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Cloud Computing in Law Enforcement

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ABSTRACT

Cloud computing allows users to access and utilize computing resources over the Internet instead of relying on local hardware or on-premises servers. These resources include servers, storage, databases, networking, and software. "The cloud" refers to servers that allow you to access software and databases on the Internet. Cloud technology has become an integral part of modern policing because it offers a widely accessible, reliable, safe and inexpensive solution for law enforcement departments. Cloud computing has recently become a popular concept in law enforcement with the widespread acceptance of body-worn cameras. Many law enforcement agencies have turned to the cloud as a solution for their data needs and for delivering mission critical information to officers in the field. This paper examines the use of cloud computing in law enforcement.

KEYWORDS: *cloud, cloud computing, policing, law enforcement.*

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INTRODUCTION

In an era where the demands on public safety agencies are ever-increasing, technological advancements are the cornerstone of effective law enforcement. Among the most significant developments is the transition from traditional on-premises solutions to cloud-based solutions. Cloud computing refers to the delivery of computing services, such as servers, databases, storage, analytics, software, networking and intelligence. This on-demand access to computing resources is available over the internet and charged via pay-as-you-go pricing.

Cloud computing has become a part of our everyday lives. If you have ever backed up your photos from your phone, checked your bank account from your home computer, or used GPS on a road trip, then you have used the cloud! Several industries are embracing cloud computing-especially law enforcement. Cloud computing is becoming an expectation in modern law enforcement, and for good reason [1].

Law enforcement officials have many responsibilities, such as deterring crime, patrolling assigned areas, monitoring activities to protect people and property, responding to emergencies, etc. [2]. Police leaders are supposed to guide their agencies through evolving technologies that enhance public safety while maintaining security, efficiency, and compliance**.** Law enforcement officials across the country are using the cloud for a variety of functions, such as data backup and disaster recovery. A cloud-based system could allow police officers to stay on top of the data they need to track down crimes as they unfold.

CLOUD COMPUTING BASICS

Cloud computing represents a newly emerging service-oriented computing technology. It is the provision of scalable computing resources as a service over the Internet. It allows manufacturers to use many forms of new production systems such as 3D printing, high-performance computing (HPC), industrial Internet of things (IIoT), and industrial robots. It is transforming virtually every facet of modern manufacturing. It is innovating, reducing cost, and bolstering the competitiveness of American manufacturing [3]. Figure 1 shows the symbol for cloud computing [4]. Some features of cloud computing are displayed in Figure 2 [5].

The key characteristic of cloud computing is the virtualization of computing resources and services. Cloud computing is implemented in one of three major formats: software as a service (SAAS), platform as a service (PAAS), or infrastructure as a service (IAAS). These services are explained as follows:

SaaS: This is a software delivery model in which software and associated data are hosted on the cloud. In this model, cloud service providers offer on-demand access to computing resources such as virtual machines and cloud storage.

PaaS allows the end-user to create a software solution using tools or libraries from the platform service provider. In this model, cloud service providers deliver computing platforms such as programming and execution.

In the IaaS model, cloud service providers can rent manufacturing equipment such as 3D printers.

Just like cloud computing, CM services can be categorized into three major deployment models (public, private, and hybrid clouds) [6]:

- Private cloud refers to a centralized management effort in which manufacturing services are shared within one company or its subsidiaries. A private cloud is often used exclusively by one organization, possibly with multiple business units.
- Public cloud realizes the key concept of sharing services with the general public. Public clouds are commonly implemented through data centers operated by providers such as Amazon, Google, IBM, and Microsoft.
- Hybrid cloud that spans multiple configurations. and is a composed of two or more clouds (private, community or public), offering the benefits of multiple deployment modes.

These services and models are shown in Figure 3 [7]. Cloud computing finds application in almost every field.

POLICE CLOUD COMPUTING

Police cloud computing can improve job performance, keep communities safer, and save law enforcement agencies money. Cost savings, rapid deployment of critical resources, off-site storage and disaster recovery, and dynamic provisioning of new and additional resources when needed are among the tangible benefits that cloud computing potentially offers to law enforcement agencies of all size. Figure 4 shows a representation of police cloud computing [8].

