Reimagining public safety operations

A next-generation approach for incident management

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Cities today are aspiring to become cognitive to enhance livability, creating memories and experiences that centralise the human experience. A key pillar of a cognitive city is the safety of its citizens, supported by the capability of its public safety agencies (PSA). Today PSAs still rely on traditional operational approaches to respond to an incident and are marked by limited data sharing, interoperability, and functionality.

Therefore, PSAs are seeing a need to adopt next-generation technology-driven operations that enable them to address complex incidents and thus meet the growing expectations of their citizens.

This paper outlines how the PSAs are currently leading the operations, some of the current challenges faced by them and the key accelerators that will further propel them toward next-generation operations.

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In the evolving landscape of public safety operations, the transformative force multiplier of technology is undeniable. Integrated Operation Centers (IOC) herald this evolution, facilitating unparalleled cooperation among agencies through seamless data sharing and unified situational perspectives.

The paradigm shifts toward ensuring functionality by harnessing advanced technology such as intelligence monitoring, immersive technologies and IOCs, coupled with cognitive insights correlation.

This paper delves into how cutting-edge technology is being applied to redefine the future of public safety operations, promising a secure tomorrow for all.

Scan to view the introduction video

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Introduction

In an era marked by rapid technological advancement and a shifting global landscape, the nature of public safety operations around the world is undergoing significant transformation. The traditional paradigms, built on foundational principles and practices that served communities for decades, are now being revisited, refined, and reinvented in response to the unique public safety challenges of the 21st century. This paper delves into the evolution of public safety agency operations, coupled with the technological innovations of the 21st century that are reshaping the future of public safety.

Historically, public safety agency operations have been grounded in a reactive model, responding to incidents and emergencies as they arise. But the multifaceted challenges of today, from cyber threats to urbanisation pressures, demand more proactive, integrated, and agile operational strategies. The complexities associated with these challenges not only test the capabilities of our traditional systems but also compel us to innovate and adapt in unprecedented ways.

> “Public safety agencies can maximise the benefits of emerging technologies by establishing a cognitive operating model”

Traditional public safety operations

Across the globe, traditional public safety agencies have largely developed incident response models that follow a similar theme. The following map visually represents this global trend, with focused references from the USA, UK, Finland, and Australia.

United States of America

The Police Executive Research Forum has developed a Critical Response Toolkit for First-Line Supervisors (FLS). This includes what to do **before a critical incident** such as investing in first-line supervisors by **preparing and training** them well before they encounter a critical incidents.

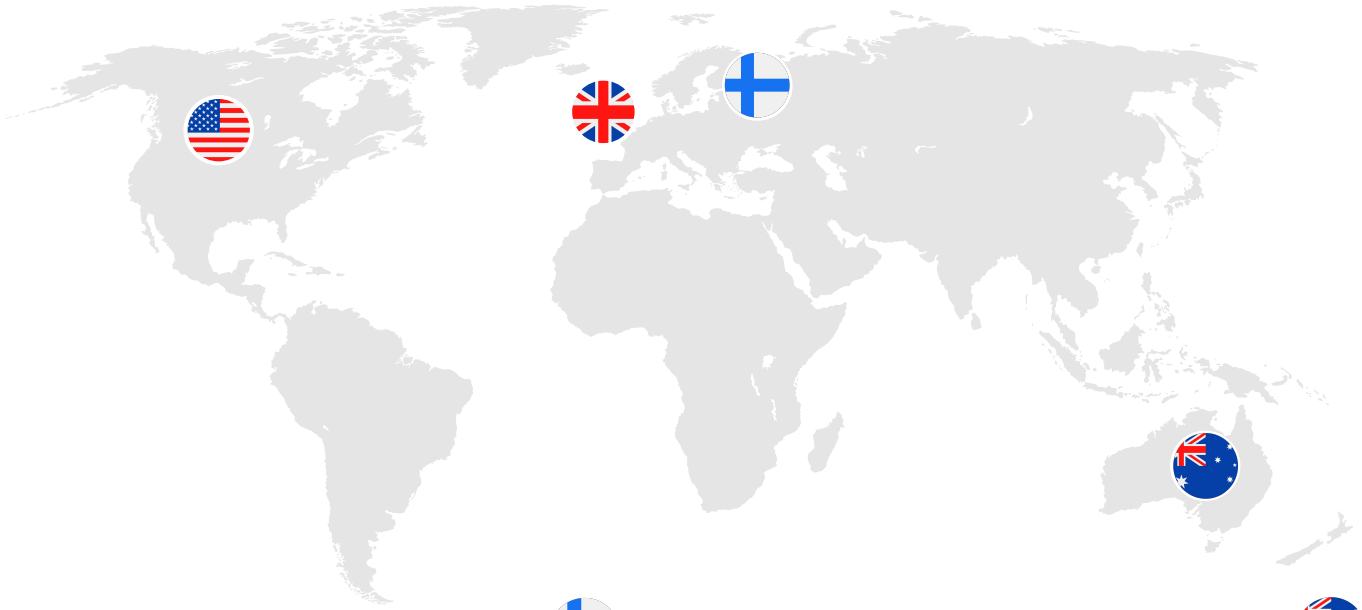
The next stage in the toolkit involves **managing a critical incident** and this includes several strategies for effectively managing a critical incident including **The Police Executive Research Forum (PERF) Critical Decision-Making Model.** The final stage is **post-critical incident** and this involves assessing how the response went and is essential for improving both individual and agency performance.

