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# *Safe cities: Collaborative monitoring*

For the community, by the community





# Preface

Today, cities face a wide range of threats, ranging from terrorism and civil unrest to kidnapping and murder. To reduce the impact of these threats, it is critical for the authorities to capture real-time information on what is happening in and around the city. Therefore, there is a growing requirement for utilising the new and emerging technologies to make our cities safer.

Given this background, one of the most user-friendly technologies that can play a crucial role is the extensive use of closed-circuit television (CCTV) cameras, which play a vital part in ensuring day-to-day surveillance, crime prevention and monitoring of illegal or suspicious activities. In addition to close supervision, CCTV cameras allow post-incident analysis and collection of indisputable legal evidence. While the government and legal authorities are also encouraging both public entities/groups and individuals to adopt such progressive technologies, mapping each and every nook and corner of a city without seeking the help of its people is impossible. This formed the basis of a unique community policing initiative called ‘collaborative monitoring’.

As the very phrase suggests, collaborative monitoring is a unique tool, wherein the security and law enforcement agency takes advantage of the extensive network of surveillance cameras deployed by communities across the city as well as the cameras of other private and government establishments on a need basis. It is an extremely prudent enabler for the police department, as while they strengthen their bond with the communities, they can use any information or footage gathered from these security cameras to support investigation and the prosecution of criminals. The advantage provided by leveraging the extensive network of external cameras ensures enhanced crime monitoring through a cost-effective, widespread and scalable model.

It gives us immense pleasure to present this report, which highlights the importance of collaborative monitoring and lays emphasis on the impact and criticality of community participation in supporting our law enforcement agencies and optimising crime prevention. Through this report, we have made an attempt to present the collaborative monitoring framework and approach in the current surveillance scenario.

We are grateful to the participating domain experts for their valuable time and for sharing their thoughts and strategies with us.

We hope you find this report insightful and useful, and look forward to your feedback.



**Neel Ratan**

India Government Leader and Regional Managing Partner, North  
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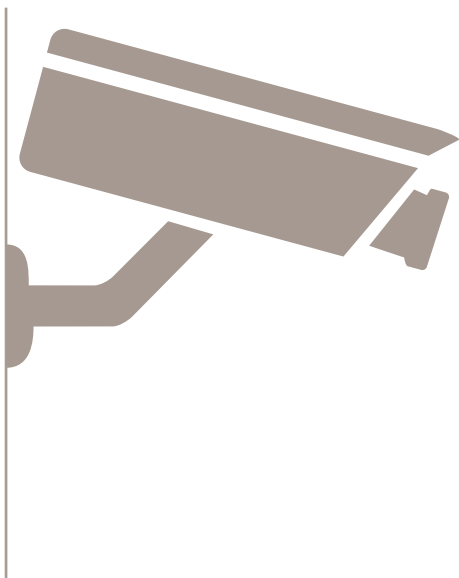
# Introduction

Cities across the world are constantly changing and evolving faster than at any point in their history. They have become more congested, and criminal activities have soared, leading to the destruction of public assets. Compounding the problems, terrorism has become a major concern that presents communities and neighbourhoods with new security problems. Faced with a wealth of challenges, which are often elusive, cities are expected to manage and control the change to allow their communities to have a standard of living that meets modern-day expectations.

The recent terror attacks around the world reveal that most attacks are highly precise and well-coordinated, and targeted at high footfall areas to create a psychological impact along with monetary losses. Most of the citizens today are well aware of the risks and are in a state of constant anxiety about their safety and security. Hence, public safety has emerged as an important function for governments across the world.

Accordingly, the federal and state government departments responsible for internal affairs and homeland security continuously assess and monitor the internal security situation, issue appropriate advisories, share intelligence inputs, extend manpower support, and offer guidance and expertise to the state governments for the maintenance of security. This also helps in establishing infrastructure for safe cities by capitalising on features from the following distinct categories of surveillance systems:

- Citywide police surveillance using Internet protocol (IP) based cameras
- Citywide community surveillance, including private and institutional surveillance for collaborative monitoring

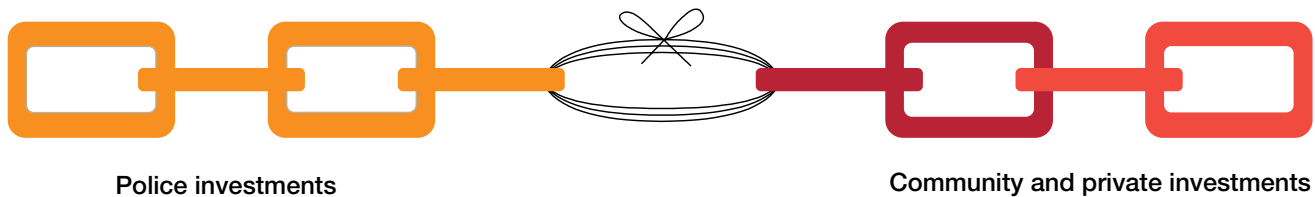


While the first system is becoming a standard solution for implementation to achieve the safe city vision, the latter is also gaining momentum to involve citizens and private and public institutions in collaborative monitoring. The following sections elaborate on the concept of collaborative monitoring.