Modern police work now involves a significant volume of electronic data derived from surveillance systems, social media and personal computers and cell phones. Modern-day policing accumulates a lot of data; body camera footage, in-car camera footage, computer aided dispatch files, accident reports, eyewitness interviews, evidence logs, and more. For example, body-worn and surveillance cameras, cell-phone multimedia, and social media generate a great deal of data. With the introduction of body cams and dash cams into most police forces, it has become important to find a reliable and more cost effective way to store a significantly increasing amount of data. The ability to transfer information from these devices is critical for providing comprehensive insight into an investigation. Traditionally, police data has lived in siloes and on servers. The traditional model was flawed, because servers take up a lot of space, as shown in Figure 5 [9]. They come with an ever-increasing cost of maintenance. Agencies are transforming the way they operate when making the shift to cloud-hosted solutions from traditional on-premise methods.

With the help of the cloud, law enforcement agencies are swiftly able to transmit the information they have gathered to other police departments. Cloud-based solutions have revolutionized policing and ensuring secure video cloud storage, remains critical. In order to guarantee the safety and security of the cloud storage for law enforcement, the International Association of Chiefs of Police (IACP) has created a list of guidelines for law enforcement agencies to follow regarding the cloud [10].

APPLICATIONS OF CLOUD COMPUTING IN LAW ENFORCEMENT

Law enforcement agencies are deploying cloud solutions in a wide variety of applications. Cloud computing offers numerous applications for law enforcement, enhancing efficiency, security, and collaboration. The most common applications for cloud computing include the following [11]:

- *Evidence Management and Accessibility*: Cloud platforms allow for secure storage, management, and sharing of digital evidence like bodycam footage, photos, and reports. Officers can access evidence from any Internet-connected device, facilitating faster decision-making in the field. Cloud solutions can help track the handling of evidence, enhancing its integrity and admissibility in court.
- *Data Analysis and Intelligence:* Law enforcement agencies can leverage cloud-based analytics tools to analyze large datasets, identify patterns, and gain insights into criminal activity. Cloud

computing can support predictive policing models by analyzing historical crime data and identifying potential hotspots. Cloud-based systems enable the creation of real-time crime centers, providing officers with up-to-date information and situational awareness.

- *Collaboration and Communication:* Police officers need real-time access to critical data, whether in the field or at headquarters. Cloud-based solutions allow seamless collaboration across agencies, enabling officers, detectives, and command staff to access reports, case files, and digital evidence from any authorized device Cloud solutions facilitate seamless information sharing between different law enforcement agencies, improving coordination during investigations and emergencies. Cloud-based mobile applications allow officers to submit reports, access databases, and communicate with dispatchers from the field.
- *Resource Pooling:* The computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customers generally have no control or knowledge over the exact location of the provided resources, but they may be able to specify location at a higher level of abstraction (e.g. country, state, or data center). Examples of resources include storage, processing, memory, and network bandwidth.

BENEFITS

Advances in cloud computing technologies can provide a number of benefits for both law enforcement and government agencies, including cost savings, rapid deployment of critical resources, scalability, flexibility, accessibility, enhanced security, and improved collaboration. Storage is often one of the biggest motivators for moving to a cloud structure. Efficiencies from cloud computing free officers to do more substantive police work, as typically shown in Figure 6 [12]. Other benefits include the following [1,13]:

- *Cost Savings:* Traditionally, agencies have invested in on-premises servers, requiring costly infrastructure, ongoing maintenance, and IT staff. The cloud eliminates the need for expensive hardware upgrades by allowing agencies to scale storage and computing power as needed. Instead of budgeting for large capital expenditures, agencies can pay for cloud services on a subscription basis, reducing upfront costs.
- *Enhanced Security:* Security is probably the most important concern for any law enforcement agency considering a cloud solution. A data breach or other malicious release of sensitive information can be disastrous for law enforcement investigations and police operations. Contrary to some misconceptions, cloud providers often offer higher security than on-premises solutions. Industry leaders such as Microsoft, Amazon Web Services (AWS), and Google Cloud invest billions in cybersecurity, providing agencies with advanced encryption, multifactor authentication, and compliance with law enforcement data security standards. Figure 7 depicts security in the cloud [8].
- *Accessibility:* Law enforcement agencies need access to information and evidence. They need real-time access to critical data, whether in the field or at headquarters. This accessibility is especially valuable for multijurisdictional investigations and emergency response coordination. Police cloud computing encompasses various systems within one platform. As a result, users can access these systems anywhere, anytime. This is important because it significantly speeds up this workflow.
- *Collaboration:* Investigations often need collaboration across various departments and jurisdictions. Cloud-based platforms make sharing digital evidence easy, improving cooperation and coordination between agencies. Cloud-based solutions allow seamless collaboration across agencies, enabling officers, detectives, and command staff to access reports, case files, and digital evidence from any authorized device.
- *Disaster Recovery:* Cloud-based storage provides built-in redundancy and disaster recovery, ensuring critical data remains accessible even in the event of hardware failure, cyberattacks, or natural disasters. Unlike traditional servers that require manual backups, cloud solutions can automatically replicate data across secure locations, minimizing downtime and data loss risks. As shown in Figure 8, p.57, data could be pulled out of the cloud because we have a backup there [14].
- *Cost-effectiveness:* Maintaining on-site infrastructure for digital evidence management can be expensive, requiring a big investment in hardware, software, and IT support. Cloud solutions are a more cost-effective alternative, reducing the need for physical storage and related maintenance costs. While there are certainly up-

front costs associated with implementing cloud-based security, it can save law enforcement agencies money over time. As an agency continues to use the system, users can determine if they need to scale up or down based on their specific needs. Another way cloud computing can save your department money is by reducing the need for in-house IT support, which can cost a significant amount of money for departments. Cloud computing services are responsible for software maintenance and updates so that your team does not get bogged down with having to complete those tasks.

- *Transparency and Accountability:* Transparency and accountability are key in modern policing. With public trust in law enforcement being so important, agencies are turning to cloud-based evidence management systems like Nexus to further strengthen these values. By adopting transparent practices in evidence management, law enforcement agencies can build greater public confidence. Demonstrating a commitment to accountability through the use of advanced technology helps foster trust and credibility within the community.
- *Scalability:* As the agency grows, the data grows. With the click of a button, we can scale the cloud service to have more storage or more horsepower behind their search engines. It is not as easy to add to a physical server. Cloud-based scalability allows IT administrators to easily customize their cloud environment and storage space to meet the unique needs of the organization, saving law enforcement agencies both time and money. Scalability also increases flexibility and speed as law enforcement agencies do not have to buy equipment, set up hardware or deal with the other inconveniences of on-site installations.

CHALLENGES

As with any new technology, police cloud computing can seem daunting. Recognizing the sensitivity of law enforcement information, and the special responsibilities that law enforcement has to ensure the accuracy, reliability, and security demonstrates some of the challenges that agencies face in evaluating the potential use of this new computing paradigm. When it comes to using the cloud in professional settings like law enforcement, cops are more skeptical. They want to know: "Will it help me do my job better, keep me safer, and save me time and money?" Other challenges include the following [15]:

- *Sensitive Data:* It can be unsettling to trust cloud software to protect your department's sensitive data. Because of the sensitivity of this data, designers created these platforms with law enforcement in mind. Cloud computing also allows investigators to securely store sensitive data in a central location where it can be accessed quickly and efficiently. Particularly, designers developed these platforms to serve as excellent tools for protecting sensitive information and enhancing departmental workflow.
- *Survivability:* The terms of any agreement with cloud service providers should recognize potential changes in business structure, operations, and/or organization of the cloud service provider, and ensure continuity of operations and the security, confidentiality, integrity, access and utility of data.
- *Data Loss:* Another benefit of cloud-based solutions is that the agency does not need to worry about losing data. This is particularly important in areas that may suffer from natural disasters or have an aging IT infrastructure. Data loss is a major concern among law enforcement agencies and departments across the US. Cyber attacks and natural disasters are the biggest culprits of data loss; the loss or corruption of sensitive information could put criminal investigations at risk. With cloud storage, information is automatically backed up; meaning law enforcement has the opportunity to recover lost or corrupted information.
- *Compliance with Regulations:* Law enforcement agencies are responsible for processing and storing a large volume of sensitive personal information. And as a result, there are many state and federal regulations that departments must follow to keep this information secure. Lack of compliance with certain policies can result in fines, legal implications, and weakened trust within the community. This puts a lot of pressure on law enforcement agencies to ensure that the technology they are using is designed to protect sensitive information. Cloud providers must comply with the requirements of the Criminal Justice Information Service (CJIS) Security Policy.

