Hytera

Technical whitepaper

Harness Advanced Push-to-talk to Transform Physical Security Operations

www.hytera.com

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1 Executive Summary

Hytera's mission is to develop the future-proof solutions with a holistic approach to your critical communications system and service needs, support public safety agencies in making the city safer, and enable security organisations to keep the enterprise more secure and ensure the safety and security of responders and staff, through driving more efficiency, effectiveness and productivity to operation and management of both daily operations and critical emergencies, while reducing the cost.

Drawing on the experience of next-gen mission-critical convergence native ecosystems, we are releasing this white paper to highlight a detailed list of physical security requirements and our insight for the future, demystifying Hytera's comprehensive security solution together with a unified collaboration enterprise platform, helping you create advanced communication systems, making a shift to digital transformation, enabling automation and intelligence.

Our teams stand ready to provide you with a world-class product portfolio, services and support, and cutting-edge innovation and creativity. In addition, our trained technicians and professionals have extensive public safety and security network design and system integration expertise. We are committed to working closely with your professional to ensure that your problem is appropriately addressed and real needs are met well into the future.

Our wish is to build a long-term relationship, providing you with the certainty that ongoing next-gen critical communication systems are functioning at their optimum level.

Thank you for your reading.

Gerald Zhang
Director of Global Marketing and Solutions
Hytera

2 Introduction

The modern security services industry involves patrolling, protecting, screening, watching, or guarding people and property with a crowd, event, or venue, controlling and bodyguarding or close personal protection services through physical or electronic means. Security services generally consider three aspects as follows when accessing and managing security risks:

- The security and safety of employees, visitors, and others associated with their operations.
- The continuity or ability to continue business without interference.
- The protection of assets, which can be physical or intellectual property.

Over the past two decades, corporations and agencies worldwide have dramatically changed, evolved, and progressed in enterprise security. However, the threat landscape has continued to evolve and widen in a myriad of ways: cyber-connected risks into enterprises, ever-increasing attacks on soft targets such as schools, theatres, and houses of worship, pandemics, various types of natural disasters, social media threats and disinformation, data privacy issues, social movements leading to civil unrest, sustainability concerns, globalization of teams and functions, various new laws and regulations, and so on. To adapt to this constantly changing world and to combat threats, security organizations need to take a more macro-level view of the risk and physical security technologies and incorporate enterprise security management into their major infrastructure in a broader, deeper, and more revolutionary way now than ever before.

3 Key Trends of the physical security transformation

In the digital era, while many industries have fully embraced the digital revolution, the physical security industry has been faced with overwhelming challenges due to a lack of using digital technologies. Much physical security still relies on analogue, labour-based solutions that can't keep up with today's complex and sophisticated security threats. To address the unprecedented growth needs for an effective, adaptable, and extensive security posture for years, it's time for physical security teams to make a change to embrace new digital transformation technologies with the following trends. This new shift will create a massive new market opportunity in many sectors.

3.1 Cyber-physical threats and enterprise transformation

Going beyond guards, gates observation, and reaction, analytics, and access control, a future-proof security transformation initiative needs to fully align with enterprise strategic priorities and emerging technologies to build a more robust system, adapting to arising critical events and preparing for unpredictable future crises, because business continuity is everyday concerns for all enterprises. Therefore, delivering a successful security digital transformation can complement enterprises' big digital transformation across entire organizations, as it often comes with automation that enhances security and benefits the whole enterprise's strategic, operational, and financial performance beyond pure security. Another point of consideration, digital transformation needs to connect people, facilities, assets, processes, technologies, and more to improve business performance. The overlap of physical security and cyber security coupled with the mobile technology revolution and the proliferation of IoT brings a whole host of risks and vulnerabilities to threaten the enterprise.

We are better protected when the right resource is in the right place and with the correct information. It highlights the need for agile, adaptive, data-driven security executions and practices to uphold automation and strengthen operational efficiency and resilience to support business sustainability and profitability for the enterprise. Physical security digital approaches must be developed with networking, automation, and mobility, where IoT, AI, and mobile broadband are the leading platforms.

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1 A proactive approach to address threats needs to combine emerging technologies and advanced solutions to address risk-related issues within the enterprise, aligning with security program shifts and organizations' core business objectives, identifying warning signs for both types and motivation of potential threats and providing predictive and preventive measures.

2 While physical security continues to expand in scope and scale, networking and management are essential priorities to undergird many aspects of systems, such as access control, video surveillance, visitor management, communications, and more sensors, all of them available for cloud services, unlocking new scenarios by moving security processes from being reactive to becoming fully automated.

3 One powerful shift that has occurred within enterprise security programs over time is an expansion of the role of intelligence. Adding or expanding intelligence capabilities can help enterprises efficiently combat combined cyber-physical threats and automate the process through machine learning AI technologies that process a massive amount of data and deliver actionable insights.

4 As the pandemic continues globally, companies have increasingly explored hybrid and remote work modes with a massive surge in mobile and remote workers. Ensuring safety and security without impeding employee productivity and supporting organizations' communications with improved flexibility and contextual awareness is essential to secure business and operational continuity, undoubtedly accelerating the adoption of PTToC during and after Covid-19.

Diving into these technologies and approaches, security organizations worldwide have been working on digital transformation initiatives to adapt and adapt to ahead of escalating threat levels. A blueprint is established through digital technologies, delivering protection capabilities that are highly integrated with their physical environment, including security operation centre (SOC), video-centric IoT and advanced communications along with automation.

3.2 Advancing security operation centres (SOC) with automation and intelligence

While threats are increasing and risks are becoming more diverse, security operations continue to grow, involving more systems, data, and users within enterprises along with digital transformation. It implies the demands for combining digital and physical capabilities, such as sensors, alarms, and cameras that send data to SOC centres. The new SOC, built on foundational blocks of personal connections, security processes, and technologies, aims to evolve from a traditional reactive system to a modern proactive approach that helps to prevent or minimize emergencies before they happen.

However, managing and controlling many of these things can be daunting, particularly when a critical event unfolds and information floods the organization. Therefore, delivering the right information to the right people at the right time is crucial to protect employees and facilitate operational continuity. As siloed processes and lacking interoperability hamper the effectiveness, the modern SOC needs to correlate events from disparate security systems into a common operating picture with richer context and real-time situational awareness, where threat intelligence identifies emergent threats faster and responds in real-time with automated impact assessment and warnings, and intelligence analysis gathers contextual information about an unfolding event or clarifies details to understand potential impacts, so security services can act more proactively.

A comprehensive platform that integrates a wide range of disparate systems and connects many IoT devices is essential to facilitate data collection, analysis, delivery, and communication while simplifying software development and increasing automation and intelligence. However, digital assets introduce more threats to enterprises than ever before, driving new SOC to take an array of measures to support enterprises to adapt to new threats while protecting their perimeters, including immersing in a sea of digital data, refining pattern recognition, leveraging innovative artificial intelligence and developing meaningful analytics and threat intelligence.

As cybersecurity was born inherently digital, digital cybersecurity and physical security are inevitably combined through a converged common operating picture at SOC of all levels, ensuring security operations deliver consistent treatment of incidents, emergencies, and crises. A new vision with digital architecture is emerging, where cyber threat intelligence, prevention, and physical security threat intelligence will be on the same platform, which makes it possible to share data and achieve complete context awareness, help to proactively manage risk and respond to potential incidents quicker in a more informed manner, and avoid human errors.

3.3 The progression of video security technologies

Situational awareness has been at the front of security programs. Video surveillance and video analytics are the main security tools that organizations always prioritize to ensure the safety of people and keep premises secure.

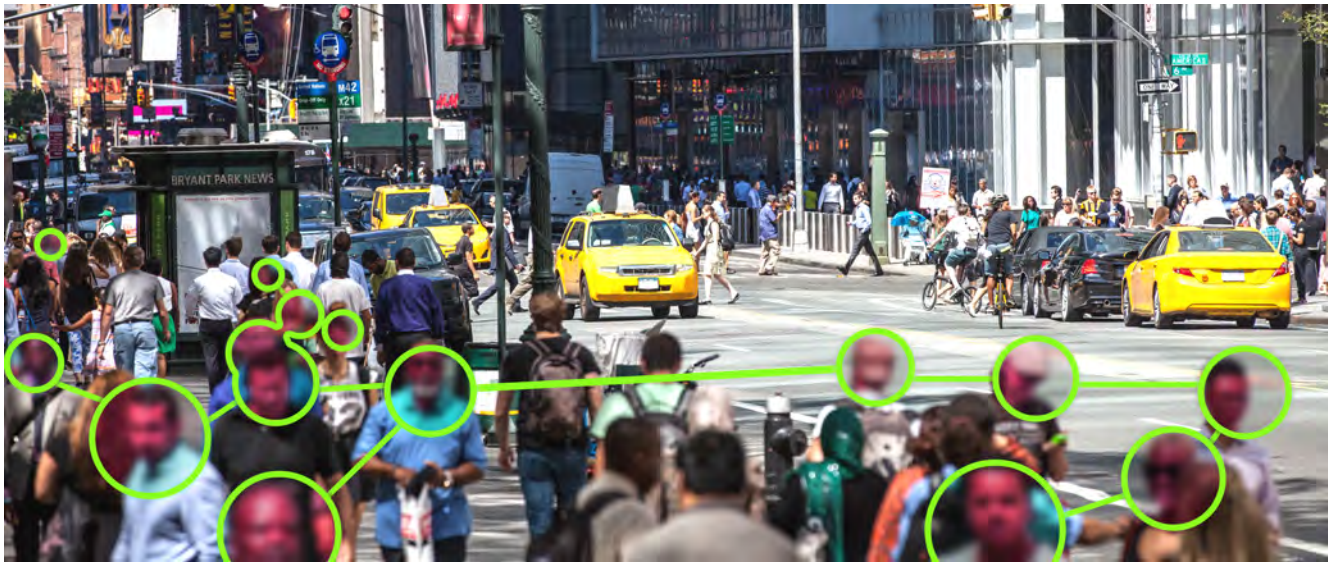
Cameras' resolution, mobility, and durability have improved dramatically over the years. Video analytics algorithms transform the raw data from field sensors into actionable information, sending real-time notifications when suspicious actions, people, vehicles, other objects, and masks are detected. Once notified, security operators can quickly take steps to minimize the risk of exposure, improving response times to incidents and efficiencies as supervisors don't need to watch every camera feed at all times. Thermal imaging identifies people with elevated body temperature and touchless security screening as part of the social-distancing process; visible light cameras could gather the imagery needed to count visitors, estimate visitor demographics, and identify visitors as employees, VIPs, or known threats.

Monitoring a remote area or an on-patrol lone worker can help keep enterprise businesses secure by tracking their routes and locations throughout the shift and allowing them to create threshold incident reports with photos or videos uploaded to security offices in real-time. Drones are helpful for large and remote areas, which can vastly improve surveillance capacities by seeing the way out past the perimeter and play a vital role in deterrence. Ground-based mobile robots with specialized functions detect suspicious objects that may put security personnel at stake. Incident responders can also use mobile phones or body cameras with built-in apps as a camera on the video platform, essentially becoming "mobile video cameras" to help SOC better understand an incident.

The advancement of deep learning and edge computing technologies enables a range of applications with higher accuracy and efficiency, such as facial recognition, automatic number plate recognition (ANPR), heat mapping, motion, line-cross, and object detection. It allows security teams to initiate faster and use a more precise response with less workforce.

Facial and license plate recognition are used to identify people and vehicles in real-time and make appropriate decisions, for example, searching a target from stored footage through a range of physical descriptions, a security management system recognizes authorized personnel and grants access to a secured facility. Crowd management is another key function of using innovative video analysis tools to analyse crowd flow to trigger alerts when a crowd count reaches a threshold or detect movement in unwanted or prohibited directions during emergency events. Intelligent video content analysis systems are trained to detect specific circumstances, such as detecting smog and fires for prevention and rescue, unusual motion detection, revealing untypical events that need investigation, and alerting when someone enters a forbidden area for intrusion detection and unattended baggage.

All these insights enable proactive monitoring and management across the enterprise and respond to suspicious behaviour before an incident occurs. Organizations of all sizes across all industry sectors have recognized the benefits of keeping their premises safe and secure with video surveillance.



4 Modernizing physical security through the implementation of advanced communications

More than ever, the ever-changing and unpredictable security environments such as the COVID-19 pandemic, frequently dangerous, disruptive events, dispersed workforces, and open spaces bring out a new level of challenge and drive the demands for implementing new communication solutions to embrace digital technologies. Traditional radios are the predominant communication tools and face challenges in the digital era, like losing range, not sending pictures and text, having no integration with other systems, limited mapping, and more. Therefore, communication modernization is essential to digital strategy, allowing enterprise and security organizations to discover various intelligent tools, empowering security services with advanced capabilities, and creating connected teams.