## What is collaborative monitoring?

A key enabler for a safe city is the aspect of collaborative monitoring. In cities, where every government and private establishment has realised the necessity to secure its infrastructure and establish surveillance, monitoring and incident response systems, it is important that the data gathered by these agencies is shared among them. In such cities, CCTV-based surveillance systems are being deployed by federal as well as state government agencies at places like bus stands, metros, railway stations, airports, other critical infrastructure spots and public places. These collaborative monitoring systems can conveniently share their data in real time with security agencies of the city. Similarly, live feeds from CCTV systems deployed by private establishments such as malls, hospitals, business parks and entertainment houses can be provided to the security and law enforcement agencies, which can make effective use of the information.





Leveraging the extensive network of external cameras ensures additional eyes are monitoring crime. In addition, the higher penetration of cameras helps in lowering costs.

### ***Why collaborative monitoring?***

In her famous work, *Participation and democratic theory*, Carole Pateman, the renowned political theorist, advocated a greater role for common people in democratic self-rule and argued that development projects are more effective when beneficiaries have a role in the way projects are chosen, planned, implemented and evaluated.<sup>3</sup> Giving citizens a role in initiatives designed for their benefit is considered to an ideal way to ensure the sustainability and success of any project.

Many cities across the world have surveillance systems deployed by multiple public and private establishments. These cities are using the collaborative framework to receive video feeds from these systems to ensure real-time responses and as an invaluable source of crime detection and evidence for the law enforcement departments.

For an instance, the British Security Industry Authority (BSIA) estimated that there are up to 4.9 million CCTV cameras in the UK, including 7,50,000 in 'sensitive locations' such as schools, hospitals and care homes. This translates to one camera for every 14 people in the UK.<sup>4</sup>

The collaborative framework shall help to meet the following objectives:



Ensuring safety and security in fragile settings remains the key objective of law enforcement agencies, in addition to crisis management during serious incidents. The strategic objectives include the following:

Security and safety	<ul style="list-style-type: none"> <li>• Live surveillance and alerts in case of an incident through a network of cameras</li> <li>• Greater coverage of surveillance within the city, with more eyes on the street</li> <li>• Supporting operations at major events, such as crowd control and safety</li> <li>• Preventing crime by detecting and deterring criminal activity, and by helping identify offenders and assisting in the apprehension of offenders, leading to the their prosecution</li> </ul>
Improved responsiveness	<ul style="list-style-type: none"> <li>• Providing citizens with access to the police for quick and effective response, along with improved visibility and transparency</li> <li>• Improved response times and a general reduction in the fear of crime in an area</li> <li>• Providing assistance to emergency services and fast turnaround time</li> </ul>
Effective policing	<ul style="list-style-type: none"> <li>• Addressing threats of terrorist attacks</li> <li>• Assisting in the management and policing of large-scale events (political, religious, etc.)</li> <li>• Aiding investigations by the police department by integrating analytics tools</li> <li>• Providing evidence for criminal and civil action in courts</li> </ul>
Improved management	<ul style="list-style-type: none"> <li>• Helping in maintaining law and order situations</li> <li>• Helping to improve traffic discipline</li> <li>• Acting as a tool for municipal corporations and other government agencies in the monitoring and maintenance of their functions</li> <li>• Providing a framework to all the stakeholders so that there is proportionality and transparency in their use of surveillance</li> <li>• Ensuring scalability and interoperability of systems</li> </ul>







# PwC's framework for collaborative monitoring

The entire ecosystem of cameras available to law enforcement agencies becomes significant when in addition to the law enforcement cameras, these agencies also have access to cameras that are installed across the city as part of other initiatives, including the very popular community surveillance cameras. Community surveillance cameras are primarily targeted for implementation at 'establishments' which are frequented by a large number of people. Such establishments may include places like commercial establishments, industrial establishments, religious places, educational institutions, hospitals, sports complexes, railway stations, bus stations, places of organised congregation and other such establishments, as the government may by notification declare to be an establishment for the purpose of collaborative monitoring.

