A Practical Guide to Mainframe DevOps For the DBA

Integrating Db2 for z/OS into Your DevOps Journey

Shifting Towards DevOps

As a consumer in today's hyper-connected world, your software providers are in a never-ending race to continuously make their apps the ones you will use throughout your day. A steady stream of new features, improvements, and bug fixes bombard you constantly.

Continuous improvement is a better fit than traditional release upgrades as the norm for software delivery. Focusing on smaller, more digestible chunks of work covering a few months rather than a few years better positions developers to react to rapidly changing conditions and deliver value in smaller doses that incrementally add up over time.
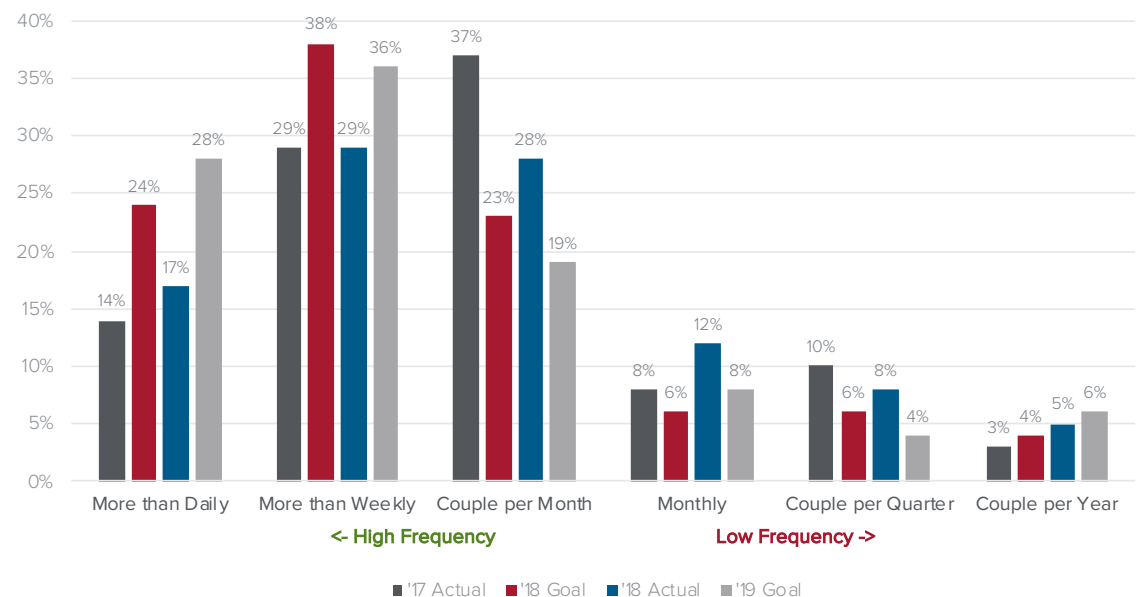
DevOps is a model of software delivery that combines agile software development and IT operations in a shortened lifecycle that provides rapid releases of high-quality improvements.

Evolving to a DevOps culture does not happen overnight; it can be a long journey.

Organizations using DevOps are increasing their frequency of application deployments, but it is taking longer to achieve their goals than expected.

One key aspect of DevOps that is very often overlooked is extending DevOps to include database update practices.

Achieving DevOps goals for app deployment frequently takes longer than expected

	More than Daily	More than Weekly	Couple per Month	Monthly	Couple per Quarter	Couple per Year
'17 Actual	14%	29%	37%	8%	10%	3%
'18 Goal	24%	38%	23%	6%	6%	4%
'18 Actual	17%	29%	28%	12%	8%	5%
'19 Goal	28%	36%	19%	8%	4%	6%

<- High Frequency   Low Frequency ->

■ '17 Actual   ■ '18 Goal   ■ '18 Actual   ■ '19 Goal

Source: 2019 Database DevOps Survey, DBmaestro

Challenge:
# Database Participation in DevOps Lags

Elite DevOps practitioners are receiving real value from their efforts. Why, then, is the percentage of elite DevOps practitioners so low?