4.1 Leveraging two-way radios and hybrid radios for digitalization

Along with the new expansions on broadband LTE and MCS in the public safety sector, the voice has always played an essential role. The digitalization of two-way radio has been ongoing for years to support mission-critical communications as PMR continues to improve and expand. The consensus is that public safety operations will rely on a hybrid PMR&LTE network that can be enhanced through convergence innovation towards next-gen MC communications. Similarly, two-way radios will remain necessary for security and industries to connect teams with reliable communications for safety, security, and operational efficiency.

As public safety agencies have been confronted with a constantly evolving array of threats with wide-scale emergencies and staffing shortages brought by the pandemic, there are growing demands calling for more close ties between private security and public safety. As security teams become more highly professionalized, like armed response teams, public safety professionals and first responders could leverage their on-scene awareness as a vital force multiplier to de-conflict potential problems via a joint response. It is imperative to create interoperable communications to bring them into one communication loop to respond to the same incident, enabling seamless cooperation and coordination. Therefore, PMR remains indispensable and works closely with LTE during the long transformation journey towards next-gen MC communications.

When detecting an emerging situation at an early stage, the security teams need to initiate instant communications with public safety teams to get their immediate support to mitigate the risk of the situation evolving towards a dangerous incident or response to an emergency. That's where voice can play a critical role, as voice can convey important and clear messages that a video surveillance camera or SMS or access control cannot, and can effectively communicate in the way of group interaction with high efficiency. In addition, integrated two-way radios and critical communications give security teams a reliable solution that essentially adds "ears" to "eyes", especially during emergency response.

In various sectors, such as hospitals, utilities and transportation, staff rely on radios to communicate with security teams to de-escalate situations and facilitate operations across the

departments within an enterprise. Likewise, stadium and hospitality security staff need clear and loud communications across the entire premise to manage crowd control and daily operations. In contrast, commercial networks are often confronted with heavy usage with a higher probability of congestion during the venue's full capacity. Therefore, with dedicated frequency bands and strong signal penetration, two-way radios remain a trusted source for critical and real-time communications, even fallback to off-network mode with DMO during an emergency.

With the advent of digital technologies, two-way radios have transitioned globally from analogue radios to digital mobile radio (DMR) and private digital trunking (PDT) that are cost-efficient and affordable, particularly for security industries. Based on Hytera-OMDIA joint research for next-gen MC communications with a released white paper, the global PMR shipment market expects to grow to $6.3B by 2025 (from $5.2B), in which 80% of worldwide MCC active radios will be digital by 2025. Based on the "gold" open standards, digital radios increase the benefits of two-way radios through a wide range of far-expanded capabilities and optimal spectrum utilization, including delivering better voice quality by eliminating background noise, adding data services for messaging and packet data applications for SCADA, providing wider-range coverage by improving uplink via multi-receivers, offering longer battery life with higher power efficiency, being able to hear and understand easily even in a loud and rough environment.

Along with evolving to broadband communications like push-to-x services while simultaneously remaining essential DMR voice-centric communication, especially during emergency response, a variety of hybrid-mode radios (i.e. converged radios) with all-in-one designs are available and combine different radio access technologies, including PMR, LTE, and Wi-Fi without having to carry multiple devices, delivering converged blend applications with the consistency of users experiences. Leveraging the benefits of extended connectivity, seamless mobility, and rugged design, converged radios can better support security organizations in keeping up with this immense wave of digital transformation whilst simplifying the implementation, withstanding rigorous conditions, and ensuring security staff gets their jobs done anytime, anywhere.

4.2 Prioritizing enhanced PTToC to improve security operations

While replacing legacy radios, advances in broadband can dramatically address the issues, solve problems and radically lay the foundation for digitalization, enabling geographically distributed teams across different functions to collaborate and work dynamically by empowering them with multimedia communications, intelligence tools, and seamless connectivity via a cloud-enabled collaborative platform. These new capabilities deliver frontline teams a complete approach to their operation and offer advanced SOC with a single view, real-time data with rich context, and centralized management to increase situational awareness and improve overall productivity and safety. In general, fast, reliable, and secure communications are essential for a modern security organization, together with several advances for future-proof digital security operations, which are described in detail as follows:

4.2.1 Seamless connectivity and interoperable communications

Security operations might be conducted anywhere: in campuses, large stadiums and entertainment venues, enterprise workplaces, manufacturing factories, oil and gas production, refinery, and more places. Therefore, security teams must operate across geographically distributed places-local, regional and remote areas and even have international duties, reacting and responding to dynamic and urgent situations anytime. Addressing such a wide range of complex scenarios is an increasing challenge to security organizations. New advanced connectivity solutions are driven by such strong demand over time to deliver security teams real-time, seamless, reliable communications with their SOC no matter where they are.

Digital radios and PTToC (Push-to-talk over cellular) technologies enable response teams to instantly and efficiently communicate through specific group or organization-wide calls, which is critical to ensure personnel receive relevant information during incident response. They also allow incident responders to add any security team members to the talk group to work together during emergency response, bringing in first responders like police, fire, and EMS through an interoperability approach that supports broader collaboration across organizations.

4.2.2 Advanced PTToC services

Range coverage is a primary issue for team communication. However, the number of floors, stairwells, and walls often affects radio signals. Consequently, communication in places like concrete parking garages is often limited, and analogue radio audio quality is poor, making it harder to distinguish voice which is crucial to critical communications. In addition, the continuing pandemic impacts enterprises to remain high rates of hybrid work and remote work, significantly emphasising remote operations. With the strong and urgent need to deal with pandemics and a succession of emergencies, enterprises and security organizations are exploring advanced systems to organize and coordinate staff better and improve emergency preparedness and response, which dramatically drives the adoption of PTToC as well as a cloud platform.

Along with PTToC getting maturity and evolving through a standardized approach, LTE-powered high-performance cellular networks and ubiquitous coverage provide the fertile ground for satisfying and boosting its massive adoption and an array of implementations with rich features and values to end users across public safety and industries. Globally, PTToC technology has primarily gained popularity as a new PTT solution in the security sector as it can address the issues and meet the demands. Advanced PTToC solutions can combine the best of two-way digital radios and LTE broadband in support of key DMR features, including messaging, instant group calling, GPS location tracking and emergency notifications, and introducing new push-to-data and push-to-video services. Leveraging MNO's LTE infrastructure and enterprise Wi-Fi access, PTToC enables the creation of extended connectivity and nationwide broadband services, supporting hybrid connectivity through integration with two-way radio.

With these advanced capabilities and higher cost-efficiency, PoC offers a compelling alternative to traditional two-way radios directly, allowing users to untether from expensive infrastructure, including repeaters, base stations, and radio frequency licenses, so that organizations can better prepare for the future. In many cases, PoC deployments are a great way to augment and expand the capabilities of DMR systems, and interoperability can be a challenging issue during the transition that uneeds to be urgently addressed.

Encryption is non-negotiable for today's security communication, allowing only authorized team members to access sensitive information, whilst voice first and its E2EE are fundamental for secure communications without limiting functionality or inhibiting device operation.

Advanced recording and storage can support operations to function well, capturing and storing all critical voice, SMS, and multimedia information across different networks for review. In addition, advanced tools that combine query, statistical analysis, and playback ensure accountability and increase productivity through actionable insight and digital reports for security organizations.

4.2.3 Advanced location services

Location-based services play an increasingly important role in security services in the era of the mobile age. High accuracy and real-time location positioning are essential to dispatch frontline security staff precisely and faster, particularly in indoor and urban areas where GPS performance tends to be poor. Advanced location services coupled with Geographic Information systems (GIS) enable the development of a variety of applications that help improve positioning, location tracking and navigation accuracy, efficient field data collection, real-time mapping, ground truth validation, location intelligence and decision support. These capabilities empower security leaders with an ability of invisibility - "what you see is what you get", allowing them to have a complete view of real-time operations, including staff location, team preparation, routine patrol, and asset tracing. Geo-fence and location-based workflows prepare for the arrival of an executive at the office or check guard locations for a set amount of time. Combining centralized visibility, location awareness and workflow support security organizations with assured accountability, improved oversight and enhanced decision-making. Resilient wireless networks ensure reliable location data transmission and always-on communication with field teams and distributed personnel working in dynamic environments.

4.2.4 Automation enables improved efficiency

Artificial intelligence technologies, such as video analytics, voice AI bots, and alerting automation, have become prevalent. By exploiting the powerful abilities of AI, a complete system can help security organizations automate and streamline the whole process through the synergy of integrated access control, sensors, video surveillance, analytics, and communications systems, ensuring the flow of information to the right people across the enterprise by monitoring facilities or visitors, triggering workflow via real-time automatic alerts, noticing SOC and delivering actionable information on security staff's devices for quick response.

Many tools are used to support operational automation, improving overall efficiency, productivity, and safety, creating new ways of interacting and collaborating, and allowing staff to respond more quickly. For example, digital two-way radios can receive message notifications directly when detecting an unauthorized attempt to access secure areas or doors propped open. PTT integrating industry-specific AI tools can help teams augment situational awareness and improve efficiency by responding to voice inquiries, commands, events, and actions. Staff and workers' safety is imperative. Man-down emergency data can automatically trigger alert management workflows, indicate staff's location, and escalate to the local fire and police bureau. Field staff can receive critical alerts when sensors detect hazardous gas and rapidly react through integration with sensors. Geo-Fencing triggers an alarm when guards enter dangerous areas or mobile patrols stray from defined territories.

4.2.5 Mobile device management (MDM)

The sheer number and diversity of devices and flooding applications drive the need for managing devices and users in a consistent and scalable way, which motivates MDM solutions to increase device supportability, security, and corporate functionality while maintaining some user flexibility. A comprehensive MDM solution can help enterprises and security organizations to manage and secure fleets of devices, including mobile phones and a variety of professional devices, even digital two-way radios, also control apps, content, and security, including initial configuration, remote software installation and update, monitoring and tracing devices (e.g. location, status, ownership, and activity). A Contemporary MDM also needs to provide the SDK tools to support cross-platform, extending the capabilities of enterprise Device Management (DM) for not only enterprises devices but security departments' devices and BYODs. By leveraging centralized MDM, the supervisors in SOC easily use a unified console to control and enforce policies "over the air" to configure, wipe, and even lock devices remotely and efficiently diagnose and troubleshoot devices remotely throughout their lifecycle, increasing productivity and ensuring security.

4.3 Seamless integration of broader systems

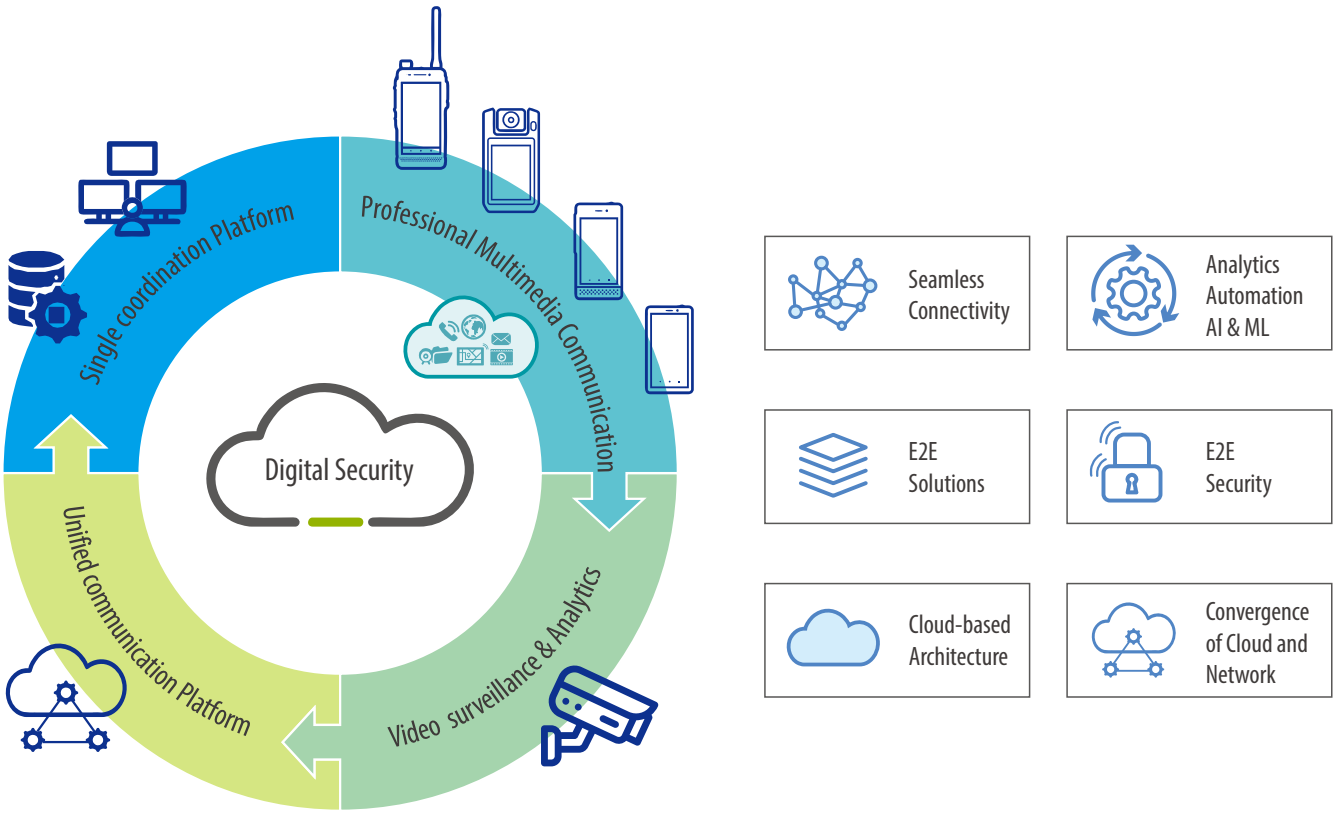
Security industry modernization programs are used to use process and technology as a force multiplier before, aiming to make security capabilities smarter and more effective. However, physical security is a people-intensive business. At the same time, companies continue to operate throughout the pandemic. Therefore, a rapid shift to reducing labour-intensive processes and digitizing workflows is ongoing by eliminating the inefficiencies of managing siloed systems through seamless integration, aiming to mitigate digital gaps and increase efficiency and effectiveness. As a whole, the fast-growing interest in new digitalized security projects around the world has accelerated demands for system integrations over the years.