To further explain this ecosystem, city surveillance at public places across the city can be divided into four categories:

1

## **Surveillance system in direct control of the city police:**

Cameras directly under the control of the police department and owned by the state government, as set up under the city surveillance/safe city project and monitored at central/distributed command centres

2

## **Community CCTV:**

Cameras installed and owned by the community in clusters, which can be integrated into the existing surveillance system. The feed of the community cameras can be viewed at the command control centre on a need basis.

3

## **Surveillance system set up by other public institutions:**

Cameras owned by and under the control of various public institutions like railways and airports

4

## **Surveillance system set up by private institutions:**

Cameras owned and controlled by private establishments such as large residential societies, hotels, malls, multiplexes, theatres, hospitals and schools

Certain surveillance systems are already being deployed by many public and private establishments. With a stimulus from the local government, the installation of community CCTV surveillance systems has started, and a cluster-wise process has been deployed at a few places. Therefore, it becomes imperative for law enforcement agencies to have a system which will have a collaborative framework for receiving video feeds on a need basis from these systems and subsystems. Leveraging the capabilities of a good video management system (VMS), when clubbed with video analytics, will also allow efficient access to these external camera feeds at the command and control centre.

Collaborative monitoring of video feeds not only facilitates greater coverage of video surveillance within the city but also serves as deterrence for crimes and assists law enforcement agencies in controlling incident escalation, crime detection and its investigation.

## **Guiding principles**

The following guiding principles should always be considered while planning, designing, implementing or maintaining the collaborative CCTV surveillance system:<sup>5</sup>

- The use of a surveillance camera system must always be for a specified purpose which is in pursuit of a legitimate aim and necessary to meet an identified pressing need.
- The use of a surveillance camera system must take into account its effect on individuals and their privacy, with regular reviews to ensure its use remains justified.
- There must be as much transparency as possible in the use of a surveillance camera system, including a published contact point for access to information and complaints.
- There must be clear responsibility and accountability for all surveillance camera system activities, including images and information collected, held and used.
- Clear rules, policies and procedures must be in place before a surveillance camera system is used, and these must be communicated to all who need to comply with them.
- No more images and information should be stored than strictly required for the stated purpose of a surveillance camera system, and such images and information should be deleted once their purposes have been discharged.
- Access to retained images and information should be restricted and there must be clearly defined rules on

who can gain access and for what purpose such access is granted; the disclosure of images and information should only take place when it is necessary for such a purpose or for law enforcement purposes.

- Surveillance camera system operators should consider any approved operational, technical and competency standards relevant to a system and its purpose and work to meet and maintain those standards.
- Surveillance camera system images and information should be subject to appropriate security measures to safeguard them against unauthorised access and use.
- There should be effective review and audit mechanisms to ensure that legal requirements, policies and standards are complied with in practice, and regular reports should be published.
- When the use of a surveillance camera system is in pursuit of a legitimate aim, and there is a pressing need for its use, it should then be used in the most effective way to support public safety and law enforcement with the aim of processing images and information of evidential value.
- Any information used to support a surveillance camera system which compares against a reference database for matching purposes should be accurate and kept up to date.
- Clear roles and responsibilities, including liabilities of each stakeholder with timelines, should be defined, as applicable.
- A crime assessment should be conducted to identify more accurately what crime problems are occurring, where and when.
- Establishments should carefully place CCTV cameras to cover all the areas of vulnerability. It is important that sensitive and critical areas are covered with proper lighting, viewing angles and visibility, so that the CCTV feeds give a clear picture of the activity and identify individuals.
- Establishments should install CCTV cameras and related components meeting open and consistent standards (and avoid any system with proprietary standards). It is recommended that CCTV cameras and related systems comply with the Open Network Video Interface Forum (ONVIF) or Physical Security Interoperability Alliance (PSIA) standards.
- A periodic review and assessment (at least once in three months, preferably by third-party firms) of the CCTV system should be conducted and documented for management verification.
- Community CCTV systems should be integrated with the control room at the local police station as

well as command centre for access to camera feeds on an on-demand basis for monitoring and incident management by the law enforcement agencies.

- Standard operating procedures and a code of practice should be developed and implemented to set the standards for and guide the operation of the scheme.
- Government/law enforcement agencies may consider contracting a consultant with appropriate CCTV expertise to assist in conducting a study of the 'as is state', developing draft specifications, functional requirements and standard operating procedures.
- The approved private sector agencies involved in the provision of CCTV services for collaborative monitoring solutions would, of course, be expected to comply with all codes of conduct, protocols and standard operating procedures developed and applied by the local government.