In 2017, the Las Vegas, Nevada, Metropolitan Police Department (LVMPD) adopted a series of interventions to reduce gang and gun violence across Las Vegas. LVMPD developed the Place Network Investigations (PNI) strategy which follows the SARA model (**scanning, analysis, response, and assessment**).

United Kingdom

The United Kingdom has pioneered a world-leading national approach to resilience and emergency response. Central to this is the **Integrated Emergency Management (IEM)**, a concept aimed at ALL responder organisations across the UK. This comprehensive approach encompasses six interconnected activities: **Anticipate** - focus on horizon scanning for potential hazards; **Assess** - analyse emergencies to understand their likely occurrence and impact; **Prevent** - reduce the likelihood or impacts of a crisis; **Prepare** - develop and validate emergency plans; **Respond** - address the immediate effects of an emergency; and **Recover** - rebuild and restore post-emergency.

The Joint Emergency Services Interoperability Programme (JESIP) is integral to this collaborative approach, which ensures effective collaborative working across these agencies.



Finland

In Finland, comprehensive security is the cooperation model of Finnish preparedness, where vital societal functions are handled together by authorities, businesses, NGOs and citizens.

This model promotes inter-agency collaboration, encompassing fire and rescue departments, medical services, police, volunteer organizations, and the public. Central to this approach is the integration of **prevention, preparedness**, and **communication strategies**. The model's objective is not only to **respond** efficiently to emergencies but also to **reduce incident risks** through **shared information** and **coordinated efforts**, ensuring a unified approach to both everyday incidents and major disasters.

Australia

In response to terrorist threats, Victoria Police in Australia have developed several current and future initiatives including SHIELD that aims to **Prevent, Disrupt, Protect** and **Respond** to terror incidents.

SHIELD focuses on increasing resilience in the Victorian community by building a strong security culture.

Another example of traditional public safety operations in Australia is ACT Policing which is the community policing arm of the Australian Federal Police (AFP). ACT policing comprises of two teams, 'Planning', and 'Emergency Management'. Each team works towards increasing the **preparedness** and **response capabilities** of ACT Policing for Major Events, Guest of Government visits and major incidents. Major incidents include, but are not limited to terrorism, natural disasters, health pandemics, recovery operations and crowded places.

Traditional public safety operations

In the realm of public safety, there's a longstanding Resilience Cycle, which provides the phases for emergency management that has been the backbone of public safety agencies worldwide. This traditional model is built on a systematic progression: starting with Anticipate & Assess to gauge potential threats, their probability and impact followed by steps to Prevent any adverse incidents. The Prepare phase ensures readiness, while the Response phase starts when an incident occurs, deploying immediate actions. Finally, the Recovery phase involves the restoration of essential services and communities following an incident. Together, these stages offer a comprehensive approach to assessing risk, managing and mitigating incidents.