These needs sophisticated approaches to create a flexible and reliable cloud-based platform that converges video and advanced communication systems. These systems generally include video security systems, communications systems such as wireline, intercom, PoC and two-way digital radios, and command-and-control systems, with the broader integration of a wide range of IoT systems such as touchless access controls, gunshot detection, fire detection with HVAC, lighting and other environmental systems for remote monitoring and operation. External information resources provide weather, traffic, civil incidents, and demographic information to add context to the captured site-specific data. These technologies converge together to collect and deliver a continuous deluge of data. AI-powered analytics is layered over the integration system to support the ability to turn data into timely and actionable insight, advancing central SOC and edge systems with a new level of intelligence and automation.

Two-way digital radio and PoC support push-to-talk, one of its most appealing aspects is simple interaction by pressing one button when activating a call, making tasks easy and collaboration quick. In addition, system integrations enable the synergy of voice and other applications, such as allowing team members to use voice assistance to control data and video applications, simplifying operations and improving efficiency, and streamlining the workflow via PTT triggered by sensor alerts and security cameras with enhanced emergency response.

5 Hytera innovations transforming the digital security experience

5.1 Creating a collaborative and convergent ecosystem



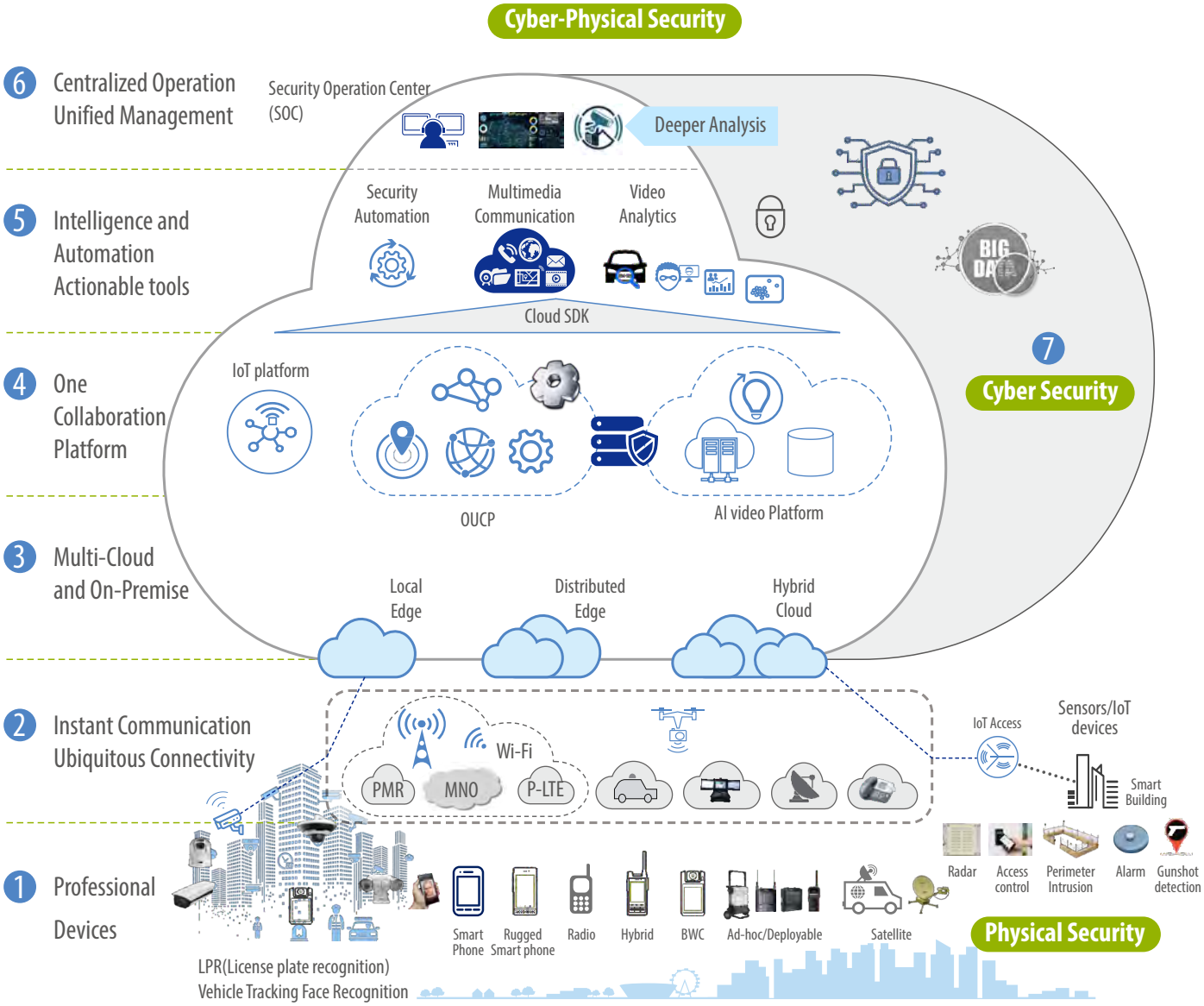
Hytera convergence technology ecosystem pave the way for the digital physical security solution

Harnessing modern technologies and cloud infrastructure, Hytera has developed innovative software and hardware ecosystem for public safety, security and business-critical industry. Drawing on the experience of next-gen MC native convergence solutions, Hytalk Pro is an advanced, flexible, and scalable platform tailored for the security industry, aiming to help security organizations around the world to overcome their challenges and address current and future demands, achieving significantly improved operations through converged multimedia communications and actionable tools. The solution also helps customers across industries to advance SOC with a consolidated view of resources across networks and deliver fast and reliable communications to security teams during day-to-day operations and emergency response wherever they are.

Modernizing communications is an essential step in digitalizing security systems and operations. With one single collaboration cloud-native platform, a comprehensive OUCP, and a variety of professional devices, Hytalk-Pro innovatively modernizes communications along with seamless connectivity, cloud-based architecture, centralized control and management, and multi-layered security with E2E encryption. Through seamless integration with partners' video security system, which plays a powerful role in helping enterprises understand rapidly evolving safety and security situations, we jointly create a complete convergence ecosystem, which unites voice, video, platform, software, and AI to reshape the security capabilities. Enterprises will increasingly rely on advanced mobile radio technologies, mostly broadband LTE and 5G, to bring IT and IoT together and further converge IT, CT, IoT and operations (OT). The future-proof solution also supports enterprises as they plan for long-term digital transformation, helping them to streamline workflow and embrace automation throughout the enterprise by simplifying the integration with other systems and avoiding information silos. We bring technologies and innovations together to make the following possible:

- Instant voice and multimedia communications across a range of professional devices to connect teams reliably and seamlessly across functions with no range limitation, regardless of the environments they are located.
- Fixed cameras video surveillance together with body cameras powered by machine learning innovation and intelligent video analytics to fully sense, quickly identify, track, and make real-time alerts across widespread areas with no blind spot.
- A sophisticated open unified communication platform (OUCP) makes it easy to integrate with various 3rd-party security systems and video-centric IoT systems and interconnect with disparate communication systems, including legacy radios.
- Single collaboration and a centralized management platform with complete visibility and unified dispatching of all resources enable the creation of an advanced SOC with one common operating picture for everyday business and emergencies.

5.2 Multi-layered converged digital security architecture



Multi-layer Convergence Architecture enable Digitalizing Physical Security

The security industry is on its way to modernising its networks to enhance operations and ensure safety, along with digital transformation within enterprises. Hytera delivers an advanced communication solution for security organizations with seamless connectivity and instant multimedia communications. Through working with our global partner in video security, we create a unified CT/IT/IoT/OT collaboration ecosystem and develop several new digital initiatives through the seamless convergence of video security and communication systems for safe city and security industries around the world, aiming to help customer tackle their challenges, enhance cooperations, mitigate security risks, ensure better safety and enable automation and intelligence, and eventually improve efficiency, effectiveness, and productiveness. In full alignment with customer service, we develop the following unprecedented capabilities by combining our particular insights and sustaining innovation to create an open and multi-layered architecture and deliver comprehensive best-in-class product portfolios in the most suitable way for customer operations and well positioned to address the challenges today and in the future.

- Leveraging dispatch system SmartOne, all-in-one management and metadata technologies, the integrated security operation centre (SOC) solution aligning with 3rd cyber security solution provide security organizations with a converged operating insight, improving collective situational awareness with rich context across domains, comprehensive collaborating through unified dispatch of all resources with full visibility, reducing risk by 7/24 automatically monitoring and streamlining workflow, getting ready for prevention and response to risk, critical events, emergency, and disaster preparedness.

- By continuously exploiting the new capabilities fueled with AI and the deep learning algorithm, video analytics, OTT PoC, and push-to-x enabler layered over the convergence platform create a number of intelligent tools and blend multimedia features for SOC and security teams, enabling automated processes and embracing enterprise digitalization with promoted productivity and effectiveness.

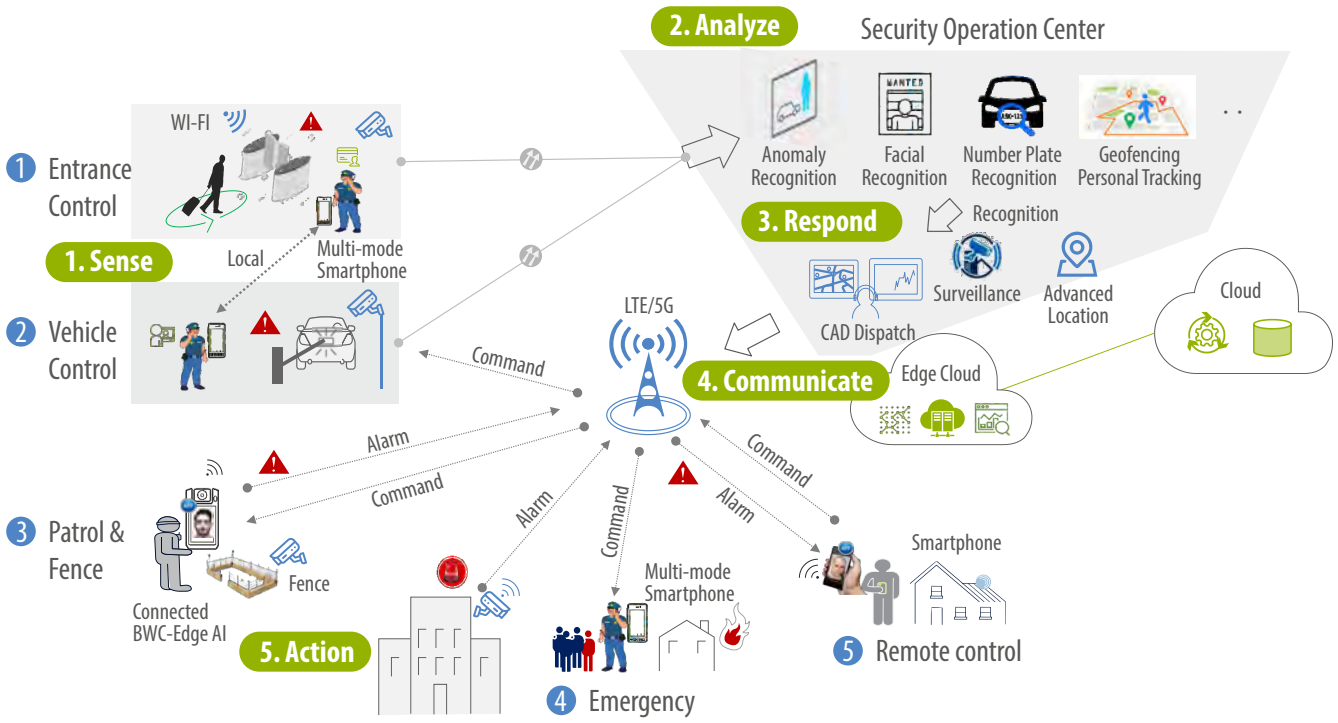
- Video-centric IoT platform integrated with an open unified communication platform (OUCP), taking standardized approaches with openness and interoperability, creates a centralized digital platform where a wide range of CT, video, and IoT systems merge. Flexible and scalable, the converged platform can be deployed over multiple cloud infrastructures (private, public and hybrid-cloud) or on-premise environments to break down information siloed, supporting interoperability and seamless communications across networks. Furthermore, the comprehensive platform easily enables blended SaaS applications through neat API and customised SDK by harnessing the latest AI and ML technologies to advance video analytics, intelligent tools, and next-gen push-to-X MC communications.