Developers enjoy a highly automated pipeline for moving code from concept to production. But automation has not rippled through the database community as quickly as it has for code.

Many database change procedures remain manual, time-consuming processes. If an application requires a database schema change, even the most highly tuned code pipeline is delayed until a DBA can execute the requested change.

In a world where more than a quarter of organizations are unable to deploy more than one database change a month, DevOps success requires a focus on automating database processes.

20% of organizations were considered Elite performers in 2019

20% Elite
23% High
12% Low
44% Medium
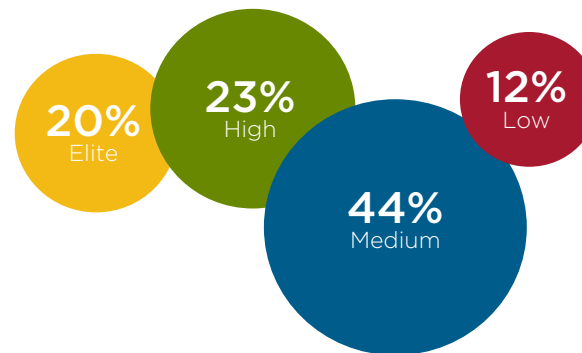
Source: Accelerate: State of DevOps 2019

DBAs are not yet fully integrated into DevOps teams

18% None
38% To some extent
20% Fully
24% Mostly
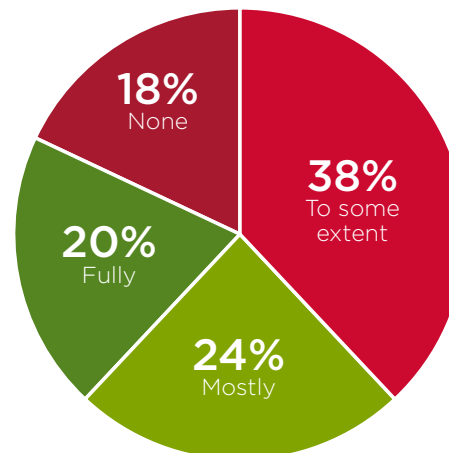
Source: 2019 Database DevOps Survey, DBmaestro

Comparing Elite performers against Low performers, Elite performers have:
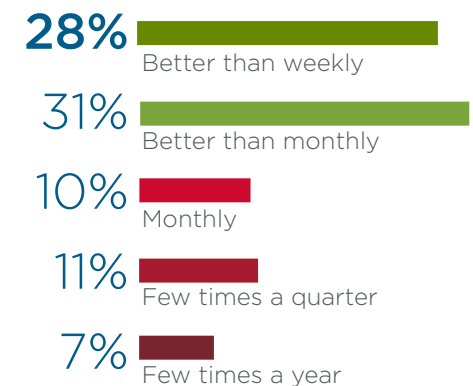
208x
more frequent code deployments

106x
faster lead time from commit to deploy

2,604x
faster time to recover from incidents

7x lower change failure rate

Source: Accelerate: State of DevOps 2019

28% cannot deploy database changes more frequently than once a month

28% Better than weekly
31% Better than monthly
10% Monthly
11% Few times a quarter
7% Few times a year

