



**APPLICATION
MODERNIZATION
IN GOVERNMENT
BREAKING DOWN
WHAT YOU NEED
TO KNOW**

**GOVLOOP
POCKET GUIDE
2018**

**MODERNIZATION IS NOT
ONLY ABOUT ADOPTING
NEW TECHNOLOGIES AND
PRACTICES; IT IS ABOUT WHAT
HAPPENS TO THE OLD ONES.**

FOREWORD FROM RED HAT

One thing that we can say with certainty about government IT: Things will always be changing.

Government has dealt with periods of true innovation in IT and periods of legacy issues that have hamstrung the development and progress that citizens deserve. Challenges such as siloed information and departments, budget restrictions, and cultural issues have made it particularly difficult for government IT to keep pace with constituents' rising demands and the creation of the infrastructure needed to support modern applications.

Today, though, we see circumstances changing yet again – for the better. There is a true evolution in IT infrastructure going on. The development process in government is beginning to get faster. It is moving, in some cases, from a waterfall methodology with upfront requirements and a long time from specification to release to iterative methodologies with frequent releases of incremental functionality, and now to highly collaborative DevOps practices with automated and continuous integration and delivery.

Supporting this progress and innovation is application modernization.

Modernization is not only about adopting new technologies and practices; it is about what happens to the old ones. Imagine an old house heated with coal, while oil and gas heat newer sections. Upgrading the entire house to solar is expensive with little return, but it makes sense to use solar in the latest addition, and it is worthwhile to make it all work together under one roof.

Application modernization has two primary goals: use existing functionality and data in new applications as much as possible, deriving new value from old applications, and bring the benefits of new processes, products and technologies to old applications.

Application modernization is the way forward for continued progress in government IT to deliver modern services, and Red Hat can help. We offer open, modular, cloud-ready platforms that help you transform legacy apps to modern, agile ones.

Throughout this guide, we'll discuss approaches, lessons learned and the vision we bring to application modernization.

Red Hat believes that government agencies can harness the power of DevOps, microservices, containers and more to modernize platforms and improve operations, and we look forward to this next stage of progress in government IT.

– Zohaib Khan
*App Modernization Practice Lead,
North America Public Sector, Red Hat*



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EXECUTIVE SUMMARY

To provide modern services and meet user demands today, government agencies must become adept at quickly delivering applications that meet citizen needs while increasing efficiency and saving money.

But IT organizations often rely on legacy platforms and traditional development processes. As a result, they struggle to innovate.

Those legacy systems make application implementation slow and innovation around them even slower. Meanwhile, the public sector continues to spend a significant amount of their IT budgets simply maintaining those existing systems. This leaves little time and money for the innovation, new tools and new processes that citizens are demanding.

One way to deal with these challenges is application and infrastructure modernization. Application modernization is the process of adapting existing production and legacy application to modern business needs.

In a world such as the public sector where legacy IT still reigns supreme, application and infrastructure modernization is sorely needed. And although many agencies are interested in making this change, they often ask, "Where and how do we begin?"

This new pocket guide from GovLoop, created in partnership with Red Hat, will give you an overview of application modernization in the public sector, explain why it matters and how government agencies can be better at it, and provide case studies and how-tos that will help you get to where you need to be today.

APPLICATION MODERNIZATION THEN AND NOW

The approach to application modernization has evolved, thanks to legislation and realities about technology in the government and among citizens.

STATISTICS

\$89B

The President requests more than **\$89 billion** for IT in the fiscal year 2017 budget, with more than 70 percent reportedly for operating and maintaining existing IT.

\$3B

Tony Scott, former Federal CIO, has estimated that **\$3 billion** worth of federal IT equipment will reach end of life by 2020.

LEGACY TECH

Several agencies, such as the departments of Agriculture, Health and Human Services, Homeland Security, Justice, Treasury, and Veterans Affairs, reported using Common Business Oriented Language, or **COBOL** — a programming language developed in the late 1950s and early 1960s — to program their legacy systems.