- High-performance 4G LTE networks integrating with traditional networks create a reliable, secure, and flexible underlay network, laying the foundation of seamless connectivity for sensing, analyzing, responding, and communications.

- A wide range of professional devices with built-in actionable tools, including rugged digital two-way radio, hybrid-mode radios, LTE/5G smartphones, and 4G LTE body cameras, to AI video cameras and IoT sensors, have proven records for high-quality design and some of the most exciting advancements. A complete portfolio of devices with effective management through central MDM helps security organizations detect and report potential security risks automatically and capture critical details in real time, delivering always-on connectivity and instant communication while keeping security staff safe.

We bring these essential capabilities together to deliver customer E2E solutions with complete hardware and software suites flexibly and practically, helping them achieve the best outcomes when facing challenging and unpredictable situations every day.

5.3 A complete digital security solution is to automate the operational process



The Complete Digital Security Solution Automates the Operational Process

Security teams often struggle to communicate seamlessly because of limited technologies, such as relying on manual operation, lack of real-time automation, and inability to respond quickly and precisely. In addition, it is often hindered by isolated systems and siloed information. E2E digitalized security solutions can deliver highly available communications and adequate situational intelligence to help security teams better coordinate and respond faster to critical situations while improving safety and simplifying the process through automated and streamlined workflow. The situational awareness and field communication capabilities are integrated with incident management and workflow management system to deliver highly responsive and effective security services on a local base managed data dispatched by SOC over the distributed cloud. A modern security operation can only be achieved through connectivity, integration, digitalization, and intelligence, along with the automated process highlighted with sense, analyse, respond, communicate, and action.

- The sensing systems know what is happening in real-time to better understand the situation to protect people, property, and assets, using access control manager, video security cameras, 4G body cameras, automatic number plate recognition (ANPR), and geo-fencing.

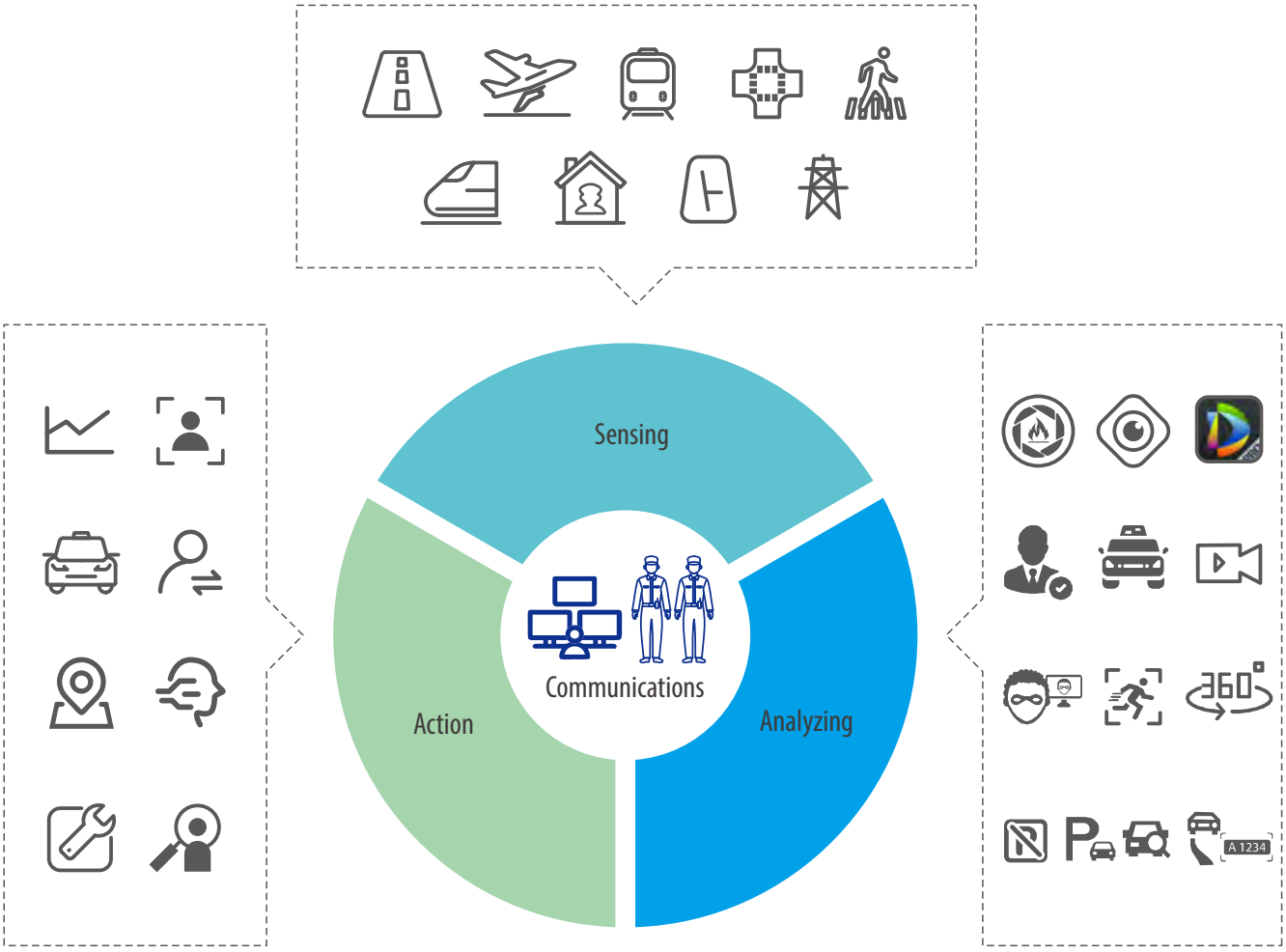
- The analytics systems immediately recognize which events are important and how critical they are as a flood of information flows is always overwhelming. Quickly find what you want, then make informed decisions to take action, such as using facial recognition, behaviour recognition, personal information tracking, and more.

- When triggered, the centralized command and control system within SOC, Smart-one, a computer-aided dispatch (CAD) system, simultaneously mobilize security teams and coordinate a fast response by dispatching the right staff and right resource at the right place in the way of "what you see is what you get".

- Always-on presence and seamless connectivity ensure instant communications across regions, devices, and networks and keep teams connected and informed through resilient voice, video, tools, and data services.

- Different professional devices meet the diverse needs of security teams, keeping them connected and acknowledging the command request regardless of the coverage area they operate within, or the networks they stay in to take action quickly to mitigate the risk in different situations, including dual-mode radio, rugged LTE/5G smartphones, connected 4G body camera radio, as well as BYO smartphones.

6 Video-centric smart IoT intelligence empowers security teams with automation



Video-centric smart IoT technologies ecosystem empowers security teams with automation

Video surveillance and video analytics are the main security tools and play decisive roles in quicker incident response and better situational awareness for making informed decisions. However, the traditional approaches with isolated systems face challenges, especially when security organizations face larger and more complex corporate structures, rapid economic/social/political changes, and more complex and unpredictable events.

The new and unified technology ecosystem that combines video security, access control, data, and communications has been built across industries. Hytera and our partners' convergence solution integrates these technologies via a flexible platform from the edge to the central cloud, adapting to the ever-changing enterprise landscape, and transforming video security from retroactive to proactive responses involving sensing, analyzing, and actions with automatic tools built on top of AI. All things are manageable on a centralized platform within SOC, allowing security organizations to have a unified view and understanding of what's happening, so they can respond quickly to events and potential threats. We will also continue to innovate our solutions on top of rapidly evolving video security technologies to enhance safety, security, and optional efficiency by automating processes and streamlining workflows.

By relying on a variety range of AI-powered IP cameras, the sensing solution supports to build of a comprehensive perception network through the integration of video-centric sensor networks and communication networks, enabling the real-time detection of activities within the enterprise, obtaining the most real-time data and supporting border control, road control, and key area control.

The popularization of deep learning advances video analytics with the automation of tasks that systematically analyse the perceived data by combining AI, big data, cloud computing, and business scenarios. The teams can obtain accurate and valuable intelligence to take informed actions accordingly. The functionalities offered by intelligent video analysis include recognition of humans, vehicles, objects, and thermal and specific event detections. In addition, video management systems (VMS) over cloud infrastructure allow surveillance video/images from thousands of cameras distributed in many locations to be stored, monitored, and analysed on central SOC.

New technologies are being adopted to advance security systems to adapt to the digital process and to streamline workflow throughout enterprises and organizations. The synergy of "video + communication + intelligence" brings powerful tools to the SOC and security team, including dashboards, big data, structured query, E-Map, AR, unified OAM, etc.

6.1 Integrated video security and access control system

From overseeing building entries to monitoring visitors' activities and controlling access, as well as managing so many security systems, enterprise premises management can be costly. A complete portfolio of video-centric smart IoT solutions comprises project-oriented products, including IPC, NVR, PTZ, XVR, Thermal, and software platform that adopts industry-leading deep learning algorithms, focusing on customers' requirements and providing precise, reliable, and comprehensive AI solutions for the security sector. The solution addresses the demanding issues to improve situational awareness and increase early risk detection, enabling quick and proactive responses to potential danger.

Video-centric smart IoT technologies ecosystem empowers security teams with automation

6.1.1 Sensing system

A one-stop integrated security sensing system is designed to support operational needs and safety and security requirements across industries. It includes fixed and mobile video surveillance, video intercom, access control, ANPR, video wall, perimeter protection, emergency alerts, and an all-in-one management platform. These subsystems come together as a complete system to allow security teams to monitor the entire pool area and spot, detect unexpected events and activities in real-time, and automatically control access by identifying personnel and vehicles.

ANPR system monitors the vehicles going in and out of the enterprises day and night by employing AI-powered cameras and analyses the number plates of the vehicles by leveraging ML mechanisms, allowing or refusing vehicles according to allowlist and blocklist. Automation enables security organizations to improve passing efficiency and reduce manual work. ANPR cameras can also detect suspicious vehicles within premises and at parking lots, automatically pushing alert notifications to officers' smartphones and reporting to SOC supervisors, who can further escalate the alerts to law enforcement.

Access Control system creates a customized access control system that provides enhanced security and convenience through greater visibility and instant control over employees and visitors entering and exiting premises at a single- or multi-access point. The role-based system supports a large capacity combined with high-quality hardware that flexibly meets the needs of small, medium to large enterprises. The system manages access to buildings efficiently by using advanced card reading and biometrics technologies as well as intelligent alerting with the methods of entering passwords, swiping cards fingerprints, as well as a combination of them, reporting a range of types of alarms, including the door time-out alarm, intrusion alarm, duress alarm and tamper alarm, and allowing remote checking through video intercom and live video.

The Fencing system that combines anomaly-based video detection and infrared intrusion detection technology offers an extra layer of protection by working together with entrance access control, video intercom, and security guarding, creating a more effective security system and providing maximum protection.

All-in-one management system: The state-of-the-art solutions with tangible cost-saving integrate these security subsystems and extend to allow the integration with building automation functions, such as biometric, mobile duress, lighting, air-conditioning, intercom, fire, etc. It manages the entire security operation from a single user interface through the all-in-one management system with a range of powerful tools, including video walls for real-time situation awareness, an E-map for complete visibility and centralized operation of all installed devices, and video linkage with alarm for quickly locating the events, and provides single-point control across all devices and centralized management of all subsystems.

Cameras: Integrated video security system monitors and

identifies unusual activity and potential intrudes across the enterprise through intrusion alarms and video surveillance. A variety of specialized cameras with embedded analytics are deployed in different locations to capture critical details and enhance visibility across the premises.

- Bullet security ANPR camera with motion detection and AI-enabled auto alarm capability is used for vehicle entrance and parking lots to reduce human effort and error. A larger lens with night vision provides a higher level of detail over greater distances and larger outdoors areas. AI-powered ANPR software, along with the hardware form of a larger lens, built-in IR illuminators (30m), protective covers from intrusive lighting, and 4MP high resolution, enhances the ability to detect license plates effectively. It supports >98% recognition rate and up to 80km/h recognition speed.

- Fisheye security camera with a dome-shaped body, built-in IR LED (40m), an ultra-wide-angle, and a varifocal fixed lens is ideal for creating a discreet, low-profile solution with low TCO, dynamic 360-degree view angles with a single high-resolution 4MP sensor are suitable for baseline surveillance for interior spaces, such as office, warehouses, and retail stores. It facilitates the investigation of people or vehicles of interest by simulating PTZ features to a specific area view.