This phase is dedicated to forecasting potential risks and challenges by analysing data, trends, and intelligence inputs. The goal is to understand possible future risks and their implications. This foresight is crucial in guiding subsequent phases and allocating resources effectively.

Focuses on proactive measures to deter or reduce the likelihood of threats materialising. This includes public awareness campaigns, security enhancements, and early interventions. Ensuring safety and mitigating risks are paramount in this phase.

Agencies establish plans, protocols, and strategies to handle anticipated threats. Resources are mobilised, personnel are trained, and backup plans are developed to ensure the best possible response in case of an incident. Collaborative exercises and drills are often conducted to test and improve readiness.

Represents the immediate actions taken to mitigate the adverse impacts of an emergency, safeguarding lives and infrastructure. This phase is characterised by rapid decision-making, effective resource allocation, and inter-agency collaboration, ensuring that the affected community receives timely assistance and a foundation for subsequent recovery.

Initiated post-incident, the 'Recovery' phase focuses on both immediate and long-term operations. Immediately, it aims to restore essential services and ensure public safety, providing a foundation for normalcy. Long-term efforts are geared towards restoring business-as-usual operations, rehabilitating affected areas or communities, and supporting victims. The 'Build Back Better' ethos is adopted to ensure the community is more resilient than before. Furthermore, comprehensive evaluations are conducted to draw lessons for future enhancements and improvement

Challenges with existing public safety operations

As the public safety landscapes evolve, existing operational frameworks are facing unprecedented challenges across strategy, operations and technology. Many agencies grapple with outdated legacy systems, disparate public safety platforms, and inconsistent operating procedures. Additionally, in recent times challenges such as staffing constraints, governance discrepancies, and cybersecurity vulnerabilities have emerged. The table below delves into these key challenges, offering insights into their implications for public safety agency operations.

Key Challenges

Strategy

- **Lack of specialized technical and operational resources -** Given the evolving threats, there is an urgent need to design, recruit, train and empower a committed, agile workforce for 21st-century public safety. Capabilities of existing workforce need to be assessed to make it 'fit for purpose'.
- **Limited innovation culture -** Public safety agencies generally rely on COTS solutions or third party partners for system customization. This hinders the adoption of emerging technologies.
- **Dispatcher skill-gap -** Call-takers can sometimes lack the tools and training to send the right response during high pressure incidents which is an inefficient use of public safety resources.
- **Outdated risk assessments -** With increasing hazards such as floods, wildfires and criminal activity; agencies that do not periodically review and update their risk registers struggle to ensure safe & resilient communities.
- **Non Alignment of strategy and budgeting -** Public safety agencies need to continuously revisit their strategic objectives for providing services to the society while addressing technology enabled challenges. Agile strategic approach aligned with a clear vision and mission should be key to important decisions.

Operations

- **Minimal interagency collaboration during incident response -** Major incidents always require a multi-agency response and there are challenges in ensuring seamless collaboration and communication across public safety agencies and jurisdictions due to different incident management tools and misaligned ConOps.
- **Slow adoption of regulatory implications -** Legislative changes affect public safety operations and agencies do not have an agile operating model to adapt to the regulatory changes (for example: changes in facial recognition rules must be incorporated in the algorithms).
- **Ineffective communication -** Traditional mission-critical systems lack QoS and extended coverage for remote, rural areas, satellite integration, deep indoor coverage, and national/international roaming.
- **Rigid Operating model -** Public safety agencies require lateral thinking and agile models. A key goal should be future-proofing public safety agencies with innovative operating models that appropriately prioritise demand and resources, boosting efficiency at the same time.

Technology

- **Disparate & siloed systems -** The lack of standardization and interoperability between public safety agency systems can obstruct seamless information flow, create data redundancies, and complicate inter-agency collaboration. Such fragmentation often slows decision-making processes and hampers the effectiveness of coordinated incident response.
- **Increased digital security threats** - With an increased reliance on digital tools, public safety operations are increasingly vulnerable to cyber threats, metaverse hacks, and data breaches.Thus there is a need for an integrated physical and cyber security platform.
- **Vendor locked solutions** - The proprietary, black-box approach from vendors is no longer acceptable in today's world. In fact, it has been shown that open source solutions can actually be more secure, although supply chains must be vetted carefully by PSAs. Systems needs to be secure by design and open to scrutiny based on global standards supported by a competitive, multi-vendor ecosystem.