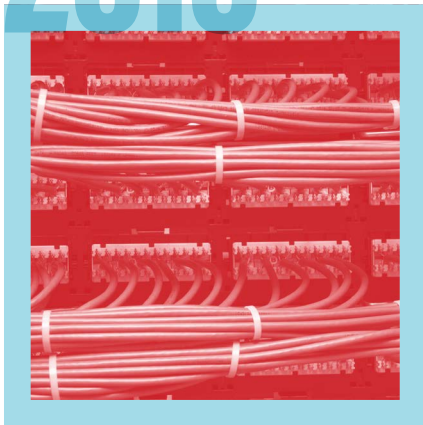
The Commerce, Defense, HHS, Treasury and VA departments **reported** using 1980s and 1990s Microsoft operating systems that the vendor stopped supporting more than a decade ago.

The development process has evolved from a waterfall methodology with upfront requirements to iterative methodologies with frequent releases to the collaborative DevOps practices of today with continuous integration and delivery. This chart shows the evolution:

TIME TO VALUE	DEVELOPMENT PROCESS	APPLICATION ARCHITECTURE	DEPLOYMENT & PACKAGING	APPLICATION INFRASTRUCTURE
Months & years	Waterfall 	Monolithic 	Physical Servers 	Datacenter
Weeks & months	Agile 	N-tier 	Virtual Servers 	Hosted
Days & weeks	DevOps Development Operations	Microservices 	Containers 	Cloud

IMPORTANT LANDMARKS

2010



The Federal Data Center Consolidation Initiative directs agencies to inventory data centers, develop consolidation plans and assess virtual or cloud alternatives.

2014



August 2014: The U.S. Digital Service is created and deploys teams to help federal agencies tackle IT modernization challenges.

2017



December 2017: The White House releases its IT modernization report, calling on agencies to speed up their modernization efforts to make their IT infrastructures more agile, flexible and modern.

December 2017: President Donald Trump codifies the Modernizing Government Technology Act into law. The act provides legislation and funding to modernize the federal government's aging IT.

2018



March 2018: Congress gives the Technology Modernization Fund \$100 million for the rest of fiscal 2018, falling short of the \$228 million the Trump administration asked for.

TODAY'S LANDSCAPE OF APPLICATION MODERNIZATION

This section will dive into what application modernization is, the benefits and return on investment it provides the public sector, what challenges an agency can expect in executing on application modernization, and how the public sector can achieve it.

WHAT IS APPLICATION MODERNIZATION?

At the most basic level, application modernization is the refinement, rewriting, repurposing or consolidation of legacy applications to meet current mission needs. It is all about adapting these legacy applications to deliver value instead of starting from scratch with new applications.

WHY DOES THE PUBLIC SECTOR NEED TO MODERNIZE ITS APPLICATIONS?

The mandates for government agencies are expanding at an ever-increasing pace. New tax changes, immigration laws and enforcement policies; Congress' expectation that agencies take

on more responsibilities; and rising citizen demands put pressure on agencies to deliver more with existing resources.

However, most agencies' IT systems are decades old and were built using older technologies such as mainframes, commercial off-the-shelf and other proprietary platforms. Agencies cannot change fast enough and, in fact, usually have at least six-month release cycles, even for small adjustments. And with the public sector working more in the cloud, applications need to be modernized to operate there.

Finally, the public sector needs to turn to open source technology and solutions for modernization efforts. Open source refers to code or technology that anyone can modify and share because its design is publicly accessible. Instead of a few agency staff working on a solution, developers nationwide can make improvements collectively, which leads to innovation, improved code, better products and faster modernization.

WHAT BENEFITS DOES MODERNIZATION GIVE THE PUBLIC SECTOR?

Government organizations that modernize applications experience numerous benefits. At the most basic, simply moving existing applications to the cloud lowers operations and maintenance (O&M) costs. Also, changing the application architecture from monolithic to microservices makes it faster to build, modify, scale and deploy applications.

Other key benefits of modernization include:

1. A better ROI with an open source stack.
2. Flexibility to adopt a cloud vision.
3. An ability to focus on delivering on mission while avoiding proprietary vendor lock-in.
4. Being able to deliver value faster and adapt to changing agency mandates.