- Pan-tilt-zoom (PTZ) with starlight is capable of a panoramic 180-degree view of the large area, such as open public areas and parking lots, supporting automatic tracking vehicles and people within the FOV (field of view), multi-location monitoring by remote control for large security operations, periodic touring with close monitoring of specific areas, and auto zoom-in people, vehicles and objects of interest with high-definition when identifying and tracking the suspicious by their physical description or detecting a vehicle by its license plate.

- The thermal hybrid speed dome camera with two sensors combining infrared, night vision, and visible light is powerfully used in perimeter fences 7/24 at a relatively lower cost compared to multiple single-sensor cameras. It can provide more flexibility and greater levels of detail across a wider coverage area, including 360-degree FoV and specific regions outside of FoV; its unique Zoom capability and longer FoV enable rendering parts of views to greater depth and details when identifying persons or objects. It can detect early and ongoing fires and smog up to 10km with no blind angle. Millisecond rapid response and timely pushing the accurate report to SOC or the local fire bureau for a quick response across large areas are often unachievable with in-person fire patrol.

6.1.2 Analytics system

Integrated video security systems are ready to tackle the challenge by monitoring a large premise and detecting many people and vehicles to maintain the enterprise's security anytime. Scouring through the multitude of collected data and comprehensively analyzing enables SOC to recognize concerning behaviours as quickly as possible on and around the enterprise and then automatically report.

A series of smart video analytics software solutions are designed to automate and simplify the process using AI technologies based on machine learning mechanisms. They are adopted to improve efficiency and effectiveness and mitigate the impact of labour shortage. Video analytics is also used for detecting potentially suspicious activity, providing real-time insights along with facial recognition at SOC. Some of the key intelligent tools are described as follows:

ANPR: The comprehensive ANPR system is designed for security organizations to recognize the number plate information of vehicles in the image, control suspicious vehicles through a blocklist, and automatically recognize VIP vehicles to ensure service excellence. Advances in deep learning algorithms enable ANPR to achieve the highest performance, including a 99% detection rate and 95% recognition rate across 58+ supported countries, and more easily and quickly locate the target vehicle in real-time for risk mitigation.

ANPR with parking space management provides 24/7 monitor of the outdoor parking lots, involving tracking abnormal events, capturing evidence by automatically detecting vehicles and extracting and displaying parking status. It improves efficiency and experience together with the support of up to 95% detection rate and detection of 80 vehicles within 30m of cameras. Furthermore, vehicle video metadata 2.0 advances ANPR with fast capturing (640 objects/s) and precisely detecting (98% rate) up to 7+ attributes for each vehicle; counts-based and target direction-based data analysis for report statistics to support more sophisticated security purposes.

Face Recognition: Face recognition 2.0 extracts the features of a captured face image and recognizes the person's identity by comparing it with those in the face image database and a range of advanced features. It ensures the accuracy of traffic by preventing duplicated detecting with only one time in case of frequent appearance and excluding data of staff, securities, and repetitive entries. The traffic statistics for all appearances and individual frequency statistics with the preset threshold, delivering customers edge-cut solutions with up to 98% accuracy rate and up to 320 pics/s face recognition speed, and the database remains up to 500k pics face database.

Privacy protection: Privacy protection2.0 is designed to protect the privacy and personal data by using the deep learning algorithm when face recognition technology is used; it supports real-time privacy occlusion with the methods of irregular polygons, mosaic or coloured blocks for the human face and body whether they are in motion or static, providing non-pixelated images of human faces, and allowing code exporting based on specified targets. The high-performance solutions can detect up to 64 objects/frames of one target with up to 98% success rate and up to 8 areas in the same view of privacy masking.

Human Video Metadata: Human video Metadata2.0 with the deep learning algorithm empowers customers with a suite of powerful capabilities to detect, track and capture images of people by selecting the best images and extracting a variety of attributes (six faces, nine humans, and six non-motor vehicles) and of targets to locate them immediately, such as targets direction analysis, data statistics combing people, non-vehicle and direction count, and personal protective equipment (PPE) detection including masks, glasses, hats, etc. The system supports a 98% detection rate and 640 objects/s targets captured with attributes.

Wide open area security: High-speed PTZ cameras, together with perceived panoramic images, enable 360-degree zero-blind angle FOV to achieve crowd and vehicle density alarms easily, as well as automatically report the occurred or potential emergency events to SOC and security commands, customized features (optional) including time-lapsed and AR panorama further enhance the overall visibility. The system supports up to 1024 persons from 8 crowd detection areas with 30m around each point and 8 vehicle areas with a radius of 125m around each end.

6.2 Security operation centre (SOC) solutions

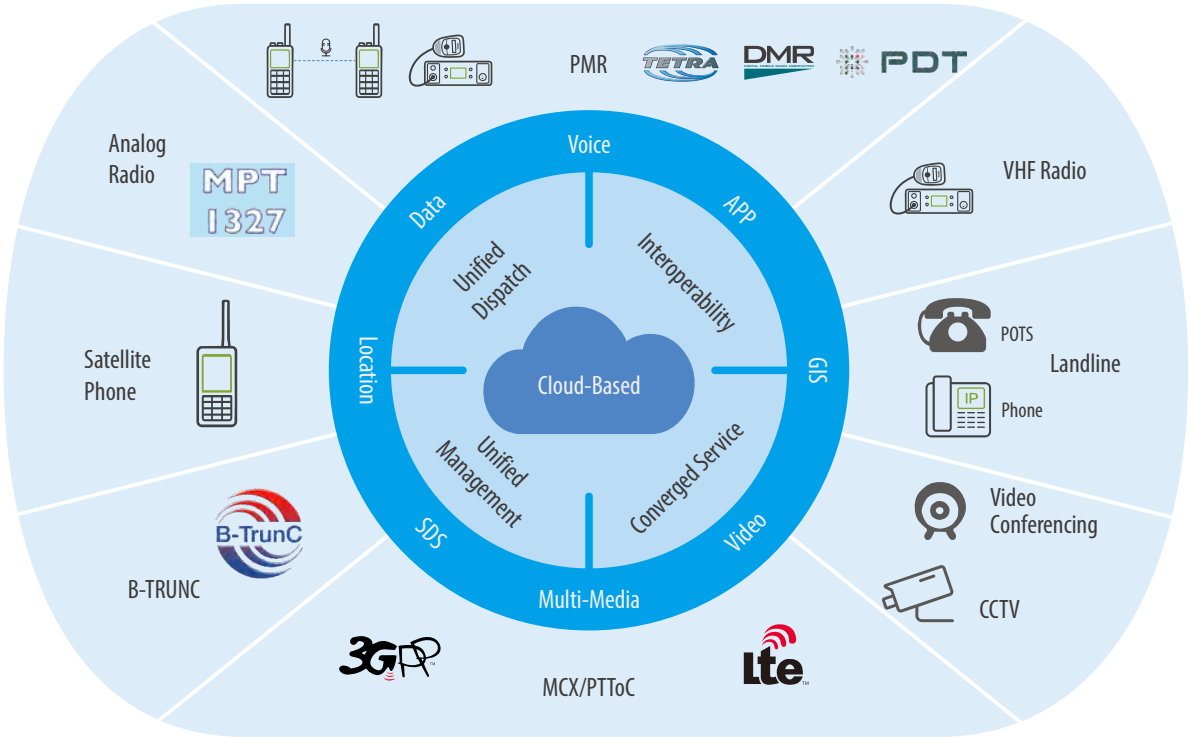
6.2.1 Response and command system

Unified dispatch solution advances SoC with high-efficient response to incident and emergency

Single console bringing together rich content with high-quality visualization and unified dispatching allows SOC and commanders to interact efficiently, collaborate, improve shared team awareness and increase efficiency with real-time staff location tracking. An open-standards platform empowers security teams flexibly to use voice, data, and video actionable tools to get the job done quickly, regardless of their physical location. The multi-layer in-depth convergence-centric system ensures seamless voice communications across enterprises between enhanced push-to-talk and telephony, radio, DMO, VOIP, and more, always keeping teams in touch across different devices, networks and locations. Private or group calls to all user devices are available during daily routines and emergencies.SmartOne is built on the OUCP platform, designed on standardisation and interoperability principles. Drawing on public safety experience, Hytera designed the next-gen CAD dispatching system tailored to advance the security sector's dispatching system, offering customers unprecedented flexibility and scalability to meet SOC needs before, during and after PoC integration. SmartOne can connect to the existing legacy system and allows seamless migration to the advanced PoC system, supporting full interoperability with other agencies and enabling security teams to coordinate with the law enforcement and fire department for an escalating emergency with professional PoC services. A broader integrated system that combines video surveillance, access control, alarm and alerting, smart building, and IoT sensors helps speed up the detection of threats, accelerate digital and automation transformation, and streamline and simplify the security workflow and whole enterprise business process.

The modular system quickly expands by adding gateways and software license upgrades on the same platform; it flexibly adapts to simple and highly complex needs and achieves the right balance between size and cost. "Opt-in" redundancy and reliability system design-cloud-based load balance and 1+1 server standby ensure "always-on" availability for 24/7 operation. The system delivers the right information at the right time to respond effectively by providing critical real-time video from body and CCTV cameras on console screens. Remote web access provides distributed operations in different locations, including headquarters, branch offices, factories, fields, and roads.

6.2.2 Open Universal Communication Platform (OUCP)



A Unified Communication Platform dresses the interoperability and integration issues

While enterprises have undergone significant digital transformation, integrating legacy systems with new systems is a major challenge. OUCP, a cloud-native and service-enabled platform, is designed to tackle this problem by employing a horizontally integrated framework coupled with IP-based gateways, standardized CT and an open IT interface. Along with providing communications service built on IP with secure connection across technologies, OUCP delivers significant values and capabilities to customers who no longer need to compromise with their business, enabling simplifying implementations and accelerating modernization.

- Provides full interoperability between new PoC systems and other communications devices, including various radio systems, landline telephones, and VOIP phones, connecting all security members with different devices anywhere, anytime.

- Seamlessly integrating communications systems with the partner's advanced video system and more IoT systems enables cross-domain orchestration of such integrated networks and IT services, integrating and automating physical security operations with ICT technology. As such, collecting data from multiple sources ensures accurate analytics, delivering actionable information, and alerting notifications to SOC and security teams.

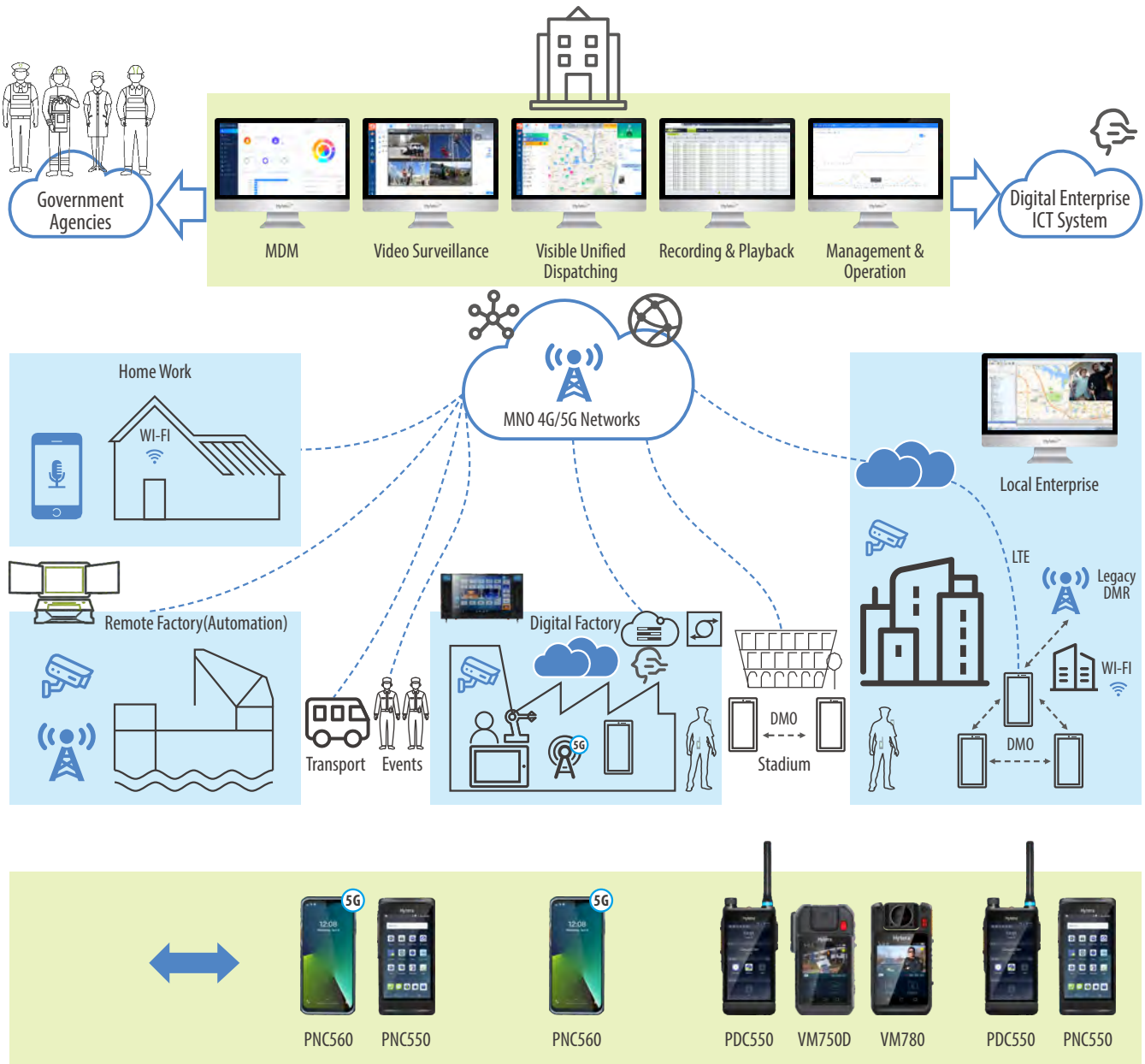
- Unified service control and neat northbound APIs with SDK enablers make CT networks more adaptable to the IT environment and easily and quickly introduce new blended services.