Source: 2019 Database DevOps Survey, DBmaestro

Databases Do Not Behave the Same as Code

Databases are far different than code, so the mentality that led to code pipeline automation does not necessarily apply to the automation of database changes required by that code.
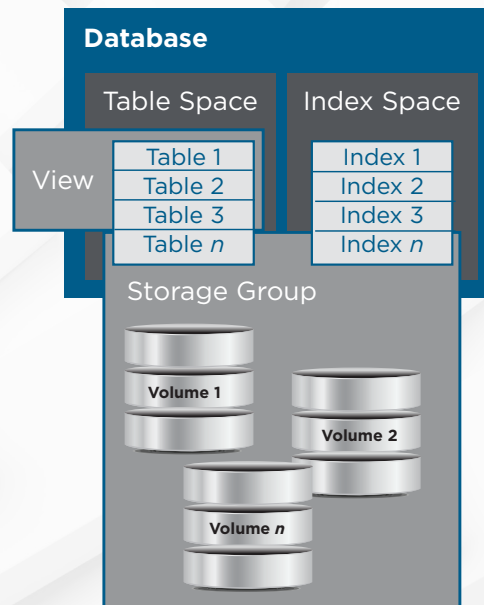
Code can be complex and difficult to write, but progressing code through the development pipeline is straightforward and relatively easy to automate. Code changes compile into executable modules that are copied from one environment to the next. Should issues be detected, it's simple to backout a change, fix the code, recompile, and refresh.

Change a line of code and you affect one application.

But change a database schema, and you affect a set of shared systems serving any number of independent applications. The complexity of database constructs and the relationship between interacting database object types introduce a fair amount of risk into database administration.

It's easy to understand why DBAs are often relied on to make all changes – the DBA best knows how to assess and execute change within the wider view of multi-system dependencies. But are DBAs really required to manually oversee every phase in the DevOps process?

Databases are diverse configuration environments

Database

Table Space	Index Space
Table 1	Index 1
Table 2	Index 2
Table 3	Index 3
Table n	Index n

View

Storage Group

Volume 1

Volume 2

Volume n

Databases are diverse configuration environments consisting of multiple, interrelated objects – a Db2 for z/OS database can consist of over two dozen object types, such as storage groups, table spaces, tables, index spaces, indexes, views, and more. Each object can be changed individually, or a change may span multiple objects, and different methods can often be used to effect a change. Imagine the work required to backout changes!

Early Stage Database Provisioning is a Key Success Factor

Historically, developers coded applications using temporary, local database stores and would only involve DBAs when they were ready to move code from test to production. But unless the full effects of database changes on the environment are considered at coding time, BINDs will inevitably fail. Database provisioning is a necessary aspect of the code, build, and test phases – and is one reason why change administration now tops the DBA to-do list.

It's critical that DBAs focus their attention on production environments. But the early stages of a DevOps pipeline can now be enhanced with automated, at-will provisioning of production Db2 replicas that suit the needs of developers without requiring direct DBA intervention.

Developers no longer need to be held up waiting for DBAs to complete a manual process, and DBAs do not lose valuable time managing Db2 object changes across early-stage environments. Eliminating the database provisioning bottleneck can remove many of the barriers to DevOps progress as well as remove application support burdens on DBAs.

DBA time is shifting to change deliver, mainly at the expense of security

- Database Changes
- Security
- Optimization
- Backup & Recovery
- Install/Upgrade/Patch
- Other
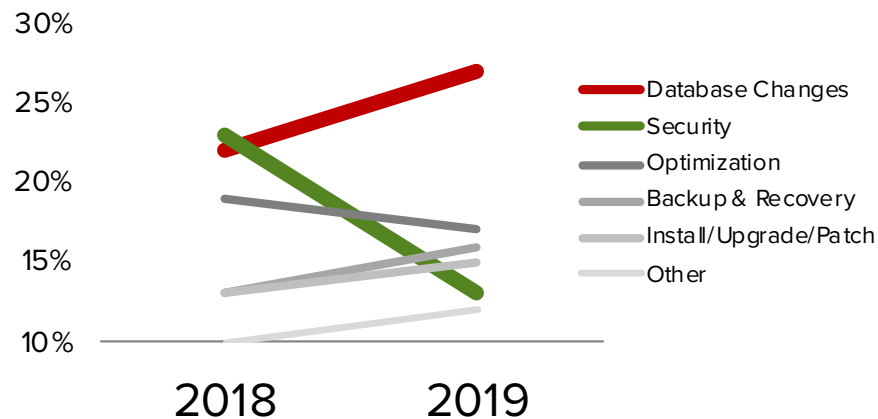
Source: 2019 Database DevOps Survey, DBmaestro