## Approach

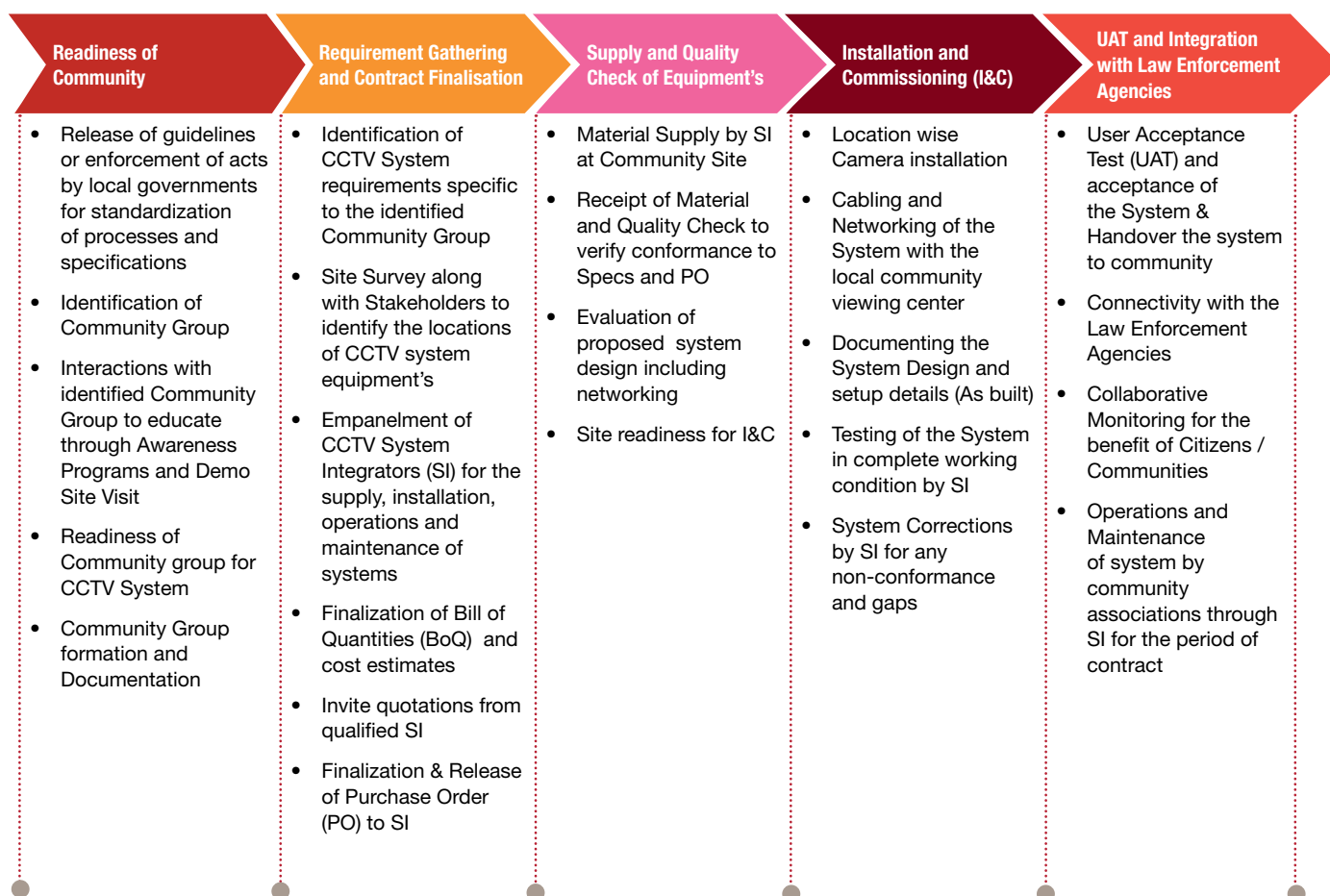
Due to the vast deployment of various CCTV surveillance systems across the city, it is imperative to adopt a standard process for such a roll-out by communities and sustain these systems for a longer period. As a first step, local governments can come up with public safety acts or guidelines with standardised processes and specifications defined to ensure that consistent, sustainable, scalable, quality-based and interoperable systems are deployed.

As part of the collaborative monitoring initiative, on behalf of the community, city police departments can also initiate a process of empanelment of CCTV system integrators (SIs) for the supply, installation, operations and maintenance of systems by public institutions or by community associations. The cost for setting up a CCTV-based surveillance system within a community area can be

borne by the respective community group, while the local government may also support them in arranging for funds through federal and state funding, if available. The option of getting financial assistance from large corporates, institutions, public sector firms, etc., can also be explored to reduce the financial burden on communities who are unable to arrange for the required funding.