- Deploying a well-designed network with high scalability and reliability through flexible configuration, module design, and system redundancy can meet the different needs of enterprises of various sizes with minimal cost and today's dynamic business and IT needs.

- While providing a framework for breaking up information silos, OUCP, a standard-based open platform with hierarchical architecture, will evolve to interact with more emerging technologies through integration with enterprise digital platforms, such as edge cloud, computer vision, and 5G.

As a next-gen collaboration platform, OUCP opens up new possibilities for a digital security transformation. It will provide security supervisors with sustained enhanced command and control over large and dispersed facilities and enable teams to initiate faster and more accurate responses. It will also drive efficiency in daily operations and effectiveness during full-scale emergency response through broader collaboration between team members and multiple organizations. Thus, OUCP ensures better security for the enterprise and provides more safety for employees.

6.3 Harnessing advanced PTToC to modernize communications



A variety of professional Devices: Rugged 4G/5G Smart PoC Radio/Converged Dual-Mode Rugged Radio/4G Body Camera

Advanced PTToC are to modernize communications along with enterprise digital transformation

At the very core of everyday operations and the response to events is the ability to communicate quickly and reliably to avoid disruption. Drawing on the longstanding critical service experience, Hytera prioritises industry-leading native convergence innovation to support the seamless integration of PoC and established networks via a flexible cloud-based platform and the connections between cloud and on-premise platforms. These abilities are proven vital in helping customers adopt both modern IT environments and traditional networks to address interoperability issues and best optimise resources to simplify processes and overcome barriers whilst minimizing the cost of modernization. For example, Integrating PTToC and video security allow real-time automatic alerts sent to security staff for quick response.

With handling large numbers of voice and data transmission concurrently, Hytera advanced PoC communication solution delivers a great experience for end users with its best-in-class seamless and instant communications. Combining useful features tailored for security services and a varied range of professional devices supports security teams in dealing with a succession of daily security tasks and emergency events effectively and efficiently in the global headquarters, regional office, factory, remote places, at home or on roads. Furthermore, the solution delivers stable, fast, and optimized communications with ubiquitous connectivity across different areas without blind spots, resolving the problem of poor and limited communications and pinpoint GPS accuracy in built-up urban areas, steel buildings, tunnels, and basements, and even cellular network fails due to insufficient coverage. On the other hand, as industries adjust to the pandemic, which drives enterprise digital transformation at post-covid ages, the increasing capabilities of PTToC over the cloud, including evolving MCX technologies, are paramount in supporting the new reality. Hytalk-Pro offers various advantages through various use cases and best practices, adopting the new changes on a surge of mobile and remote work and new workflow processes within enterprises with reduced budgets.

- PTT apps easily download from an app store and are managed on an IT platform.
- OTT app works over any data connection, such as LTE, Wi-Fi, mesh, 5G, and even 3G, and roams across various MNO networks.
- Rich features with integrated capabilities such as data sharing, photos, messaging, and video are adapted to implementing more advanced applications to meet new requirements.
- Cost-effective with an application layer-enabled system and works on various devices, including off-the-shelf smartphones.
- Delivers an efficient experience for users with fast call-setup time, low latency, and confidence that the PTT app has been fully tested with both the networks and the devices that it runs on.
- Cloud-based solutions that support the deployment of over on-premise and multi-cloud platforms connecting to the carrier's network can ensure a level of QoS with end-to-end performance optimization and reliability.

6.3.1 Professional devices deliver next-gen MC communications

A variety range of types of professional devices meet all needs

Tthe solution provides a range of rugged devices, including LTE/5G smartphones, dual-mode radios, and connected 4G body cameras, designed for professional industry usage to deliver exceptional voice with advanced audio features enabling high-level speech intelligibility. A dedicated PTT button and an emergency button for intuitive use ensure the teams are all connected clearly in loud and rough environments, ranging from noisy stadiums to factories with heavy machinery. By accessing high-performance 4G LTE and Wi-FI networks, the devices with built-in PoC apps on their Android operation system give security teams the great advantage of using new instant PTT services and multimedia services, including push-to-video, push-to-data, geo-locations to improve optional efficiency and safety. Furthermore, by incorporating additional tailored tools, security teams are empowered with more comprehensive capabilities than ever, including geo-fencing, automatic alerting, navigation assistant, intelligent voice assistant, and more 3rd applications, enabling them to simplify the process and automate the workflow.

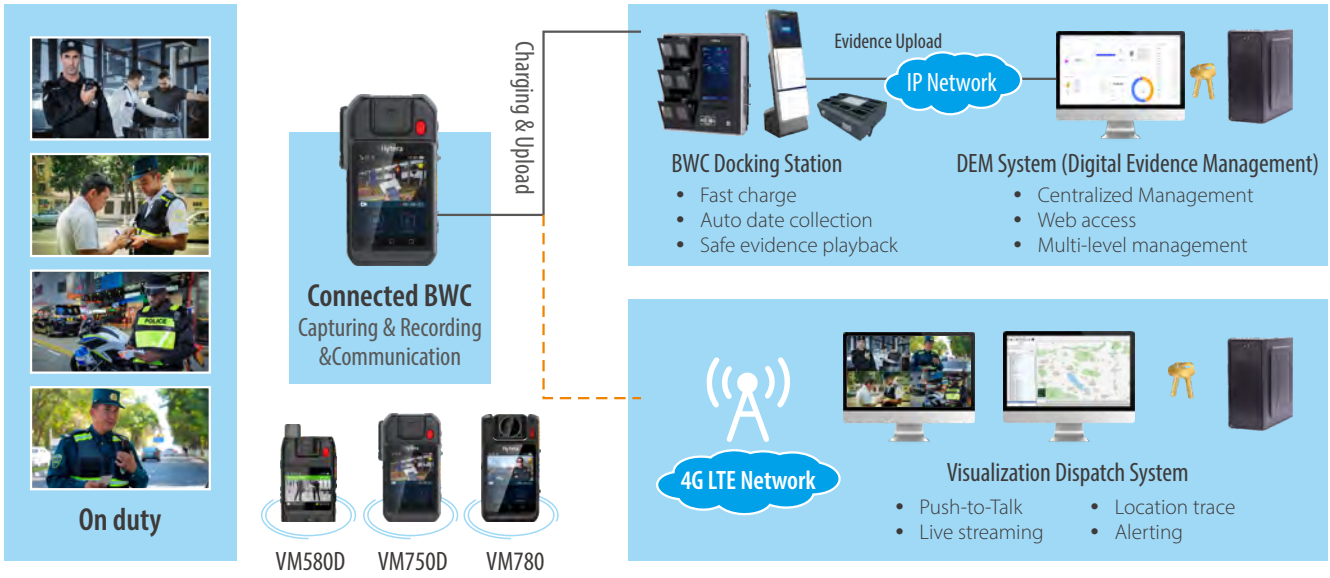
- The dual-mode device ensures voice-first with one-touch emergency SOS whenever and wherever through higher audio fidelity via LTE/Wi-Fi plus superior voice clarity via PMR with resilience and reliability from PMR standards.

- 4G body video camera provides security staff with an all-in-one platform combining PoC radio, video streaming, and facial recognition while capturing footage during daily patrol and emergency response.

- 5G rugged device that supports a number of innovative features delivers much higher performance multimedia communications and data applications by accessing either 5G MNO networks or 5G private networks, enabling extraordinary situational perception such as by connecting AR cameras, 5.5-inch touch screen delivers excellent user experience for exploring apps and high visibility through accessing to security management and enterprise workflow.

Leveraging native convergence innovations and seamless connectivity, taking advantage of ubiquitous LTE coverage from outdoor to inside buildings, and delivering better signal penetration into a complex structure for direct communications due to poor LTE coverage through integrating DMO mode, these capabilities ensure instant communications between different roles and different devices across organizations wherever they are. Furthermore, various types of smart devices can also interconnect with traditional radio by integrating with legacy networks, combining seamless connectivity and advanced location service, supporting SOC and security team with real-time visibility and always-on availability.

6.3.2 4G body cameras



Connected Body-Camera communicate instantly while increasing safety

Body cameras are primarily designed for the operational needs of public safety and have been broadly taken up across police, fire, and ambulance services with a range of use cases. In the security industry, there is an increasing need for body cameras to assure the safety of security staff members, as many have experienced workplace violence such as abuse, harassment, and more. While on duty, wearing body cameras can help de-escalate confrontations between staff and the public. They also capture high-quality evidential videos if the situation spirals out of control. Each business has different requirements for body cameras in terms of size, affordability, and operational needs, with specific features such as using RFID and ID for simple shift checkout and a physical emergency button.

We offer several types of body cameras to meet different needs while improving operational efficiency with additional capabilities. They never miss capturing high-quality audio and video in all weather conditions and rigorous environments. They simultaneously keep teams connected via built-in PoC apps while conducting patrol or guard daily. Real-time situational awareness is critical for supervisors in SOC to realize the escalating situation or an emergency event and take proper action. It can be a mobile video sensor to complement fixed cameras to minimize blind spots.

Furthermore, the embedded edge AI analytics offer facial recognition to identify a suspicious person with a real-time automatic alert sent to SOC via 4G LTE, allowing security teams to respond in moments before committing any offences. Digital evidence management (DEM) ensures to provide you with evidential footage when they are needed for prosecution in court. With many compelling capabilities, the all-in-one body cameras aligning with Hytera's solutions ecosystem best meet the different requirements of security teams, assuring staff safe and mitigating staffing issues.

- The built-in starlight camera features a professional CMOS with exceptional starlight sensitivity and a state-of-the-art video stabilizer, enabling better performance than IR night vision in terms of image clarity and quality. A 6-axis Electronic Image Stabilization(EIS) with over 500% gimbal stabilization over OIS gives you sharper and clearer colour vision in low light conditions, even below 0.5 Lux illumination within 10m without the need for artificial lighting. These capabilities help security members better detect vehicle plate numbers and human faces and capture an image with high identification while boosting video resolution and minimizing image blurring during patrol or emergency response at night.