HOW CAN THE PUBLIC SECTOR ACHIEVE MODERNIZATION?

The prospect of modernizing a large portfolio of traditional government applications to run in the cloud is daunting. Where to start? How can you do it gradually, as staff time permits? What if you later choose a different cloud? During the transition, how can you make it simple to manage a mixed portfolio of monolithic and microservices applications?

The first step to modernizing government IT is moving existing Java EE applications to an open source application platform. Agencies can deploy an open source platform anywhere — bare metal, on-premise cloud or public cloud. With the right platform, agencies can host monolithic, virtualized or containerized applications in the same runtime environment. They can make their journey to the cloud in phases or all at once.

Generally, there are three patterns to modernizing applications in government, depending on what the agency is looking for or capable of doing: lifting and shifting; augmenting with new layers; and rewriting.

- Lifting and shifting modernizes how existing applications are packaged and deployed. By lifting and shifting, existing components are implemented on a modern platform.
- Augmenting with new layers involves creating a new layer of application software that wraps the existing application functionality and data with an interface that is accessible to new applications.
- Rewriting an application is different from creating new applications from scratch; it is the process of creating new functionality to replace and retire existing applications.

DEVOPS, CONTAINERS, AUTOMATION & APPLICATION MODERNIZATION

DevOps comes up often during discussions of application modernization. It describes approaches to speeding up the processes by which an idea, such as a new software feature, a request for enhancement or a bug fix, goes from development to deployment in a production environment where it can provide value to the user. With a DevOps approach, teams use automation, in addition to continuous integration and continuous delivery (CI/CD) practices, to modernize their software and applications faster. Historically, developers would create and adapt quickly, but sometimes their software could not be deployed quickly because of holdups with the operations team.

Teams using DevOps to modernize their applications rely on containers to get the job done. Containers help software run reliably as it moves from one computing environment to another. They offer technologies that allow the packaging and isolating of applications with their entire runtime environment. This makes it easy to move the contained application among environments — development, testing, production, etc. — while retaining full functionality.

In a DevOps environment that uses containers, some responsibilities are refined to give team members greater autonomy and reduce challenges. Standardizing and automating processes and technology make software delivery more efficient and accurate. Technology platforms can be standardized while preserving team autonomy and giving developers and operations teams choices based on relevant skills and application suitability. Standardized processes can then be automated.

Automated deployment frees operations from having to deploy urgent application fixes by eliminating human error, and allows continued modernization to happen even quicker.

API- AND MICROSERVICES-LED APPLICATION MODERNIZATION

To understand microservices, you must first understand that most legacy applications are monolithic.

In a monolithic application, server-side logic is bundled together in the form of a monolith. This means that all the server-side logic runs in a single process, and for every update to the system, you must deploy a new version of the server-side application. The government has operated on monolithic applications for a long time, but in this modern era, they are no longer suitable for constant and large-scale deployments. This is because in a monolithic application, even a small modification must be tied to an entire change cycle.

Microservices, in contrast, are an architectural style of building and operating IT systems for massive scale, based on reusable and replaceable components. A microservices architecture uses application programming interfaces (APIs) to connect the various microservices together.

With microservices, applications are broken down into their smallest components, independent from one another. Instead of a traditional, monolithic approach to apps, where everything is built into a single piece, microservices are separate and work together to accomplish the same tasks.

THE THREE PHASES OF APPLICATION MODERNIZATION IN THE PUBLIC SECTOR

Successful leaders are turning to DevOps methodologies, microservices architectures and containers to accelerate application development and delivery, maintain high levels of quality and reliability, and achieve technical flexibility. However, not all government agencies are ready to move to a full microservices architecture, and some may move some applications from monolithic to microservices while others may take longer to process.

Now that you know more about API-led modernization, DevOps and containerization, you can decide which phase of application modernization is right for you.