Key global incidents impacting public safety operations

Hawaii Wildfires - 2023

In August 2023 wildfires devastated Maui killing over 90 people becoming the deadliest in modern U.S. history. The early warning sirens had failed to sound which impacted residents being able to evacuate before the wildfire swept through the island.

Suffolk Flooding - 2013

Areas in Suffolk had suffered devastating effects from the most serious tidal surge in over 60 years. The 2013 event highlighted the blurred lines between response and recovery and a need to adapt the initial recovery effort to reflect that.

Manchester Arena Bombing - 2017

A suicide bomber detonated an improvised device outside the Manchester Arena, Lessons learnt on the response indicated that fire crews took more than two hours to attend the scene due to poor communication and lack of a Common Operating Picture

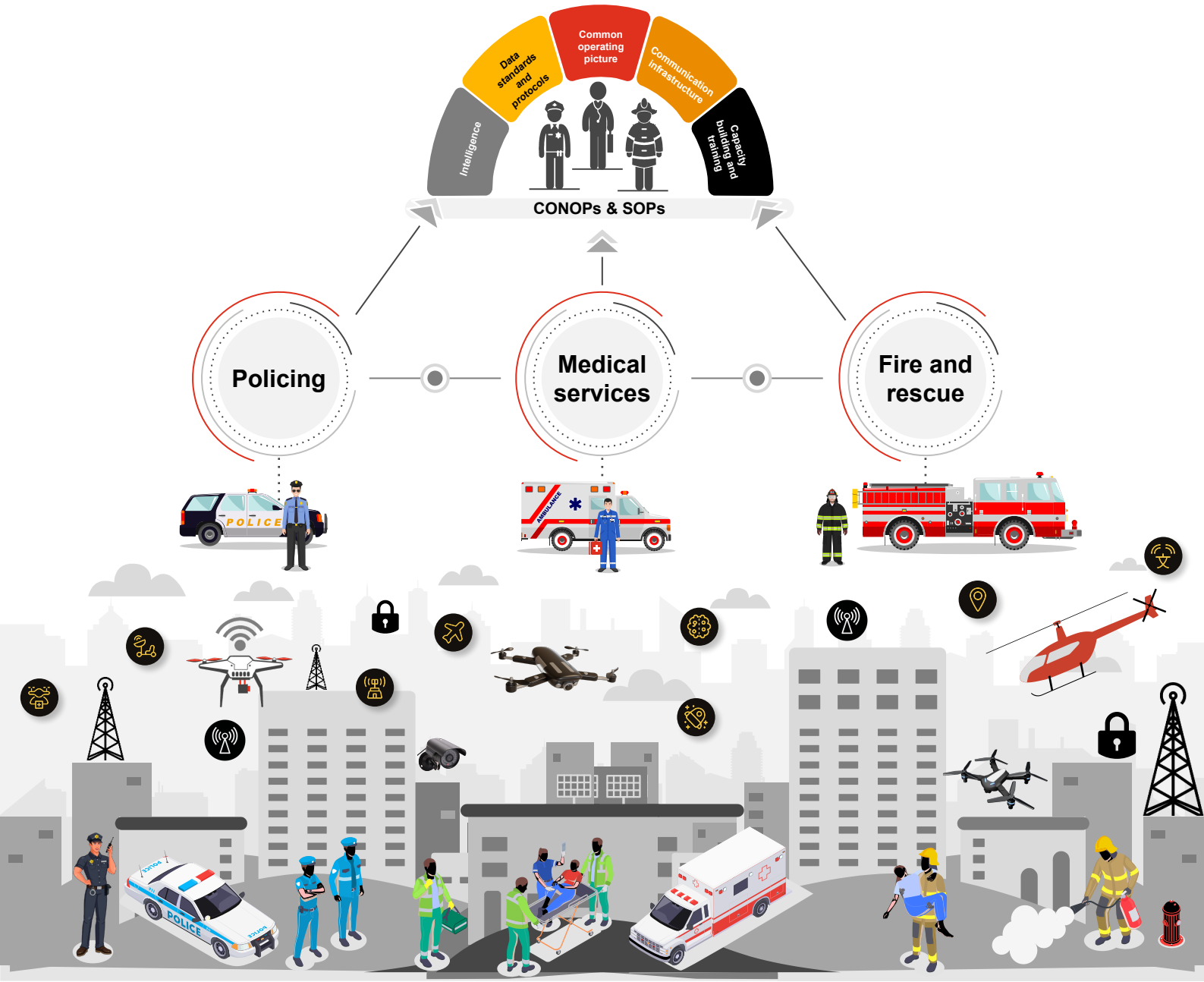
Hurricane Maria - 2017

Hurricane Maria, a Category 5 storm, struck Puerto Rico in September 2017, causing the death of approximately 2,975 people. The hurricane inflicted an estimated $90 billion in damages, making it the third costliest tropical cyclone in U.S. history. The emergency response agencies faced significant criticism due to delays in aid distribution, logistical challenges, and inadequate pre-storm preparations.

The changing landscape of public safety operations

Public safety operations have traditionally involved linear processes and systematic protocols. In the past, we've followed a step-by-step approach, where the phases of 'response' and 'recovery' took place one after the other. However, modern technology can enable these phases to operate concurrently, allowing a quicker, more effective initial recovery phase and changing how we manage crises. With the help of advanced analytics, real-time