Once this community surveillance system is implemented, it should be connected with law enforcement agencies for collaborative monitoring. The cost for connecting the community with the viewing centres of law enforcement agencies and maintenance cost of this connectivity can be borne by the local governments. Sharing of resources within communities may further reduce the total cost of ownership for these communities.

## Process overview



## ***Suggestive architecture and integration scenarios***

#	CCTV Technology Implemented	Approach	Requirements	Outcome
1	Analogue cameras with digital video recorder (DVR)	Application programming interface (API)/ software development kit (SDK) integration	The DVR manufacturer needs to share the API/SDK with the vendor of the command control software.	All cameras would be part of the camera tree at the video management system (VMS) and would enable complete integration of the cameras into the system. This will also allow for recording of each video feed.
2	Analogue cameras with DVR	Encoder	Each camera, irrespective of the make, would be needed to connect to an encoder and then to the network.	All cameras would be part of the camera tree at the VMS and would enable complete integration of the cameras into the system. This will also allow for recording of each video feed.
3	IP cameras with network video recorder (NVR)/VMS	API/SDK at camera level	All IP cameras would need to be Open Network Video Interface Forum (ONVIF) compliant or else should share the API/SDK for integration.	All cameras would be part of the camera tree at the VMS and would enable complete integration of the cameras into the system. This will also allow for recording of each video feed.
4	IP cameras with network video recorder (NVR)/VMS	API/SDK at NVR/VMS level	The VMS of existing cameras should be ONVIF and share API/SDK	All Cameras would be part of the Camera Tree at VMS and would enable complete integration of the cameras into the system & also recording of each video feed can take place.

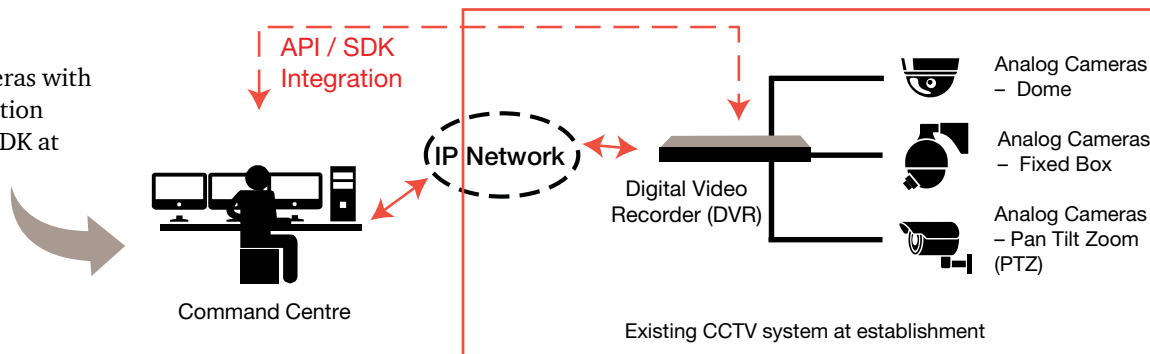
Further to the above, some of the design considerations to be followed while planning the integration of community surveillance systems are as follows:

- Only a third-party VMS, which has a pure play Web interface, must be deployed (i.e. no need to configure specific ports or install intelligent ActiveX/Java). This will ensure no compromise of the IT security of the control centre.
- A third-party VMS capable of providing replay using a screen-recording solution will ensure the displayed video is available later for replay/playback.
- Third-party VMS configuration will be accessible only from the native third-party VMS module.



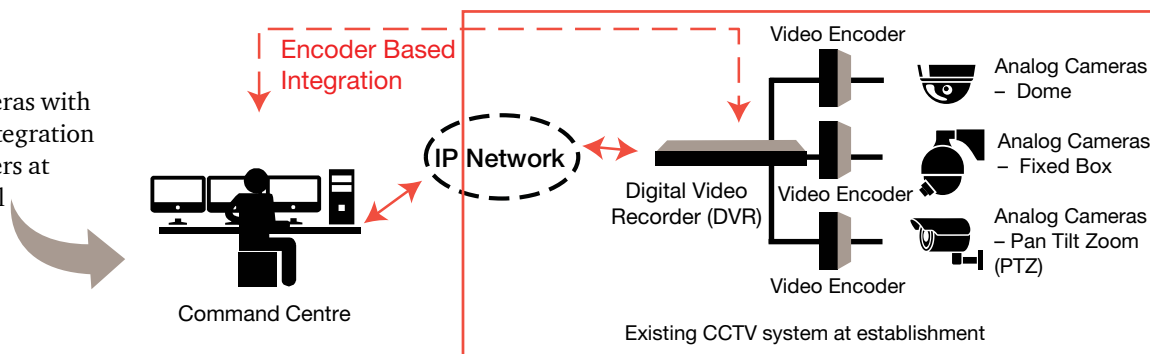
### Case 1:

Analog Cameras with DVR: Integration using API / SDK at DVR Level



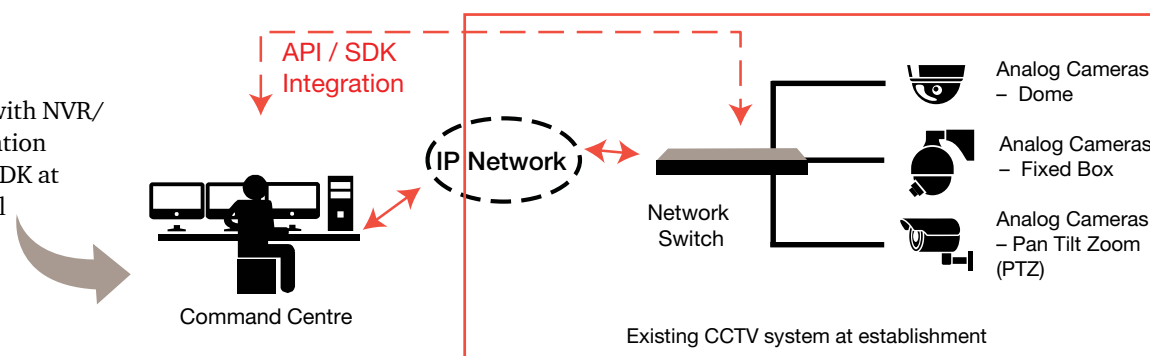
### Case 2:

Analog Cameras with Encoders: Integration using Encoders at Camera Level



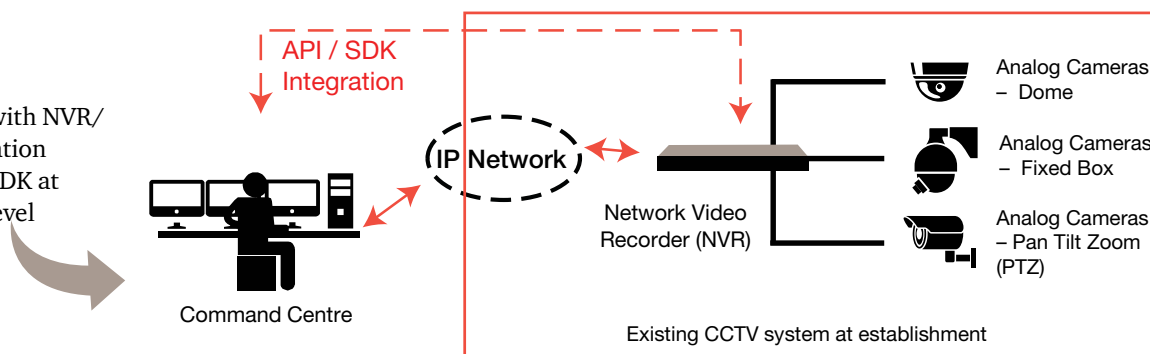
### Case 3:

IP Cameras with NVR/VMS: Integration using API / SDK at Camera Level



### Case 4:

IP Cameras with NVR/VMS: Integration using API / SDK at NVR/VMS Level





# Challenges

- **Multiple stakeholders:** With more stakeholders using and accessing the same systems, there is a greater risk to an individual's privacy.
- **Waste of resources:** If not planned correctly, systems are used in the same areas and are independent of each other, covering the same space, using different networks or fibres and for the same purpose, which is a clear waste of resources.
- **Risk to freedom of expression and association:** A sufficiently powerful public camera could endanger rights to freedom of expression by giving the government an extensive record of what individuals do, and whom they associate with.
- **Government accountability and procedural safeguards:** Pervasive public video surveillance systems could allow officials to evade both procedural safeguards and accountability. Moreover, with numerous organisations working together to offer a completely integrated CCTV model, it is quite possible that lines of responsibility will be blurred.
- **Equal protection and anti-discrimination:** Discrimination retards the very ability of any insular minority group—be it religious, racial, cultural, political or ethnic—to participate fully in civil society. Discriminatory use of surveillance can also give ammunition to those with salacious or malicious agendas.
- **Existing laws and regulatory proposals:** Conflict with existing laws and regulations is to be avoided and protection of all rights of the citizens as per the constitution is to be ensured.
- **Standardisation and interoperability:** Since each community will be responsible for its own solution being implemented, non-standard equipment/applications and lack of interoperability may defeat the whole purpose of putting the system in place. If necessary, new acts such as public safety (measures) can be enforced to ensure a consistent, standardised and sustainable framework.
- **Lack of awareness within communities:** Many a times, such initiatives do not move forward for next steps due to a lack of awareness or motivation within communities. This can be avoided if proper awareness campaigns and visits to model sites are arranged across the communities.
- **Funding issues:** Sometimes, a lack of sufficient funding or sustainable operations and a maintenance framework creates a bottleneck in moving forward. The government may come up with various subsidies or may even have a rate contract with approved SIs to provide services at an already negotiated rate, with a cap on maximum charges. Funding from urban local bodies (ULBs) can also be utilised.
- **Crime displacement:** In few of the cases, efforts to implement community surveillance to reduce opportunities for crime do not truly lower crime but merely change where, when or how it is committed. Thus, the introduction of cameras in one area or neighbourhood could result in increased crime elsewhere.
- **Privacy and anonymity issues:** Unless procedural limits are implemented, law enforcement officers might use video surveillance to improperly monitor private activity or otherwise go beyond the bounds of their authority. Without accountability safeguards, moreover, the officers might never have to explain their actions. The following are a few of the key concerns which may arise in the minds of citizens:
  - Which organisation is collecting images and for what purposes?
  - Where are the images stored?
  - Who has access to this information?
  - Are they being transferred to third parties?
  - What are the safeguards in place to protect these images?
  - How long will they be stored before deletion?
- Hence, collaborative monitoring could be a way forward, but it is not without risks. However, with careful consideration, these risks can be managed. The process itself should ensure checks on such risks to garner the maximum fruits out of such initiatives.



The Citywide CCTV Surveillance Project with 1,00,000 CCTV cameras expected to be set up with the help of the community and other stakeholders and 10,000 cameras to be set up by the government is one of the largest community-supported collaborative monitoring systems. All cameras will be networked and converged at the community level, police station level, zonal level and at the Central Command Control Centre level. The Central Command and Control Centre will act as a technology fusion centre supported by high-end data analytics and image analytics and utilised by all government departments/agencies for improving service delivery to cutting-edge levels. This project will help in achieving the objective of “certainty of being caught and certainty of being punished” for all violators of the law as per the due process. This also will act as a safety net for law-abiding citizens in the process of the investigation of crimes and identification of offenders. This will enable Hyderabad city to transform itself into a safe and smart city by enhancing the standards of safety and security in particular and quality of life in general for all its citizens.

– M Mahendar Reddy, IPS  
Commissioner of Police, Hyderabad



# PwC: Case studies

## **Case study: Collaborative monitoring - Hyderabad city, Telangana state, India**

### **Introduction**

The Telangana state government (part of the then Andhra Pradesh state) enacted the AP Public Safety (Measures) Enforcement Act, 2013 (Act 6 of 2013), dated 18 January 2013 and subsequently published 'AP Public Safety (Measures) Enforcement Rules, 2014' dated 18 February 2014 with the provision of expanding citizens' participation in creating a larger footprint of IP-video surveillance systems throughout the state to safeguard its neighbourhoods.

This initiative served as a foundation for the Hyderabad/Cyberabad city police to come up with a collaborative monitoring solution to monitor 10,000 high-definition (HD) surveillance cameras to be set up by the police department, as well as 100,000 HD cameras which are envisaged to be set up across the city in participation with various communities. This shall be one of the biggest initiatives of its kind anywhere in India which is envisaged to be implemented through community support to make Hyderabad a police-citizen friendly city.

### **Solution and key features**

The Hyderabad and Cyberabad city police pioneered the collaborative video surveillance monitoring initiative in the interest of communities to elevate a sense of safety and security within their neighbourhoods and protect the investments made by these communities in setting up such systems. The city police department organised multiple sessions across the city, including visits to the model set-ups to create awareness among the various communities. The facilitation provided by the city police department encouraged the communities to set up the video surveillance monitoring centres within their respective capacities. The video feeds from these cameras were also integrated with the nearest police stations and the central collaborative monitoring command centre to track, monitor and analyse them in order to detect criminal activities, traffic violations, road conditions, etc.

