Staying on the cutting edge increases your market value, keeps your work rewarding, and helps you avoid being redundant. But for really ambitious developers it could be smart to go contrarian and add a decidedly un-buzzworthy technology to their resume like Mainframe. These developers will have a rare marketable skill on their resume and will still be able to stay in touch with modern languages.

Making the biggest impact with every line of code.

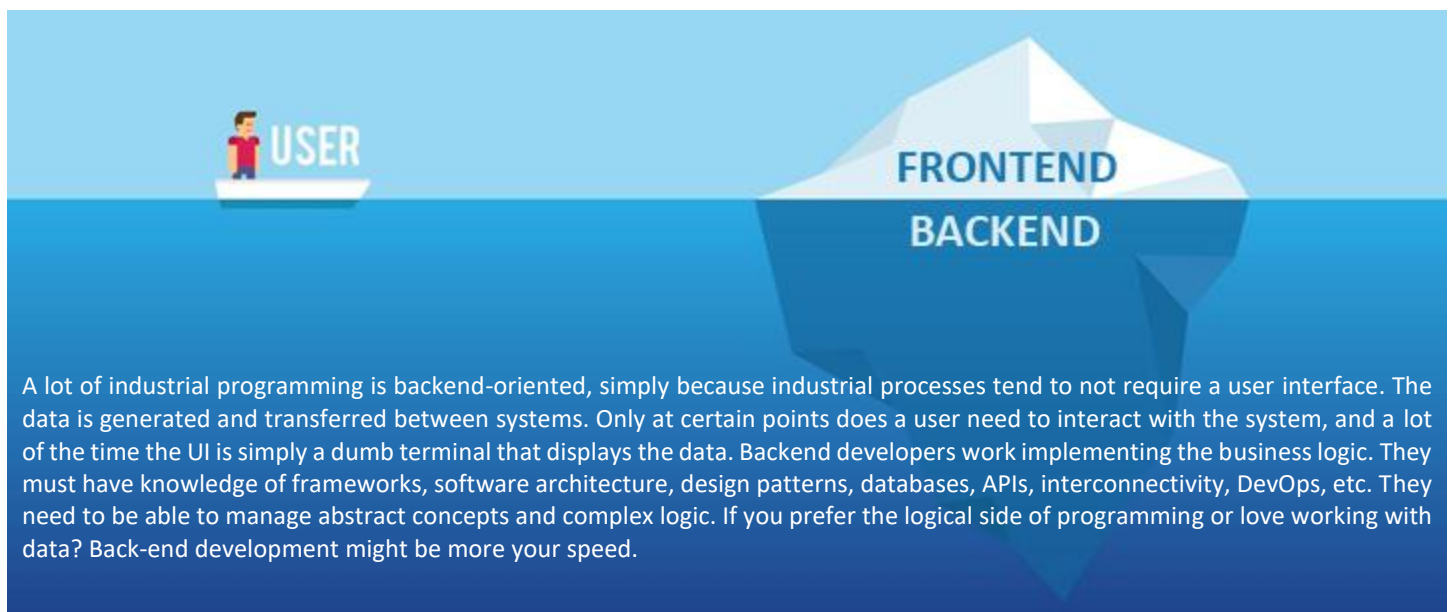
if you want every line of code you write to have the greatest positive impact on the greatest number of people, mainframe development is the place to be. It is the heart of the company, it is where most of the business logic is implemented, and where the most critical data is stored and updated. And for the arsonists among you, just imagine the damage you can do with one coding "error".

It is not that different from other technologies.

There was a time when the prospect of getting up to speed on mainframe development would have been daunting. Mainframe developers worked exclusively with arcane, "green screen" tools that required extensive, hard-won expertise in both the tools themselves and the idiosyncrasies of the underlying IBM z/OS platform. Because of these tooling and platform knowledge issues, the only way to become competent on the mainframe was to completely devote yourself to it, and that meant sacrificing any involvement at all with cloud, mobile, or any other technology that captured your interest. No more. A new generation of mainframe devops tools now provide the same graphical look and feel you'd expect from any other tool that plugs into an Eclipse IDE.

It is not that difficult.

Code, after all, is code. No one needs to be intimidated away by the mainframe. You don't have to make an either/or choice between the mainframe and more mainstream platforms. You can quickly become mainframe literate without sacrificing the currency of your other skills in any way. In fact, it's exactly the combination of mainframe and mainstream skills that will make you most valuable to large enterprises.



A lot of industrial programming is backend-oriented, simply because industrial processes tend to not require a user interface. The data is generated and transferred between systems. Only at certain points does a user need to interact with the system, and a lot of the time the UI is simply a dumb terminal that displays the data. Backend developers work implementing the business logic. They must have knowledge of frameworks, software architecture, design patterns, databases, APIs, interconnectivity, DevOps, etc. They need to be able to manage abstract concepts and complex logic. If you prefer the logical side of programming or love working with data? Back-end development might be more your speed.

A Modern view on the mainframer role.

As we try to demonstrate in this document the mainframe is no longer the mainframe of 50 years ago. Little mainframe environments remain as isolated silos, instead most mainframe environments are evolving to modern work areas, whether it is through migration or modernization. For a company to keep hiring and training their mainframe staff as they have done in the past 50 years would be inefficient and self-damaging.

The connected mainframe.

The concept “Connected mainframe” is introduced in the IDC whitepaper “The Business Value of the Connected Mainframe for Digital Transformation.” (which can be found at <https://www.ibm.com/downloads/cas/GNR0008P>).

The study looks at the role of the mainframe in digital transformation efforts and the benefit organizations can gain from its adoption. Organizations are evolving toward what IDC calls the “connected mainframe.” The system is moving from being a supporting platform of transaction revenue to becoming a source of revenue growth and innovation. This evolution to the platform is also enabling the mainframe to play a central role in organizations’ digital transformation (DX) journey.

The IDC study goes on to emphasize that key steps in achieving the connected mainframe require organizations to modernize and integrate the platform with their internal and external environments. IDC finds that these modernization and integration initiatives lead to new business innovations, which in turn are driving revenue growth and improving organizational operational efficiency.



Hiring modern connected mainframe profiles.

It's somewhat of a truism, that each programmer possesses a unique set of skills, strengths, language/IDE preferences, experience, etc. Many companies have historically hired coders according to a system that essentially amounts to a checklist. If a programmer's resume doesn't check the proper programming language boxes, the assumption is that he/she doesn't have the relevant skills to perform the job. This approach is certainly outdated with regards to the mainframe.

There will always be a need for pure legacy IBM experts, but the focus of the team should not only lie on legacy topics. Instead of only hiring developers with pure legacy experience, companies should look for profiles with high analyst, team lead, client-facing skills, but junior mainframe developer skills.

- By hiring developers with wide skillsets but an interest in big data batch design.
- Cross-training by teaching mainframe basics to resources of the company's existing workforce with different specialties.
- Cross-training by offering mainframe as a second career track besides a more mainstream attractive track.

Companies realize that having a mainframe team of only pure legacy developers is no longer realistic. It is difficult to find young developers who are willing to spend their future careers only in Cobol, and within the connected mainframe world these developers would lack the modern skills to be agile. Providing a modern mainframe environment linked to modern trainings can show to be a hiring advantage and having a modern multiskilled team is both a benefit for the company and the employee.

The ideal connected mainframer knows the basic mainframe principles, understands big data batch design concepts and is able to code in Cobol or PL1. but has also a wide skillset and understands the modern technologies, to be able to implement them on the mainframe platform or to migrate mainframe jobs towards them.

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