data, and modern communication tools, agencies can act more flexibly, swiftly and accurately. As we embrace tools like Artificial Intelligence, Augmented Reality, and Fusion Technology, this enables the integration with a diverse set of data sources allowing for real-time correlation to enable faster analysis of risk data. Public safety agencies will not only react to incidents but will also adapt and improve continuously, leading to faster and more effective public safety measures.

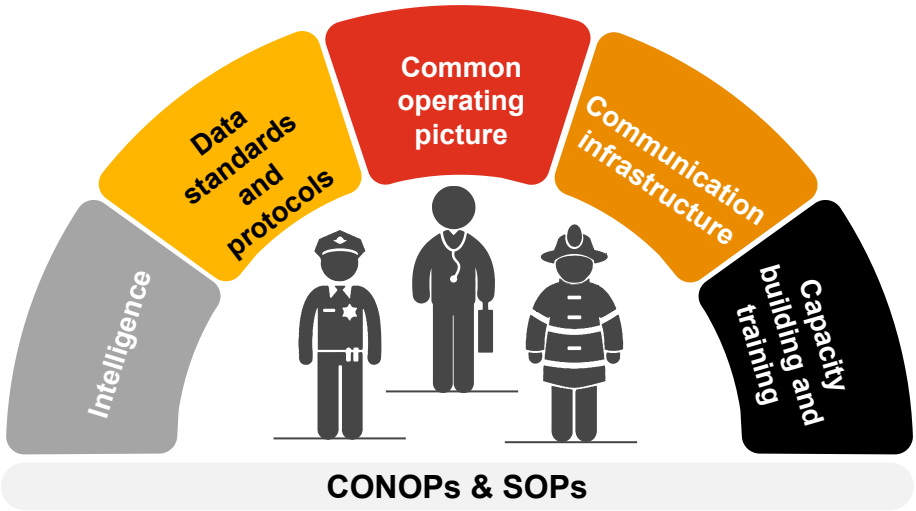
The illustration below captures the essence of a next-generation public safety operational fabric model as it weaves through a the public safety landscape of a city. It offers a visual journey of how intelligence, communication infrastructure, training, and other key layers seamlessly interlink the police, medical, and fire and rescue responder agencies. These interdependencies underscore the paramount importance of interoperability, ensuring that, regardless of the challenge, the city's safety mechanisms act in unison, enhancing efficiency and effectiveness in safeguarding its residents.



The changing landscape of public safety operations

Our proposed operational fabric comprises of several crucial components to redefine public safety operations. At its core, accurate intelligence guides decision-making. This is complemented by consistent data standards and protocols, ensuring unified and clear information flow. The common operating picture provides a real-time visual representation, enhancing situational awareness. Bolstering this is a robust communication infrastructure for seamless inter-agency interactions. All these elements are strengthened through continuous capacity building and training, ensuring personnel are always equipped with the latest skills and knowledge.

