# DevOps:
## A Smarter Strategy for Software Development in Government IT

**Government IT organizations are under growing pressure** to perform on par with the private sector. Like Google, Facebook, Amazon and other corporate powerhouses, they need to deliver reliable, scalable digital services — and do it faster than ever. How do private sector companies accomplish this? By embracing DevOps — a smart concept that emphasizes collaboration in software development — and pairing it with modern solutions like microservices and containers.

## WHAT IS DEVOPS?

The term DevOps, a combination of "development" and "operations," defies easy explanation. For the purposes of this paper, it refers to a series of cultural, automation and platform design practices that emphasize collaboration and communication between software developers and other IT project stakeholders. In essence, DevOps enables developers to concentrate on delivering business value rather than underlying technical detail.

DevOps combines elements of "agile" — a principle that advocates for evolutionary software deployment with rapid and flexible response to change — with the idea that operations and development engineers continuously collaborate through all stages of the software development life cycle. In short, software is better when the people creating it work with the people who will ultimately manage it.

By automating software delivery and infrastructure changes, DevOps allows IT to deliver government services more rapidly. It establishes a culture in which building, testing and releasing software happens rapidly, frequently and reliably. Developers can test and deploy code often on the same day they write it, rather than having to wait months.

DevOps embraces open source culture, enabling government agencies to modify or add to open source code to match their needs. Furthermore, it improves security and quality through more iterative deployment, updates and operations.

According to a recent report, high-performing IT teams using DevOps practices deploy code up to 30 times faster, experience 60 percent fewer failures and recover from development issues 168 times faster than their peers.[1]

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What does DevOps look like in practice? The U.S. Patent and Trademark Office (USPTO) is applying DevOps through its Fee-Processing Next Generation (FPNG) initiative — a makeover of the agency's fee collection processing and refund system — to process approximately $3 billion annually in fees.[2] USPTO officials are confident DevOps will enable them to streamline the fee collection and refund process, and reduce manual data entry.

At the University of North Carolina at Chapel Hill, the Information Technology Services' Middleware Services Group has built a unified application development platform that is easily administered from a central location.[3] By moving to Platform-as-a-Service (PaaS), the middleware team can deliver a flexible hosting environment that encourages custom development and innovation, minimizes system integration problems, and strengthens security for better peace of mind.

## MICROSERVICES: A SMARTER APPROACH TO APPLICATION DEVELOPMENT

A microservices architecture (MSA) is a key component of DevOps. MSA breaks down enterprise applications into smaller components that work together, making them easier to build and maintain. Each component is developed separately, and the application is the sum of its components. Rather than rely on a single virtual or physical machine, MSA components can be deployed across multiple servers or data centers. And because microservices are atomic units of work isolated from concurrent processes, they scale and maintain resiliency independently. If one component degrades, the entire system won't come down with it.

A relatively recent phenomenon, microservices are rapidly increasing in popularity. Close to 70 percent of private sector organizations worldwide are either using or investigating microservices, and nearly one-third are currently using them in production, according to a recent survey of more than 1,800 developers and IT professionals.[4]

Microservices enable software development teams to focus on business results, allowing them to develop features more quickly and with higher quality. MSA makes it easier to develop and maintain an application as a suite of services, such as a web-based app that runs 24/7. It also creates fast, scalable and effective mobile apps, web services and constituent portals. It's no wonder that leading technology companies such as Google, Amazon, Netflix and Uber use microservices to deploy an array of dynamic services every day.

## WHY CONTAINERS MATTER

Containers enable DevOps by making it easier to move applications between development, testing and production

environments. For instance, a Linux container provides each application with a dedicated CPU, memory, storage and network. This lets developers package and isolate applications with everything they need to independently run and scale — application files, required runtime environments, dependent libraries and configurations. In an MSA, containers let agencies rapidly adjust and independently scale new microservices to meet changing requirements.

Dr. William A. Brantley, a project manager and data scientist for USPTO, offers an easy way to visualize containers and what they do: Think of them as lunch boxes inside a refrigerator. Each container holds a different lunch item (application), such as a sandwich or salad. All the containers can be stored in the same refrigerator (operating system), but are separate with their own specific utensils for eating lunch.[5]

Government IT systems at the federal, state and local level are embracing container technology, and for good reason. Containers deliver value, particularly as networks grow and demand greater efficiency, scalability and security — a combination well-suited to match the rapidly evolving needs of government IT.[6]

## THE IMPORTANCE OF DOCKER AND KUBERNETES

The open source tools Docker and Kubernetes are also key components of DevOps.

The Docker container specification and engine project is a technology that standardizes the way organizations package their applications safely and securely. Why does this matter? Before containers, developers had to write applications to a specific hardware platform — HP, IBM or Dell, for instance — or write to a specific virtualization offering such as Red Hat, VMware, Citrix or Microsoft.

Now, developers can write an application, package it with the Docker specification, and run it on a variety of environments, including Google, Amazon (AWS), VMware, a public cloud or bare metal (a virtual machine installed directly on hardware rather than inside a host OS).

Kubernetes is the industry standard project for managing clusters of Open Container Initiative (OCI)-compatible containers, including Docker, across multiple hosts. Started by Google in 2014 and baking in over a decade's worth of experience in running containers at scale, Kubernetes (a Greek word that roughly means "helmsman"[7]) provides better ways to control related, distributed components across a cluster of nodes. It groups containers that comprise an application into logical units for easy management and discovery. Kubernetes also runs on many different environments, including laptops, multi-node clusters, public clouds, on-premises deployments, virtual machines and bare metal.

### CONTAINERS VS. VIRTUALIZATION

It's easy to confuse containers with virtualization or virtual machines, but there are distinct differences. Containers share the same Linux host operating system (OS), and isolate the application processes by allocating dedicated compute, network and storage resources for each container. Virtualization, on the other hand, requires a dedicated OS for each virtual server running on a hypervisor. Virtualization platforms require more physical server resources, which reduce the application density. In other words, fewer applications can be deployed to physical servers using virtualization hypervisor technology compared to a container management platform strategy.

Why does this matter? Virtual machines require a lot of system resources. They run a full copy of the OS, as well as a virtual copy of the hardware the OS needs to function. A container, by comparison, needs just the OS, supporting libraries and programs, and system resources to run an app.[8]

One of the greatest strengths of Kubernetes is its community. There are more than 2,200 contributors, spanning individuals, users and vendors, including Red Hat, Google, IBM, CoreOS, SAP, VMware, Cisco, eBay, Intel and others. This open community, under the guidance of the Cloud Native Computing Foundation, results in rapid innovation of features, future-proofing enterprises' investments in Kubernetes.

Red Hat's OpenShift Container Platform (OCP) builds upon the Red Hat Enterprise Linux operating system, the OCI specification — including Docker — and the Kubernetes container management engine to help organizations implement DevOps effectively. OCP adds features such as hardened security, telemetry, networking, container registries, storage, application life cycle management and more. This lets developers reap the benefits of operating on a containerized platform without having to focus on building the containers. OCP allows organizations to concentrate on delivering business value rather than the underlying technical detail, hence, DevOps.

## CONCLUSION

DevOps principles enable organizations to concentrate on business results, not arcane technical details. Microservices and containers are essential tools that help government agencies apply DevOps effectively, enabling them to centralize, automate and extract technical details — freeing their developers to focus on writing code.

## ENDNOTES


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