How you use the application platform	PROCESS	How the application environment evolves	PLATFORM	ARCHITECTURE
PHASE 1: Move existing monolithic applications.	Continue existing development and deployment processes.	Deploy anywhere: on-premise or in a public cloud — as virtual machines or on bare metal.		Monolithic
PHASE 2: Gradually refactor existing monolithic applications.	Transition to DevOps, using OpenShift for automation.	Continue running legacy applications on-premise or in a public cloud— as virtual machines or on bare metal. Deploy refactored applications in containers — on any cloud.		Combination of monolithic and microservices
PHASE 3: Have a full microservices architecture.	Fully adopt DevOps	Deploy containerized applications on any infrastructure.		Microservices

INDUSTRY SPOTLIGHT

USING OPEN SOURCE INNOVATION TO POWER APPLICATION MODERNIZATION

An interview with Zohaib Khan, App Modernization Practice Lead, North America Public Sector, Red Hat

Legacy applications — which can stand in the path of efficiency and cost savings, particularly for agencies that need flexibility and agility to keep up with citizen demands — remain at the core of many public-sector organizations today. Although replacing these monoliths with modern architectures such as microservices and containers isn't an easy "rip-and-replace" endeavor, there are paths to modernization that work.

To explore best practices for modernizing public-sector application portfolios, particularly through open source innovation and technology, GovLoop sat down with Zohaib Khan, App Modernization Practice Lead, North America Public Sector at Red Hat.

Open source, although not as common as in the public sector as in the private sector, is gaining traction. It refers to code or technology that anyone can modify and share because its design is publicly accessible. Instead of a few agency employees working on a solution, developers nationwide can make improvements, which leads to innovation, improved code and better products. This in turn can help efforts to modernize applications.

"Modernization can deliver value faster with open source technologies," Khan said. "Agencies who are not adopting open source as their first choice are going to be left behind with even more expensive technology that will do less and cost more."

Government IT teams will find that commercially supported open source middleware solutions can help deliver new services quickly and cost effectively, while also providing a strategic path for transitioning workloads to an on-premise or external cloud. Open source middleware uses non-proprietary source code, which significantly lowers costs and complexity while allowing more freedom to innovate and providing government services via a variety of computers and mobile devices.

By using open source middleware and open standards, agencies can modernize legacy applications for use in mobile, web-based and cloud applications.

One such open source middleware solution is OpenShift. OpenShift is Red Hat's cloud development Platform-as-a-Service (PaaS). The free and open source cloud-based platform allows developers to



"OpenShift actually gives agencies everything that has been built with open source technology, and [it's] out of the box so you actually deploy right away."

create, test and run their applications and deploy them to the cloud.

"Many government agencies struggle to just stand up environments for application development," Khan explained. "So if there is a new application that needs to be developed or a new set of releases that needs to be done at an accelerated pace, the first thing agencies generally need to do is stand up the infrastructure that will provide the capability for any team to start working. This can take sometimes up to nine months, and is a real drag on productivity."

However, when you deploy a solution such as OpenShift, agencies obtain self-service that allows them to spin up as many environments as they need, just by clicking a few buttons.

"This means agencies can actually develop applications in their data center and take them to public cloud without changing any code," Khan said.

When agencies partner with Red Hat, following their consulting approach and OpenShift implementation, compared to self-assessment and implementation, they can achieve mission value faster. As a result, IT teams can devote more time to other initiatives that deliver additional value.

"Red Hat has a patterns-based modernization process called RAMP (Red Hat Application Modernization Program) that allows agencies to undertake modernization across their application portfolio while minimizing their technical, operational and security risk," Khan said.

Key elements of RAMP include:

- Systematically rationalizing applications across the portfolio, ranking them based on complexity and priority, and selecting them based on desired modernization outcomes.
- Identifying key technical risks upfront, managing and mitigating them early in the cycle.
- Modernizing mainframe-, Java-, .NET- and COTS-based applications on an open source stack.
- Incorporating DevSecOps, CI/CD and release automation, and building modern, cloud-native applications across the portfolio.

Using open source middleware solutions from Red Hat, government organizations can integrate with a wide range of data sources, including databases, file systems, devices, kiosks, third-party applications, legacy systems and API-based solutions.