And anchoring this entire fabric, ensuring its coherence and functionality, are the foundational Concept of Operations (ConOps) and Standard Operating Procedures (SOPs)



Advantages

Enhanced situational awareness

Public safety agencies benefit from a unified perspective of ongoing incidents, ensuring effective decision making and streamlining multi-agency response operations.

Unified communications

With shared protocols and dedicated communication platforms amongst public safety agencies information exchange becomes efficient and instantaneous.

Harmonised operations

The implementation of holistic CONOPs across public safety agencies eliminates overlaps, and ensures coordinated response efforts and efficient incident management

Joint intelligence exchange

Fostering a shared intelligence ecosystem that empowers public safety agencies to seamlessly share and benefit from correlated insights for enhanced and proactive decision making

Continuous improvements

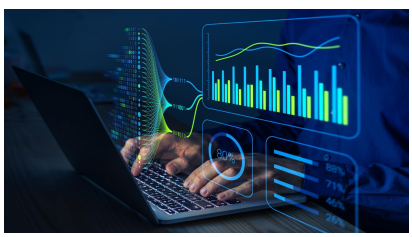
The built-in feedback and review mechanisms ensure that public safety agencies have the capability to constantly refine, evolve and learn refine based on real-world incident scenarios.

The changing landscape of public safety operations

In a world of evolving threats and challenges, public safety agencies must constantly innovate to stay ahead. A new public safety operational model comprising of "Predict, Pre-empt, Prescribe" considers a progressive approach to public safety that leverages advanced analytics, proactive strategies, and sustained prevention measures. This model represents a paradigm shift from traditional reactive methods to a holistic, proactive model. By accurately forecasting threats, intervening before they escalate, and implementing robust preventative protection measures, agencies can navigate the complexities of the modern landscape with enhanced agility and efficiency. This model doesn't just seek to address challenges; it aims to redefine the environment in which they arise, ushering in a new era of public safety. The illustration below provides an overview on each phase of the next generation public safety operational model:

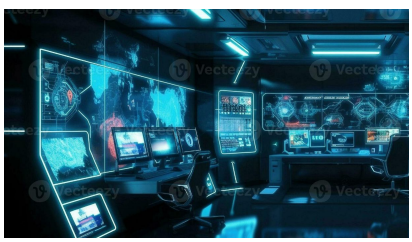
01 Predict

Through the application of advanced technologies like AI and machine learning, PSA's will have the capability to process vast amounts of data to identify patterns and trends. This technological prowess, combined with real-time data analytics, allows for the accurate forecasting and correlation of potential security & safety risks. By utilising predictive modelling, agencies can anticipate areas of concern ensuring they're always one step ahead of emerging threats or hazards.



02 Pre-empt

A proactive pillar in next generation public safety operations, placing emphasis on intervening before threats or incidents fully materialise. By leveraging real-time data analytics, advanced urban surveillance, and cognitive insights, this phase enables agencies to strategically deploy resources, initiate early technology interventions, and enact measures that deter or diminish the impact of potential threats. In essence, "Pre-empt" is about strategic foresight and timely action, ensuring a step ahead in safeguarding communities.



03 Prescribe

For this phase, public safety agencies leverage insights from predictive analytics and pre-emptive measures to outline specific, actionable strategies. This phase focuses on ensuring that the most effective interventions and resources are deployed, optimising outcomes and enhancing the overall efficiency of public safety operations.This phase also embraces continuous learning which is subsequently embedded into the "predict" and "preempt" phase. This ensures an adaptive, responsive, and ever-evolving approach to public safety.

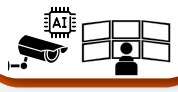
The changing landscape of public safety operations

Several weeks before a high-profile government conference there have been several suspicious security incidents throughout the city. Using the new public safety model of **Predict, Preempt and Prescribe,** we illustrate how public safety agencies can automatically detect unrelated security incidents, predict threats via pattern analysis and suggest proactive protection measures instantaneous via technology enabled force multipliers.