CONCLUSION

The cloud is the future of law enforcement technology. The transition to the cloud is not a question of "if" but "when." By taking a proactive approach, agencies can harness the power of cloud technology to drive positive change in policing. When used to its fullest capabilities by police departments, the cloud can be one of the most powerful, efficient and effective weapons in the law enforcement arsenal. The International Association of Chiefs of

Police (IACP) has set up some Guiding Principles on Cloud Computing in Law Enforcement. With so many agencies expressing a desire to start migrating their data to the cloud, the International Association of Chiefs of Police has established a set of 10 guiding principles for law enforcement cloud computing. Most of the principles are fairly cut-and-dried stuff such as reliability, integrity, confidentiality, and accessibility [16].

The use of cloud-based records management systems can make a real difference in a police department's overall productivity. By storing and sharing records in the cloud, departments can raise their case-solving capabilities to the next level, harnessing the power of information technology and the web to do much more with the people and financial resources that they have. More information about cloud computing in law enforcement can be found in the books [17,18] and the following related journals:

- Journal of Cloud Computing
- IEEE Cloud Computing
- IEEE Transactions on Cloud Computing
- International Journal of Cloud Applications and Computing
- International Journal of Cloud Computing and Services Science
- i-manager's Journal on Cloud Computing

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Figure 1 The symbol for cloud computing [4].

Figure 2 Some features of cloud computing [5].

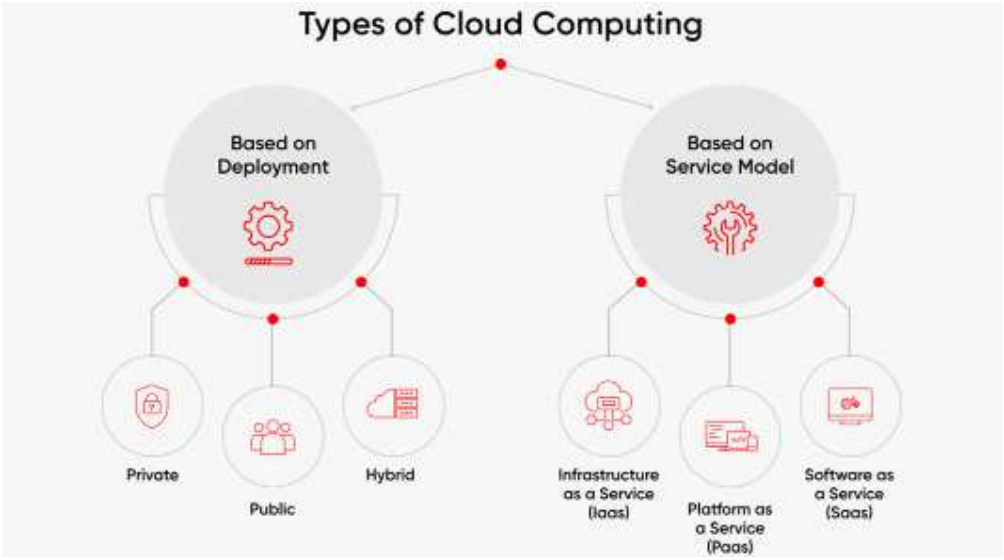

Figure 3 Cloud computing services and models [7].

Figure 4 A representation of police cloud computing [8].

Figure 5 Servers take up a lot of space [9].

Figure 6 Police officer at work [12].

Figure 7 Security in the cloud [8].

Figure 8 Data could be pulled out of the cloud because we have a backup there [14].
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