Modernizing applications and moving workloads to the cloud involves abundant moving parts and multifaceted decisions. By partnering with an industry leader in open source solutions, such as Red Hat, agencies can gain hands-on experience and methodical processes to help evaluate each application, where it should run and what it should be connected to, especially when security and regulatory requirements are at stake.

"OpenShift actually gives agencies everything that has been built with open source technology, and [it's] out of the box so you actually deploy right away," Khan concluded.

LEARNING FROM OTHERS: CASE STUDIES

“I have one platform we deploy containers on. We don’t make uncontrolled changes. From a security standpoint, I can curate what we make available for developers in an environment where most of the security has already been done for them.”

***Steve Grunch
Branch Chief of Enterprise Cloud Services, USCIS***

CONTAINERIZATION FOR MODERNIZATION AT USCIS



Government IT teams often hear conflicting messages. They know they need to modernize — and fast. But everything they have to do must also be incredibly secure, which sometimes can slow the modernization process.

One answer to the conundrum is DevSecOps. DevSecOps, the combination of DevOps and information security, is an agile approach to delivering secure software applications quickly.

The Department of Homeland Security’s U.S. Citizenship and Immigration Service division wanted to speed up their modernization process, but didn’t want to sacrifice any of the security that was built into their applications and hosted data. They were also struggling with spending lots of time on incident responses when sections of applications failed.

“From an operations perspective, a lot of our applications were having high failure rates and we were having to do a lot of incident response,” said Steve Grunch, Branch Chief of Enterprise Cloud Services at USCIS. “We wanted to start looking at ways we could decompose our applications.”

Containerization and an agile development methodology was the approach that eventually allowed the team to move to DevSecOps, or a secure development and operations cycle, so they could modernize applications faster.

Containers allow you to package and isolate applications within their own environment with all the files necessary to run. This makes it easy to move the contained application between environments — development, testing, production, etc. — while retaining full functionality.

“What appealed to me about containers was the consistency,” said Adrian Monza, Chief of the Cyber Defense Branch at USCIS. “I have one platform we deploy containers on. We don’t make uncontrolled changes. From a security standpoint, I can curate what we make available for developers in an environment where most of the security has already been done for them.”

The journey to a DevSecOps culture, enabled by the adoption of an enterprise container platform, has allowed USCIS to produce higher-quality releases with greater application scalability and isolation.



U.S. Citizenship and Immigration Services

MODERNIZING TO GET REAL-TIME ACCESS TO DATA AT DOD

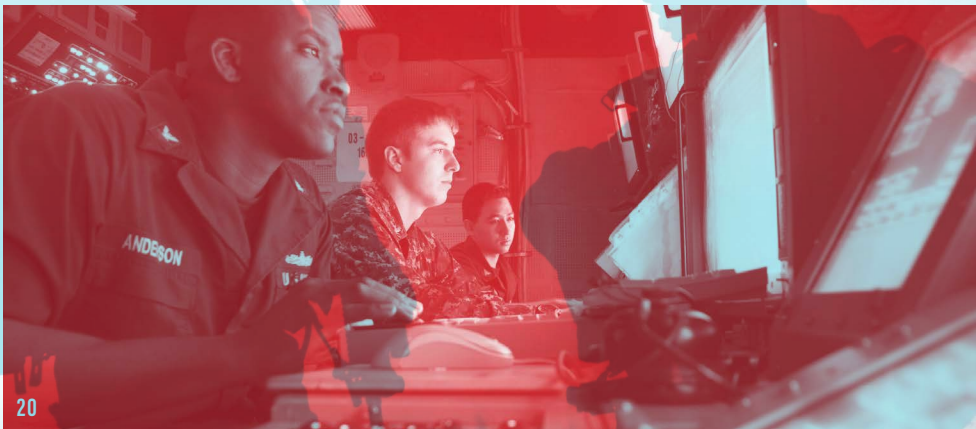
While working on a data consolidation project for the U.S. Department of Defense (DoD), SpinSys, a Red Hat systems integrator, encountered a scenario familiar to many government agencies: Legacy applications, decentralized information and disparate IT systems were preventing timely access to information and the seamless integration and sharing of data and applications across the enterprise. Patient records and hospital data resided in more than 100 systems spread worldwide and none of these systems communicated with one another. The lack of data and integration left healthcare providers and military personnel in the dark.