As part of this initiative, a community can also access the video feeds from the CCTV system set up by the other communities through the police department on a need basis. Many other government agencies like ULBs/municipal corporations, utilities departments and cantonment boards have also shown interest and some have already started monitoring these feeds on a need basis at their respective command centres. The central command centre facilitated by the city police department provides a common platform for such government agencies to have collaborative monitoring of the video feeds.

The citywide core backbone network connectivity to connect field locations, police stations and data and command control centres is provided by a third-party network service provider, while last-mile connectivity is provided by the solution implementation partner. All the cameras, once established and networked, will be driven with advanced video analytics.

Qualified firms were empanelled by the police department through a competitive open bid process involving stringent evaluation of the organisation and its technological capabilities for community-based CCTV surveillance solutions. The scope of work included supply, implementation and a five-year on-site warranty. The key aim behind this empanelment was as follows:

- Standardisation of solutions to ensure quality, scalability and interoperability of the systems
- To ensure capping on the maximum rate for supply, implementation and maintenance of systems as per the rate contract finalised with the SIs, which may be further negotiated by the communities
- Sharing of resources and cost by the communities to reduce the total cost of ownership

The Hyderabad and Cyberabad city police also supported the communities who were not able to bear the operations and maintenance (O&M) cost of the video surveillance system by encouraging various corporates and institutions to provide financial assistance to such communities. Apart from corporates and institutions, the local members of parliament (MPs) and members of legislative assembly (MLAs) also contributed to provide financial assistance to such communities within their respective regions.

PwC was brought on board as a technical consultant and transaction advisor for the preparation of a detailed project report (DPR), request for proposal (RFP), bid management and providing project management services for citywide CCTV surveillance system for the Hyderabad and Cyberabad police commissionerates. The scope of the project included integration with the existing surveillance systems, community CCTV systems (1,00,000 HD IP cameras), integrated traffic management systems (ITMS), emergency call response management systems (dial 100) and other existing IT systems, with the objective of improving citizen services and enhancing safety and security in Hyderabad city. The proposed command centre and data centre (tier 3) is envisaged to be a world-class facility which will serve as a platform for safe and smart city projects not only across the city but also across the state.

### Key benefits to department

- Provides greater coverage of surveillance within the city
- Ensures scalability and interoperability of systems
- Acts as a crime deterrent in sensitive zones like procession routes and public gathering spots
- Assists the police in gaining evidential quality recording of incidents
- Helps in controlling incident escalations by providing improved response time
- Helps reduce fear of crime in the area and prevents crime by deterring criminal activity by detecting such activity and helping to identify and apprehend offenders, leading to their prosecution

### Impact

- On an average, two cases are detected per day by approximately 8,000 cameras commissioned as on date, which helped in detecting and solving many cases of crimes like vehicle thefts and chain snatching. The number of case detections are likely to increase with the rise in the number of cameras commissioned on ground.
- Collaborative monitoring ensured a safe and secure environment, especially for the procession routes during religious festivals with zero crime reported in the last two years.
- It elevated the confidence of police officials and supported in fulfilling the objective of 'certainty of being caught and certainty of being punished'.
- There was immediate collection of evidence/clues within 24 hours for quick and significant progress in case resolution.
- Collaborative surveillance was one of the major contributors for bringing down crime by 14% in 2015 when compared to previous year.

## ***Case study: Voluntary code of practice - City and Industrial Development Corporation (CIDCO), Navi Mumbai (India)***

### Introduction

- CIDCO has implemented a CCTV surveillance system within the city of Navi Mumbai to support the Navi Mumbai Police in maintaining law and order, improving traffic management and attaining a faster turnaround time for crime resolution and investigations.

### Solution and key features

- This initiative aims to expand the city's surveillance by not only deploying cameras for law enforcement agencies in public places but also using the CCTV surveillance systems implemented by various private/public establishments like hotels, malls, theatres, hospitals, schools and railways. This not only improves the coverage within the city but also initiates a collaborative way of ensuring public safety.
- Across the city of Navi Mumbai, public and private establishments, including factories and residential societies, have already installed CCTV cameras within their jurisdiction, mainly covering indoor surveillance. The Navi Mumbai Police and CIDCO are hoping to create a collaborative framework for receiving video feeds from these private/public establishments.

### Key benefits to department

- Helps in appropriate and effective use of surveillance camera systems by relevant authorities
- Brings clarity and transparency to the businesses and general public on the intent and subsequent operational aspects
- Provides a framework to all the stakeholders so that there is proportionality and transparency in their use of surveillance
- Helps to ensure the systems are capable of providing good quality images and other information which is fit for the purpose
- Ensures scalability and interoperability of systems









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