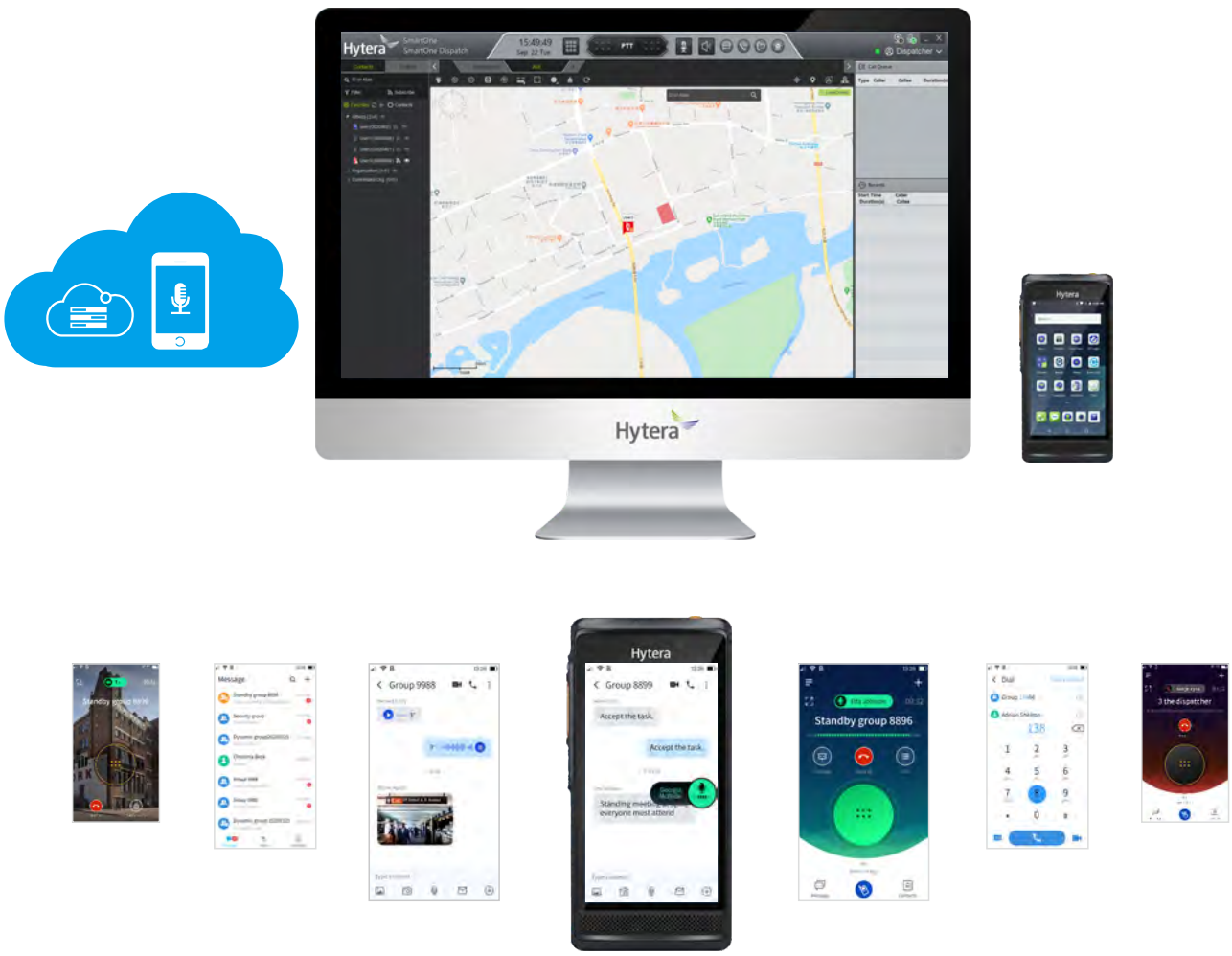
- 2)More than a body camera, the connected 4G body camera features 3-in-1 communication functions-PoC over 3G/LTE/Wi-Fi with the built-in app and location service, video

RSM connecting to smartphones by BT or cable, and an up to 2W speaker and dual-mic noise reduction algorithm having a normal voice at distances ranging 30cm in a level of noise of 85dB (the most excellent level). Moreover, security members or supervisors can transmit real-time streaming by triggering it whenever necessary. Furthermore, with a super wide-angle lens and a rotatable HD camera, connected BWC transmits a livestream for a clear objective view to instant response to ensure staff safety and reassurance staff during an incident.

- AES256 Encryption mechanism to prevent the disclosure of evidence and ensure security and integrity Certification of Evidence(HASH) to keep the integrity of evidence and ensure transparency.

- NFC chip with an intelligent ID switch function allows security members to share one device to cope with an enterprise's limited budget while meeting the actual needs.

6.3.3 Advanced Hytalk Pro delivers a single collaboration platform



A single collaboration platform, Hytalk-Pro

Hytera's convergence-native innovation, a proven market-leading solution for next-gen MC communication with extensive global reach, is designed as multi-layer convergence architecture with a standard-compliant open platform, achieving many successful implementations with best practices and best track records in creating new levels of customer experiences. With public safety pedigree, the Hytalk Pro solution is tailored for industries and is increasingly adopted across diverse industries worldwide, including security, transportation, utilities, construction, hospitality, and more. In addition, Hytalk Pro creates a single collaboration platform to offer advanced PTT communications across commercial LTE networks, enterprise or public Wi-Fi, private LTE networks, and any IP access, enabling seamless communications through interworking with traditional radio and landline, achieving automation by integrating with video surveillance systems.

With access to the essential voice and multimedia services, Hytalk Pro enhances traditional voice-only communication by providing the following capabilities: full/half-duplex private voice/video calls, group voice/video calls, push videos, images, and files, multimedia messaging, SOC emergency call, location sharing/query among groups, video transmission, real-time presence, group call merging, later entry. Furthermore, combined with the SmartOne, Hytalk Pro offers a range of advanced features that enhance security member safety, increase situational awareness, and improve operational efficiency.

- Location-based temporary/dynamic groups allow dispatchers to manage talk groups visibly by adding and removing members as they enter or leave a defined geographic area.

- E-Map electric fencing combined with location tracking enables automatic detection of users and alerts triggered when crossing the boundary for high-security specific regions controlling and VIP personal protection.

- Video pull/forwards/push enables dispatchers in SOC to trigger video transmission via a specific device, enhancing situational awareness, mainly where CCTV is unavailable.

- Use ambience listening/viewing in an emergency to ensure staff safety by remotely opening a device's microphone to monitor voice activity in the local vicinity with no indication where security members' health and safety might be at risk.

- A dispatcher with discreet listening permission can monitor any communications by listening to calls (voice) of target users without being perceived and also be able to forcefully clear the monitored call without the call owner's consent for security or emergency needs.

- With emergency calling & alerting, security members can quickly initiate an emergency call with the highest priority and preemption for help by pressing a dedicated hard button and alerting the dispatcher with a real-time location.

- Users enable/disable functions to ensure security by allowing supervisors to remotely enable or disable the PTT function on a specific device wherever the uses are.

- Call recording/playback of voice and video services allows supervisors to review operations of incidents with statistical reports and security members to playback important communication, ensuring transparency and accountability.

With all of those capabilities, Hytalk Pro delivers security organizations with complete mobility communications, broadly extending legacy radio systems' reach and modernizing security communications by connecting various smartphones, tablets, laptops, and BYO (bring your own) devices to adapt to modern enterprises' digitalization.

Supporting four deployment options-Hytalk hosted, On-Premise, Private Cloud SaaS, and operator-centric Cloud deployment to cover no matter how organizations plan to deploy.

Mission-critical-innate and professional PoC solution with advanced broadband abilities deliver voice-first and multimedia-centric push-to-x group services with new compelling features, enhancing situational awareness with speed and simplicity. In addition, its advanced location services with GIS-based mapping enable the always-on presence and real-time location to help SOC and supervisors better plan their response with high visibility and improved productivity.

6.3.4 MDM is a must to manage a whole ecosystem of devices

Innovative mobile device management (MDM), comprising a suite of hardware and software, is a single console platform to simplify and enhance the management of all offered radio and rugged smartphone devices, either wired or wirelessly. By centralized controlling, optimizing the functionality, and protecting the data and configuration settings of devices within networks, smart MDM can reduce organizations' support costs and risks while simultaneously protecting the corporate network. In addition, MDM can be further integrated into enterprise unified endpoint management (UEM) and other software via SDK. The key features include:

- Remote software management via LTE or Wi-Fi connectivity helps users to improve work efficiency through managing hybrid-model devices comprehensively, including programming and upgrading radios (via PMR network), installing and uninstalling apps and licenses, encryption management, pushing multimedia services, cloud-based data backup automatically and recovery.

- Battery health management software enables users to monitor the state of batteries and trigger alerts to users for a given ratio of the total charge capacity to design capacity shown on a glance screen. With this tool, users can ensure good radio performance and get the job done, extend battery lifespan and save maintenance costs.

- Managing devices safely and seamlessly boosts productivity and keeps threats at bay, particularly in the current environment where remote and hybrid working has become the norm. Device inventory management software supports device tracking and maintenance reports within access networks, allowing users to manage devices centrally and gain complete visibility into devices' health details. It enables you to know where and how they are used, pinpoints the devices that are not currently in use, and locks/unlocks the lost devices or remote-wipes the critical data from the devices to secure safety.

- The core security functions include a safety app with an allowlist and blocklist; customizing device configuration through OTAP; disabling all interfaces including BT, Wi-Fi, hotspot, NFC, USB, GPS, LTE, and camera to avoid malicious access; advanced Identifying and access management; transmission and data security with MD5+Salt encryption enhancement between devices and platform.

6.3.5 Securing communications through end-to-end encryption (E2EE)

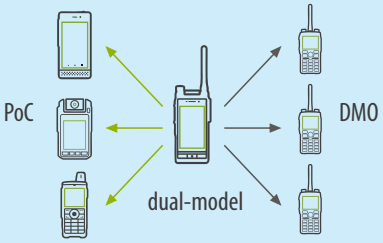
Securing communications through end-to-end encryption (E2EE)-All voice communications are secure and encrypted, along with each voice call initiated and received. The complete security solutions support multiple models required by security organizations, ensuring end-to-end encryption in three different ways: symmetric encryption encodes data and offers trusted security between PoC-to-PoC users through Advanced Encryption Standard (AES)-256 algorithm with 256 bits keys transmitted securely and confidentially, and proprietary encryption machine supporting encoding and decoding for both open AES-256 and DMR standards encryption algorithm allows end-to-end encryption between PoC and DMR users, which can be supported alternatively through direct E2E encryption between each other by PoC system integrating DMR encryption algorithm, and also supporting hardware encryption algorithm by integrating 3rd party or customized hard encryption approach. Moreover, DMO offers direct communication to create a safer, more secure local environment. In addition, all captured voice and multimedia files on the recording and storage platform are always kept secure through end-to-end software and customized hard encryption.

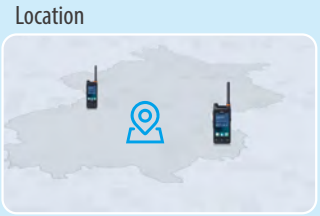
6.3.6 Intelligence tools improve operational efficiency

Automatic voice call recording and playback

Intelligent voice assistant

Field Interoperate between radio and PoC groups





Fast positioning and Navigation tools

Automatic alerting system

Edge-AI Video Analytics

Intelligent tools support automation

Security teams need to communicate and share information in a targeted and intelligent way to achieve the best possible outcome while improving situational awareness and efficiency. Hytalk Pro also supports them with a range of smart tools and advanced features that provide the technological benefits of instant and easy communications. Innovating these new tools helps security organizations tackle current and future challenges, automating operations, overcoming blind spots, and making teams stay connected and respond faster.

Automatic voice calls recording and playback on demand on the device: All voice calls for both PMR and PoC PTT communication and group and location information are recorded and stored in devices locally. Records can be easily searched and played back whenever you need, and you never miss any critical information. This option can help security forces focus on operations for critical missions without distraction, particularly in harsh environments.

Intelligent voice assistant: Intelligent voice assistant tools leverage AI-powered voice recognition technologies to support hands-free device operations through 14 types of requests and queries, including usage status, switching between talking groups, trigger-taking photos and video images, location sharing, audio playback, etc. The APP software licenses can be easily managed and remotely controlled by MDM. AI voice provides real-time intelligence making routine work more productive and emergency response reacting faster.

Interoperability between radio users and PoC groups in fields: An innovative solution that integrates DMR and 4G LTE into a robust and secure platform, a multi-mode smartphone with built-in PoC application to keep teams connected, safe, and informed. Resilient DMR provides high transmit power to extend the coverage and keep DMO users connected. Software enhancement gives field commanders the benefit of quick and easy connection of all users in one pre-defined group whilst operating in different modes, including PoC and DMO. When the feature is triggered via one push, a multi-mode smartphone immediately initiates simultaneous calling to several other PoC users and DMR DMO users to connect them in real time. The breakthrough addresses one of the most challenging issues of the coexistence of LTE/PMR DMO, uniquely achieving D2D communications between hybrid modes without additional

hardware or the need for the involvement of dispatches, simplifying interoperability between LTE and PMR devices. It has been proven a powerful tool in overcoming the blind spot of MC communications, allowing organisations to adopt any situation, delivering customers real benefits of lowering costs and protecting the previous investment.

Fast positioning and navigation tools: With advanced locations service and a built-in app, the navigation tool supports fast positioning by automatically reporting location while initiating a call so that other members in the talk group visibly percept his place and quickly get there. It helps to increase operational efficiency with enhanced collaboration among frontline staff.

Automatic alerting: The location-based alerting system offers man-down and emergency SOS alarms, automatically detecting falls and impacts and sending a man-down alarm to SOC with the location on the map. Push the SOS button immediately triggers an alert to SOC with a location alert and emergency call. Alerting a system ensures security organizations protect your staff when they are at risk of slips, trips, and falls, monitoring isolated, remote, lone, and high-risk staff. Geofence support alerting uses voice, location, tracking, and context for situational intelligence to respond to emergencies, location breaches, and other incidents.

Edge-AI video analytics: Through innovative edge AI technologies, a built-in facial recognition app tailor-made with the professional body camera provides security teams with a new approach with the support of a mobility detection edge system to track, capture and analysis a human face among a moving crowd. Single body camera device supports up to 1k local face image database that can be updated easily online, automatically alerting SOC audibly and visually when detecting suspicious people and then triggering communications to respond if possible. Body cameras with AI-powered video analytics is a valuable tool for security teams to complement CCTV quickly, mobile, flexibly, and convergently during daily patrol and emergency events that usually occur in areas where people often gather.

7 User cases

Our solution supports various industries, including school, hospital, transportation, manufacturing, hospitality, and property management, followed by many successful use cases.