10:10 am: Border police screen a vehicle using a **non intrusive vehicle scanner** and detect a suspicious package with traces of explosive chemicals at a land border crossing

03:12 PM Unauthorised Drone **detected flying in the vicinity of the venue** that will be hosting the government conference

10:22 PMs CCTV with edge based analytics **generates an alarm of a group of people loitering** late at night nearby a hotel where a key government official will be staying during the conference



11:46 PM Open source intelligence **triggers insights from disgruntled citizens complaining** about recent government policy changes

Predict

On further pattern analysis it was ascertained **that a drone was also detected flying near a hotel where a senior government official** and undertaking reconnaissance of planned vehicle routes from the hotel to the conference venue.

Facial recognition technology detected a known criminal within the group of people loitering near the hotel.

Cognitive insight generated by the system based on **correlation of security alarms** throughout the city has identified that there is a **high probability of a protest during the upcoming government conference** with disruption to key routes from the hotel to the conference venue

Preempt

Based on the insights generated, proactive measures can be taken to mitigate against potential threats during the government conference:

01 - Concept of Operations (CONOPs)
Escalation of threat profile from **business as usual** to **heightened threat mode.** Increase in the number of vehicles screened at land border entries.

02 - Strategic Resourcing
During the government conference **Fire Brigade and Ambulance** services are strategically deployed near the hotspots to **minimise response times.** Traffic police are also deployed at key road intersections to ensure smooth traffic flow.

03 - Enhanced Situational Awareness
Deployment of **a variety of counter-drone measures** such as **ground based jammers,** to intercept rouge drones and **mobile command centres** to provide **on-site coordination** and **inter-agency collaboration** leading up to the government conference.

04 - Training Simulations
Utilise **XR/VR** to provide immersive training environments, simulating real-world scenarios for public safety personnel.

05 - Real Time Communication
Unified communication platform to foster **seamless** collaboration amongst public safety agencies (Police, Fire, Ambulance, etc)

Prescribe

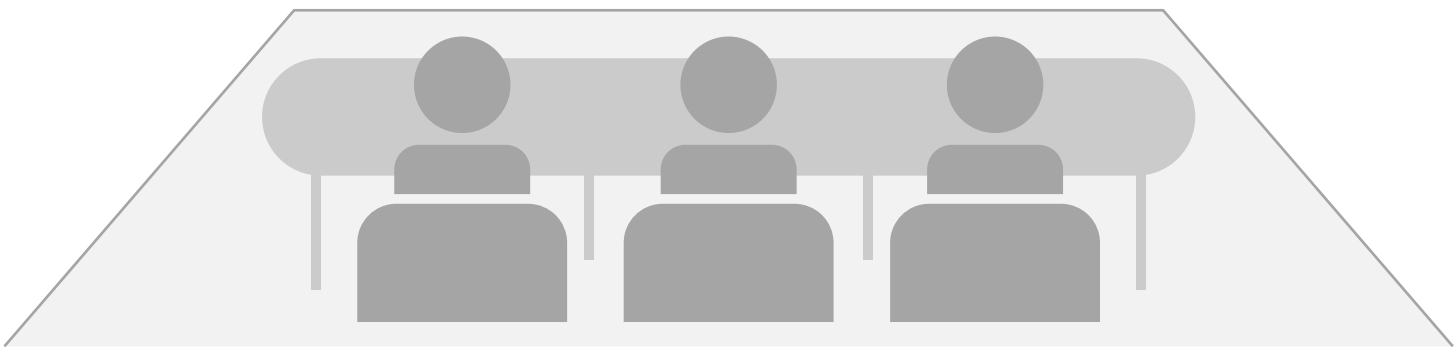
Adoption of actionable strategies for efficient incident response

01 - KPIs - Measuring the effectiveness and efficiency of prevention measures against agreed KPIs

02 - Inter-agency communication
High quality video and audio connectivity with the ability to transmit large amounts of data for seamless collaboration and coordinated action between agencies

03 - Decision Support Systems
Provides real-time recommendations based on situation data, assisting public safety officers in making informed decisions

04 - Public feedback mechanisms
Community engagement platforms used to provide feedback from the public that can inform and refine incident response strategies



The changing landscape of public safety operations

Based on the example scenario, specific futuristic technologies seamlessly align with the "Predict, Pre-empt, and Prescribe" model. These tools facilitate pinpoint threat anticipation, timely preemptive actions, and strategic prescriptions for optimal outcomes. The adoption of these technologies showcases the transformative potential for modern public safety operations.