To make better decisions and have more control over daily operations, DoD needed to pull data in as near real time as possible and then aggregate that data into one centralized enterprise location.

Using commercially supported open source middleware, organizations can easily and cost effectively address key drivers of application modernization, including the need for real-time access to big data; the ever-increasing demand for mobile, web-enabled and cloud-based applications; and the Internet of Things. SpinSys used an open

source middleware integration solution from Red Hat to act as a centralized enterprise repository for health records that were collected via software designed by SpinSys. Daily, the solution collects billions of patient records — more than 30 terabytes of data — in near real time and saves them in the enterprise repository, where they're available anywhere, anytime via a web browser or other channels. The system is updated every 30 seconds, allowing health care providers to immediately access patient information.

Red Hat's open source middleware allowed DoD to launch an online portal for patient health records. In the past, military personnel, who are frequently stationed at multiple bases throughout their career, had to contact each base to collect their medical records upon completion of their military service. Now they can download their health history online because the data is available in a secure, centralized location. Easy access to personal records alleviates administrative burden and helps military personnel more easily enroll their children in new schools when they move — immunization, medication and allergy records are readily available.



CHEAT SHEET

This takeaway section will give agencies actionable steps toward application modernization, as well as best practices and further resources on the topic.

What agencies need to modernize their IT:

- 78 percent of IT budgets go toward O&M
- O&M spending increased from 2010-17, leaving less budget for development, modernization and enhancement
- Lack of support for older systems increases security risks
- Old IT makes it harder to compete with the private sector for top talent

Key benefits of application modernization include:

- Better ROI with an open source stack
- Flexibility to adopt a cloud vision
- Agencies can focus on delivering their mission while avoiding proprietary vendor lock-in
- Delivering value faster and adapting to changing agency mandates

Key steps to take on your application modernization journey:

ARTICULATE the vision, current capability and gaps.

- First, identify and clearly articulate the need for modernization. For example, you may say: We need to meet a new immigration mandate or serve disaster victims with real-time response, etc.
- Second, identify current capabilities that are preventing the agency from meeting the new or changing mandates/mission goals.
- Third, articulate the type of capability needed to bridge the gap. For example, increase system release frequency from once in nine months to once per quarter, or enable field agents with mobile technology to eliminate manual data entry and submit real-time queries, etc.

RE-TAILOR the request for proposals process from a big bang award contract with little visibility and control to incremental steps in which your agency maintains oversight, makes small incremental releases and adjusts direction every three months or so.

REQUIRE solutions to default to open source software.

Red Hat's Methodology for Modernization:



THANKS TO RED HAT FOR THEIR SUPPORT IN PRODUCING THIS PUBLIC-SECTOR RESOURCE



About Red Hat

Red Hat® is the world's leading provider of open source solutions, using a community-powered approach to provide reliable and high-performing cloud, virtualization, storage, Linux® and middleware technologies. Today, Red Hat is at the forefront of open source software development for enterprise IT, with a broad portfolio of products and services for commercial markets. That vision for developing better software is a reality, as CIOs and IT departments around the world rely on Red Hat to deliver solutions that meet their business needs. Solutions that provide technology leadership, performance, security, and unmatched value to more than 90 percent of Fortune 500 companies. Learn more: <http://www.redhat.com/en/technologies/industries/government>



About GovLoop

GovLoop's mission is to inspire public sector professionals by serving as the knowledge network for government. GovLoop connects more than 270,000 members, fostering cross-government collaboration, solving common problems and advancing government careers. GovLoop is headquartered in Washington, D.C., with a team of dedicated professionals who share a commitment to the public sector.

For more information about this report, please reach out to info@govloop.com.

***For the public sector,
the question is no
longer whether
to modernize
applications and
move to the cloud,
but how.***



1152 15th St. NW Suite 800
Washington, DC 20005

P (202) 407-7421
F (202) 407-7501
www.govloop.com
[@GovLoop](https://twitter.com/GovLoop)