Provisioning Db2 for z/OS in DevOps

DevOps is generally viewed as a cycle of phases – automatic database provisioning focuses on the phases relating to development.
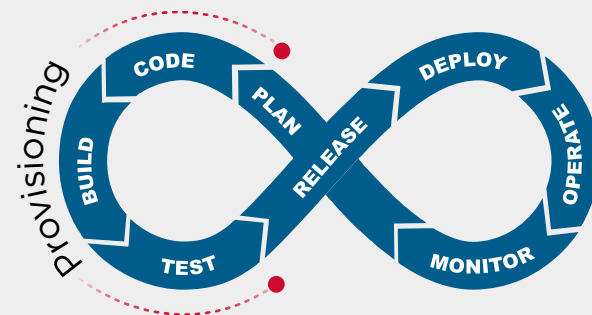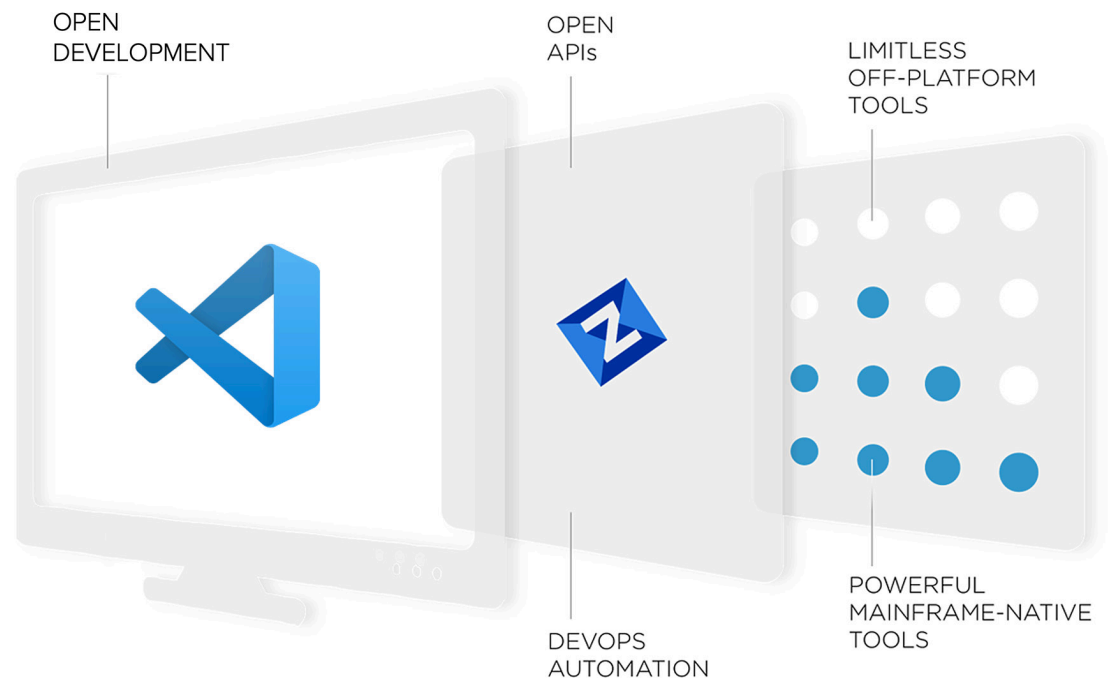
Broadcom's Open-First Approach to DevOps

At Broadcom, we strive to make the mainframe as easy to use as cloud and other modern platforms. Our open-first, community-based approach to DevOps offers freedom and flexibility by opening the mainframe to popular, off-platform DevOps tools without disrupting existing workflows or compromising the platform's rock-solid reliability and security.