Technology	Public Safety Operations			
	Predict	Pre-empt	Prescribe	Remarks
4K Multi sensor camera with embedded analytics	✓	✓	✓	With more pixels per meter captured by 4K cameras and high zooming capabilities, the multisensor camera can run several deep learning analytics simultaneous analytics for various use cases
Facial recognition (FR)	✓	✓	✓	Advanced FR algorithms assist in real time identification of persons of interest against a known watchlist and forensic search capabilities.
Social media monitoring		✓		Intelligence gathering and monitoring public sentiment across social media platforms
Counter-drone measures i.e Jammers, and spoofers		✓	✓	Detects and mitigates threats of unauthorised drones using different technology options
Unified communication platforms	✓	✓		Integrates multiple communication mechanisms such as mission critical communication, telephony and cellular network, streamlining interactions across various channels
Mobile command control center		✓	✓	Equipped with cameras, drones and body worn cameras integrated with a security platform via secure wireless communication. Can be rapidly deployed based on evolving threats.
XR/VR			✓	Enabling remote monitoring without physical presence and used to provide an immersive training and simulation experience to the first responders
Holographic display		✓	✓	Enabling instantaneous and simultaneous ‘live’ broadcast of public safety personnel
Community engagement portal			✓	Platform or channel for the public to log incidents and provide feedback on the public safety agency's response and operations.
Cognitive public safety platform	✓	✓	✓	Management of all public safety operations via a common operating picture

Accelerators for adoption of next-gen public safety operations

In order to accelerate the transition from traditional public safety operations to NextGen operations, key accelerators need to be adopted. These accelerators can be adopted as per the current state assessment of the Public Safety Agency (PSA) ranging from stakeholder involvement, ecosystem readiness, regulatory mandate, technology partners and other relevant parameters. To expedite the conceptualisation, design, implementation and adoption of the NextGen Operational Model, it is crucial to leverage key accelerators as shown below.

Accelerators

User-centric approach

Placing users at the center of the design process to ensure that their needs are taken into account, and the following are the key accelerators under this category:

- Motivated leadership
- Align user experience with requirements
- Immersive training and capacity building programs for users

Innovation in the DNA

Infusing innovation and creativity into the development and deployment to achieve optimality through leveraging emerging technologies, and the following are the key accelerators under this category:

- Setting up of Innovation lab
- Setup sandbox environment
- Proof of concepts and minimum viable product

Cognitive operating model

Leveraging emerging technology including AI to transform the service and capabilities of the public safety agencies enabling improved response, decision making and efficiency. The following are the key accelerators under this category:

- Delivery of futuristic services and capabilities
- Agile organisational structure
- Integrated CONOPs

Governance

Establishing a robust and comprehensive governance structure to oversee and manage the implementation, and the following are the key accelerators under this category:

- Establishment of dedicated entity / Special Purpose Vehicle (SPV)
- MOUs with different participating agencies
- Robust PMO setup
- Framework for KPI and SLA monitoring

Repurpose over recreate

Reducing costs by renewing existing systems rather than building new ones, and the following are the key accelerators under this category:

- Leverage lessons learnt from others (leading practices)
- Repurpose existing use cases over create
- Adoption of open international standards
- Leveraging proven design/ simulation tools

Conducive environment

Ensuring the availability of a favourable environment for all the needs of the implementation, and the following are the key accelerators under this category:

- Enable wider tender participation
- Ensure market scan / Expression of Interest (EOI) prior to procurement initiation
- Adoption of open international standards

Collaboration

Fostering the participative efforts of all involved stakeholders from all relevant sectors, and the following are the key accelerators under this category:

- Deployment of a PPP model
- Co-creation with industry players
- Leverage global expertise
- Alignment with regulators

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