Developers can use their favorite toolset to automate the progression of code and database changes through the application lifecycle, regardless of whether the application will eventually deploy to a mainframe or a distributed system.

While others seek to maintain vendor lock-in, Broadcom champions open interoperability, allowing companies to interact with the mainframe like any other platform while still leveraging the value and benefits derived from using Broadcom's mainframe software.

Application developers view Db2 for z/OS as just another database, like any other. They do not want to learn its specifics, nor be limited in the tools used to interact with it. Broadcom fully embraces this point of view and believes the key to folding Db2 for z/OS administration into the DevOps world is to integrate open APIs into our database management portfolio, allowing our products to be used transparently by any modern tooling.

This requires provisioning a set of open REST APIs and CLI commands that enable DevOps architects to automate creation of the environment an application developer needs to test their application without requiring DBA intervention.

OPEN DEVELOPMENT

OPEN APIs

LIMITLESS OFF-PLATFORM TOOLS

DEVOPS AUTOMATION

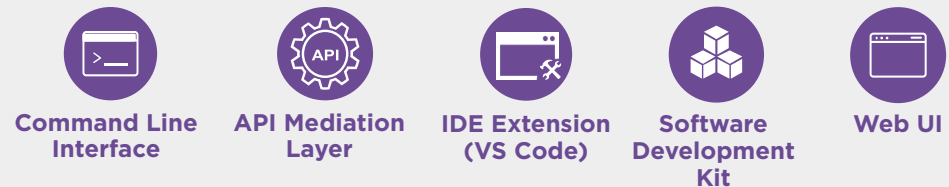POWERFUL MAINFRAME-NATIVE TOOLS

Broadcom and Zowe

Zowe is an open-source initiative within the Linux Foundation's Open Mainframe Project, with initial contributions from Broadcom, IBM, and Rocket Software. Zowe is the first open-source project based on z/OS and currently has more than 12,000 downloads. As a leader of Zowe and other open-source projects, Broadcom is addressing the needs of the entire mainframe community.

OPEN **MAINFRAME** PROJECT
Zowe

Modern, open source interface for the mainframe

Command Line Interface

API Mediation Layer

IDE Extension (VS Code)

Software Development Kit

Web UI

Mainframe databases to be accessed and managed by a wide variety of open-source tooling

git

Source Control Systems

Visual Studio Code

IDEs

python™

Language Environments

docker

Platform Containers

Jenkins

Source Control Systems

OPEN **MAINFRAME** PROJECT
Zowe

Open Frameworks

Automating Database Provisioning for the Developer

A typical DevOps workflow spans development, quality assurance (QA), and production environments. Definition information (DDL) from the production environment is used to provision the development environment with a replica. A developer makes Db2 object changes along with application changes and tests them together.

When all updates and testing are completed, changes are promoted from development to QA in the same way the development environment was originally provisioned from production.

QA engineers can either accept or reject the changes. A rejection returns the process back to the development environment for corrections. Once QA accepts the changes, they are promoted from QA to production, again using the same process. At this point a DBA is notified to give final approval before the changes are deployed into production.
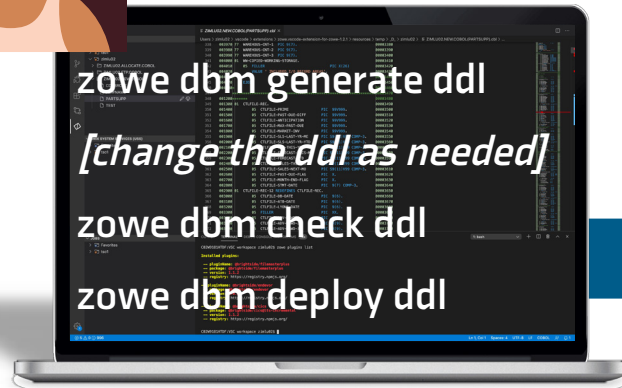
Quality Assurance

Production

Development

Provision

UPDATE

Promote

Deploy
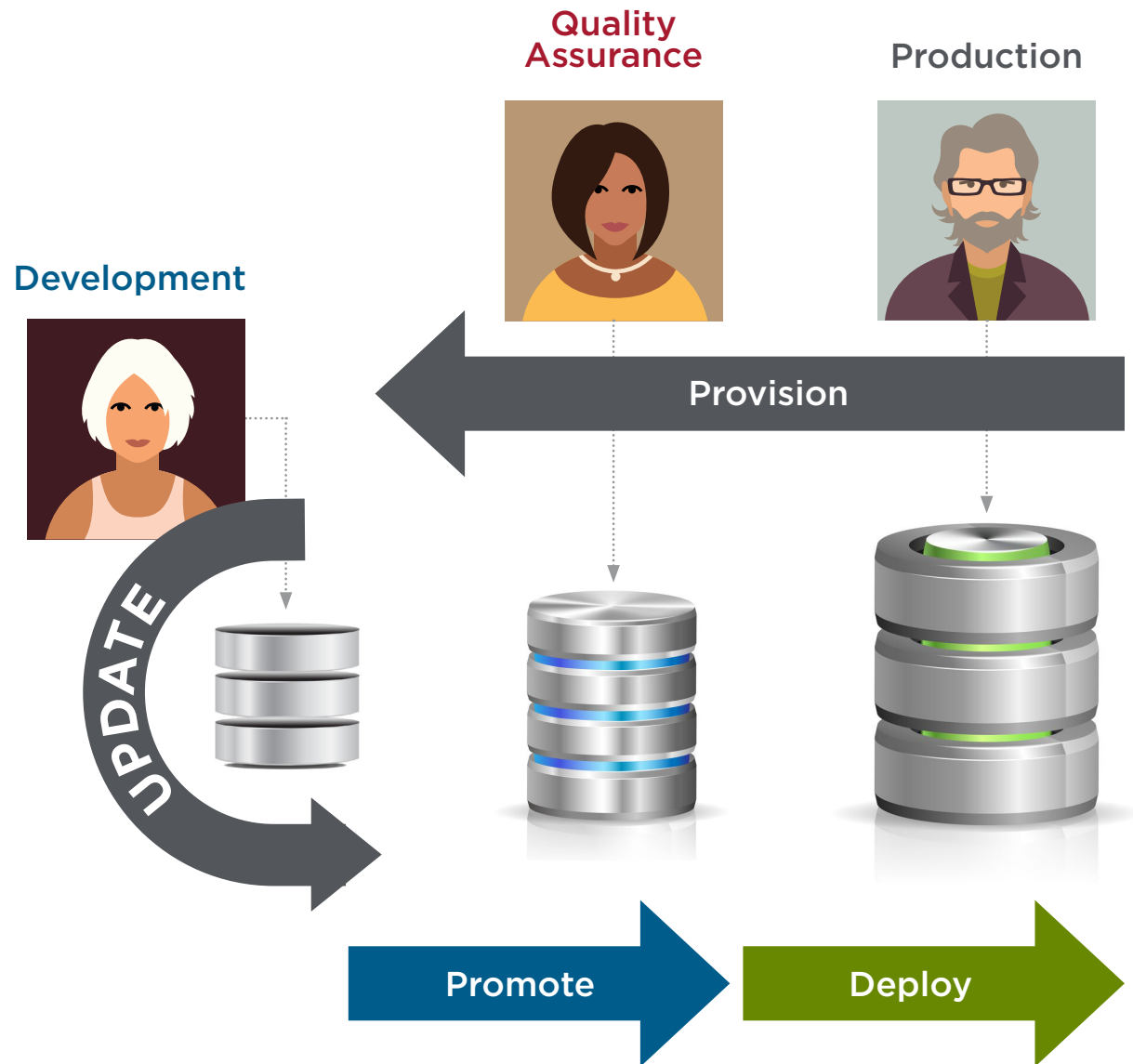
Entry Point
Zowe CLI-enabled DevOps Automation for Db2

Application developers commonly use their machine's Command Line Interface (CLI) as part of their development activity. The Zowe CLI is a foundation for script-based automation, enabling application developers to use their CLI to transparently retrieve mainframe-based Db2 object definitions (DDL) from the production environment, provision a replica of that environment to their sandbox, alter, check, and push production change requests back into their sandbox. This allows developers to completely build and test their database changes without requiring the intervention of a DBA.

In this entry point, the developer's Zowe CLI commands invoke Broadcom's intelligent management products, such as those found in the Administration Suite for Db2 for z/OS, under the covers.

Application Developer

Production

Development

Provision

zowe dbm generate ddl

[change the ddl as needed]

zowe dbm check ddl

zowe dbm deploy ddl

Promote
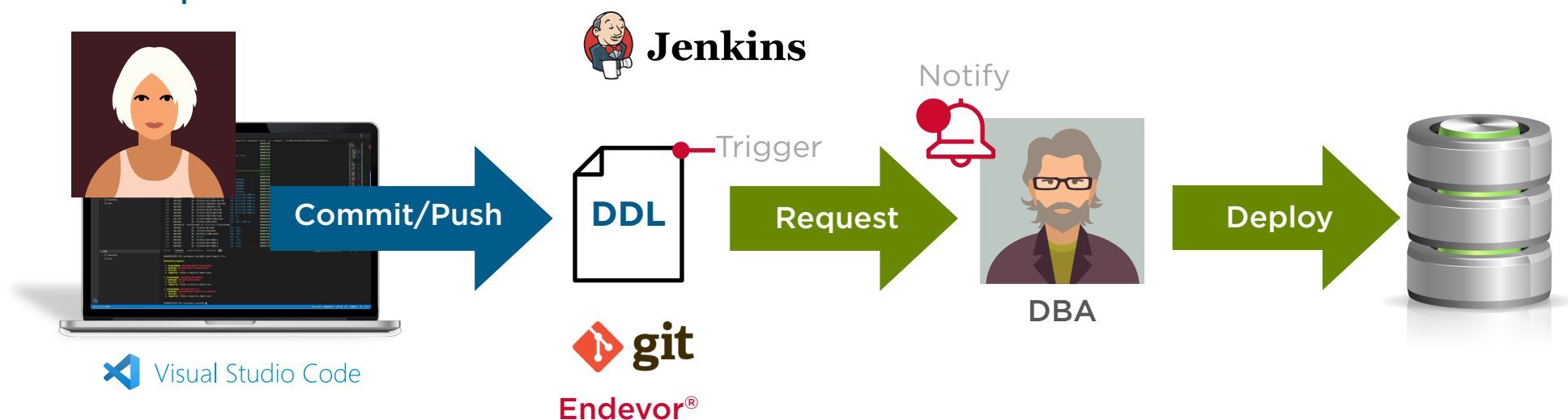
Visual Studio Code

Entry Point
DevOps Automation Servers for Db2

The CLI-enabled pipeline can be enhanced to incorporate modern automation servers, such as Jenkins, enabling next generation developers to seamlessly incorporate Db2 DDL updates into their automated workflows.

Most application developers use central code repositories (such as GitHub or Endevor) for source code change management. In this scenario, GIT is also used to deploy Db2 DDL schema changes to production – keeping the source code and schema linked. Whenever DDL schema changes are checked into the GIT source repository, a Jenkins pipeline can be triggered to manage the deployment of changes back into the production environment on the mainframe.

Again, Broadcom's intelligent management products, such as those found in the Administration Suite for Db2 for z/OS, are used transparently to incorporate database changes into production faster and with fewer errors. This scenario is just one of many possible implementations that can be built and tailored to a specific set of needs with tools and technologies of choice.

Application Developer

Visual Studio Code

Commit/Push

Jenkins

DDL — Trigger

git

Endevor®

Request

Notify

DBA

Deploy

Entry Point
Open-Source Monitoring Solutions

DevOps is not just about improving the development pipeline, it's also about extending the open-first vision to the tools that validate applications are truly meeting customer objectives with respect to both functional and non-functional objectives.

RESTful API support in Broadcom's intelligent management solutions, such as SYSVIEW for Db2, enables open-source tools such as Prometheus and Grafana to collect and visualize Db2 performance metrics in real time, simplifying the task of ensuring that database changes meet all objectives.
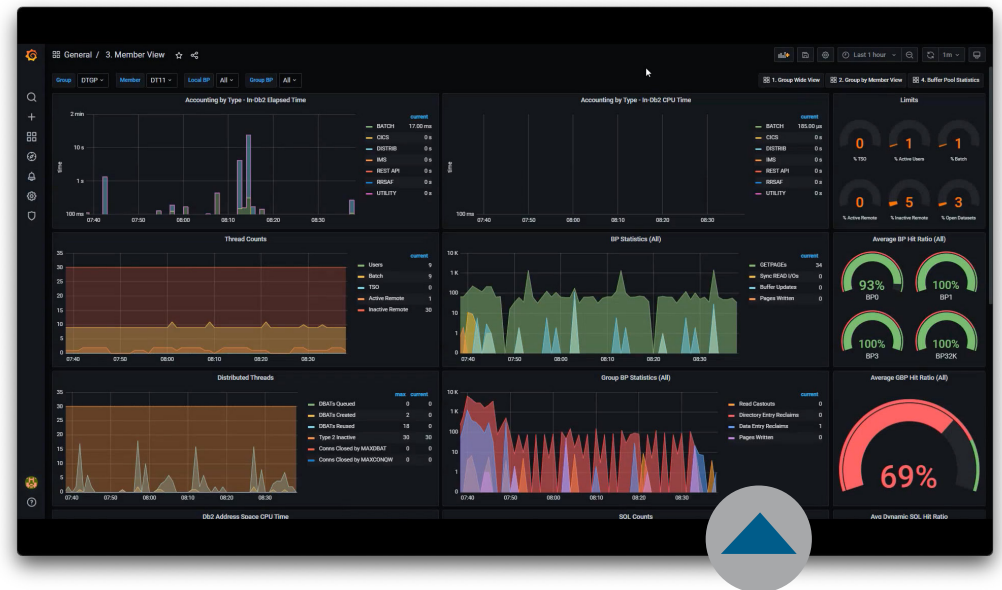
Benefits of Integrating Databases Into Your DevOps Journey

Broadcom's Database Management for Db2 for z/OS portfolio allows you to integrate the automation of database changes into your CI/CD pipeline. Eliminating database provisioning bottlenecks can remove many of the barriers to DevOps progress and allow your organization to:

- Drive new levels of productivity by freeing DBAs from manual tasks

- Expand the next-generation talent pool by making the mainframe an appealing career choice

- Accelerate software delivery by opening up a universe of powerful off-platform automation tools

- Increase quality by testing and promoting code and database changes together

- Be an equal partner in digital transformation!

Broadcom Inc. is a global infrastructure technology leader built on 50 years of innovation, collaboration and engineering excellence.

Broadcom Inc. (NASDAQ: AVGO) is a global technology leader that designs, develops, and supplies a broad range of semiconductor and infrastructure software solutions.

Broadcom Mainframe Software continues to drive the next evolution of open, cross-platform, enterprise innovation. We specialize in DevOps, Security, AIOps, and Infrastructure software solutions that allow customers to embrace open tools and technologies, make Mainframe Software an integral part of their cloud, and enable innovation that drives business forward. We are committed to forging deep relationships with our clients at all levels. This goes beyond products and technology to partner in creative ways that support customer success.

Learn more at:

mainframe.broadcom.com/db2/devops