7.1 Automation and critical communication ensures a safer school post-pandemic

Physical security aims to maintain positive, safe, and effective learning environments. Schools and educational organizations have been dealing with challenges brought on by the pandemic, such as hybrid learning models and staffing shortages, for nearly three years. As we turn our insights into next year and the future, beyond the continuing implementation of social distancing, mask-wearing, and daily health checks, schools and education organizations are now beginning to refocus on managing mental health and violence on campus, where social media is also complicating matters.

Schools' security organizations have been facing challenges posed by the continuous Covid-19 pandemic and also new challenges due to a lack of digital technologies in school security work, which drives them to prepare to prevent potential violence before it happens, or detect, monitor, and take quick response after an incident happens.

AI Cameras monitor entrances and public places across campus and always detect dangerous threats through ML-Powered advanced behaviour recognition technology. When detecting the presence of a suspicious bullying incident in an underground garage that any students do not report, a real-time alert is automatically sent to administrators in the operation centre with visibility, and it may simultaneously transmit to the security offices' device with a notification identified by location on the app. There are no security staff on patrol or guards nearby, and nearby AI cameras are allocated to monitor the targeted areas and detect the involvement of the event. A variety of powerful IP cameras with a range of features ensure real-time situational awareness on video walls. Identifying students can be applied, if applicable, via facial recognition tools when they come into view of a camera.

In a violent situation or at risk of violence, supervisors within SOC visibly dispatch nearby security staff via SMART-one console through the location-based temporary group features with GIS-based contextual mapping of cameras and the security team's presence to avoid potential threats. Hytalk Pro platform delivers advanced services and instant multimedia communications such as push-to-video and push-to-picture to keep security staff connected, allowing them to respond the events as quickly as possible. With the support of a range of tools built into their professional smartphone, like navigations and intelligent voice assistant, solutions further improve efficiency and productiveness. If the event evolves into an emergency, security staff immediately use one-button trigger body cameras to capture and record the footage for possible evidence and simultaneously transmit real-time video streaming of object view of the event to the operation centre. So officers can be kept informed and be aware of the situation in real-time particularly when fixed cameras are out of view, making an informed decision to escalate this event to law enforcement for support through the connection link to public safety systems. Security staff and first responders stay connected with no disruption, including DMO extensive communication in the field until mitigating the risk before committing any offences. All text, voice, and video communications are recorded and stored during the whole event for post-event investigation and review with statistic analysis reports.

The amount of time it takes to react to school violence or an active assailant can be a matter of life and death. Automation would be a game-changer to make it happen to "zero" time response and address operational efficiency. Hytera solution integrating with partner's video security combines AI with digital business workflow to help organizations automate and streamline the whole process, enabling them to achieve successful response throughout early detection and intervention, comprehensive analytics and real-time notifications, informed decisions for quick dispatch with reliable communications, emergency response and on-site coordination. More than ever, communicating effectively, quickly, and consistently will be valuable for everyone in the school community. The Hytalk Pro platform ensures that staff can instantly and efficiently communicate to prevent dangerous incidents and respond faster to emergencies.

7.2 Hytera solution helps Wanke service, the largest property management company in China, create a nationwide communication system.

As a controlled subsidiary of the leading housing company, Vanke group, Wanke service has been ranked as the No.1 comprehensive strength for ten consecutive years among all property companies in China. Wanke has more than 400K employees with a nationwide security organization and 400 security operation centres across China.

They are confronted with many challenges in maintaining a high level of customer service due to the lack of using digital technologies. Security guards use analogue radio to communicate with each other and often lose connection when they are out of radio coverage range. They usually operate across geographically distributed and large public areas, along with fast expansion in residential areas. Regional managers used to rely on landlines to communicate with local frontline supervisors in residential areas, which makes it hard to understand the actual situation and unable to make quick decisions in stressful situations. Due to a lack of integration of systems and devices, security staff cannot receive real-time notifications from other systems, for example, alert messages from a video camera when detecting dangerous behaviours and suspicious visitors, so they cannot respond quickly to events and prevent potential threats. Using a labour-based approach with voice-only communication via two-way analogue radios becomes challenging to meet the new demands in day-to-day services, such as dealing with more complex situations and meeting higher customer expectations. The increasing concerns also come from responding to critical events, especially when implementing quarantine and other social distance measures for controlling Covid-19. In addition, more than half of security guards have experienced verbal abuse while on duty, leading to guards feeling undervalued and staffing issues such as labour shortages; retaining good employees is more critical than ever by reducing workplace violence.

Along with the ever-changing and unpredictable situations with a variety of confronted challenges, Wanke service has been exploring the use of new technologies to resolve their problems.

As a large-scale nationwide company, the frontline workforce must connect their teams, managers, operation centres, regional centre, or headcounter. Therefore, communication over any devices over any networks around the country was critical for business continuity and readiness to address critical situations and was also essential to enhance customer experience and increase the safety of staff and customers. As a part of the digital program, Wanke service equipped its security staff with connected 4G body cameras from Hytera to increase the safety of staff and residents and improve work efficiency while maintaining a high level of service to their customers.

The connected rugged body cameras combining 4-in-1 functions, including evidential video, PoC, mobile camera, and RSM, into one platform is mainly designed to address the issues of Wanke service and residents' concerns while minimizing

customer investment and operational cost. The solution delivers LTE-powered push-to-talk and video streaming services while capturing high-quality audio and video in all weather conditions. Aligning a unified compact platform combining Hytalk Pro and Smart 2.0 dispatching, the customized solution supports the specific operational, safety, and security needs. They include leveraging ubiquitous LTE coverage. The body camera with two sim cards and a built-in PoC app to keep supervisors and staff connected all the time, delivering instant voice and video communications by pushing a PTT button to support everyday operations or emergency response no matter whether they are in residential areas, on the route, at central offices or home, through integration with 3rd system, camera with embedded analytics can send alerts to PoC to notify staff to address safety threats when an unusual activity is detected; connected 4G body camera can transmit real-time video-streaming triggered by pushing one button while capturing the evidential video during an escalating situation, de-escalating confrontation between staff and residents, providing staff reassurance and keeping supervisors consistent monitoring the evolving situation for the quick and proper decision to protect the safety of staff and public. Furthermore, the enterprise's NFC chip with an intelligent ID switch function allows security members to share one device to save money and simple and fast checkout during the shift change. Man-down and emergency SOS By pushing the SOS button, the body camera can immediately send an alert notification to the operation centre with its geo-location on the e-map, ensuring the enterprise protects remote and lone staff as quickly as possible when they are at risk.

With five hierarchical structures of management and dispatch, Wanke service creates a comprehensive communication system augmenting existing legacy radios to connect all geographically dispersed staff over any distance. As a result, supervisors and operation rooms in all residential communities and commercial real estate across the nation can better serve the community and residential owners.

The solution systemically supports Wanke service to improve their ability to prevent and respond to risk, events, emergencies and disasters with cross-level dispatch and broader coordination and corporation. With the support of Hytera's new security digital communication solution, Wanke service has been awarded as "the leading high-quality services" corporation for three consecutive years across the top 100 property management companies in China.

7.3 Hytera solution supports hospitality businesses for the smooth running of events and safety while significantly minimizing infrastructure investments

Resorts Haihua island - dubbed "Dubai of China", is a resort of enormous artificial archipelago on Hainan island in China, consisting of three independent islets that occupy a total area of 1980 acres. It attracted over 200K visitors during the 2021 national day and a total of 5.5 million tourists since January 1, 2021. As an integrated large-scale tourism and leisure hub, the key attractions in the resort include an international convention and exhibition centre, oceanarium, theme park, shopping centres, museum, and cruise ports, as well as many hotels and restaurants. The resort employs up to 10000 people.

While struggling to recover from the disruption of Covid-19, hospitality businesses are highly focusing on service and safety, addressing the challenge brought on by labour shortages, enforced quarantine, and constrained budgets. Wireless communication is critical in maintaining business continuity and managing the critical situation, especially in such a large geographical footprint. The two-way radio system initially deployed on the central island has supported the resort staff's daily operation and the safety of tourists with reliable and resilient communication in that area. With a whole opening in late 2020, the customer also needed dynamic connections across various functions, such as housekeeping, security, grounds, transportation, and front desk, and communication across hotel rooms, floors, and spas all over the resort to enhance guests' experiences and safety. However, it's undoable to spend a tremendous amount of money to expand new repeaters, base stations, and in-building systems to achieve full coverage. Leveraging the ubiquitous range of commercial 4G/LTE networks, Hytalk Pro, an innovative collaboration platform, is suitable for business industries. It converges the existing DMR system, and advanced PTToC has been adopted to best meet the customer's needs in addressing the issues around cost-efficiency, business sustainability and resort safety. Drawing on the experiences of next-gen MC communication and leveraging the expertise of the native convergence ecosystem, Hytera offers customers a unique new compact system. It delivers seamless connectivity and versatile applications across the islands for working staff and security staff while minimizing customer budgets without additional radio infrastructure expenditure. The convergence innovation also makes it easy to achieve interoperable communications between two-way radios and PoC to maintain service continuity by allowing direct

communications between frontline and security staff through a dynamic approach, protecting the existing investment while introducing new technologies. In addition to augmenting two-way radio's voice coverage, the converged system offers a wide range of expanded capabilities with multimedia services and actionable tools, including push-to-video, push-to-text, advanced locations, and geo-fencing, automatic alerting from access control and video security, navigation assistant, intelligent voice assistant and more. Customers have benefited from these new capabilities, instantly connecting and quickly coordinating security staff for better daily operations like patrolling large areas and responding to emergency responses more quickly. As a result, they have greatly ensured staff and tourists' transparency, safety and security, achieving the best possible outcome through improved overall efficiency and effectiveness by automating processes, streamlining workflow and information sharing.

By providing the customer with the best solution in responding quickly to events and tourism needs and assuring their safety, Hytera innovation has significantly contributed to the smooth running of all events and avoiding disruption of Covid-19 in Resorts Haihua Island since its first launch in the middle of 2020.

7.4 Hytera Multi-Converge Communications Solution for Dubai Luxury Hotel, Atlantis the Palm

Atlantis The Palm, Dubai is a luxury hotel resort located at the apex of the Palm Jumeirah in the United Arab. It was the first resort to be built on the island and is themed on the myth of Atlantis but includes distinct Arabian elements. The hotel is redefining the concept of international luxury living.

With the contemporary living spaces offering uninterrupted views of the ocean and the Dubai city skyline, guests will also be able to enjoy a variety of unique amenities, including soaring private gardens with their pools and an awe-inspiring rooftop infinity pool suspended 90 meters above the Palm, relaxing private beaches, and world-class restaurants with award-winning celebrity chefs.

The massive size and scale of the properties throw up multiple challenges when it comes to ensuring security and enabling smooth operations across the vast site. In addition, a reliable communications network is essential to efficiently coordinate the many types of activity across the hotel, water park, monorail & beach areas.

Atlantis, the Palm in Dubai, has already deployed a private Tetra communications network, which has been used for some years. The hotel includes a water park, aquarium, and beach restaurants, which need different communication solutions. And also, interconnection is difficult since there are many communication standards over dedicated networks.

Hytera provided customers with portable radios and repeaters with DMR and TETRA standards, IP repeater stations interconnection and indoor tetra coverage using TS9200 systems, and overall communication solutions. One-stop solution with multi-user communication with multiple technologies, which includes DMR Tier II, Tetra, LTE, PoC, and Mobile Device Management solution.

Security team using TETRA communication includes PT580H plus, Z1P slim and rugged portable unit, and MT680H plus for control room radios.

The water park uses the dual-mode terminals PTC760, which connect the security team for emergencies and use the hotel management application, also extending indoor coverage by using TS-9200. Hytera offered a PoC solution with MDM and DMR Tier II solution with Rugged Hand portable radios at Atlantis the Palm, Dubai, a luxury hotel resort located at the apex of the Palm, helping them for enhanced coverage, excellent reliability and a more comprehensive range of additional features.

The water park has a separate radio communication system called Digital Mobile Radio (DMR). They installed rugged and waterproof radios since lifeguards were constantly dropping them into the pools and rivers around the park, resulting in a significant expense incurred to replace them. This digital System consists of one repeater, one antenna in the water park, and the same combination in dolphin bay. Dolphin bay is a separate part of the water park dedicated to dolphins. Although this is a DMR system as opposed to the Tetra system in the hotel, the same brand of hand radio is used.

However, the model is different from that used in the hotel, as the PD605 used in the water park is a very rugged and much more efficient communication solution. In addition, Hytera manufactures a specific brand of radio supported by the Tetra system (Atlantis The Palm) and a different model of radio supported by the DMR System.

Internal staff needs a smart communication solution over smartphones, including handling hotel management applications. Hytera offered a smart PoC terminal integrating smartphone and professional Push-to talk function over WLAN & LTE.

Deploying a Push-To-Talk system over 3G/4G/Wi-Fi networks enables instant communications with extensive coverage for the entire hotel. The centralized MDM allows customers to easily configure and manage PNC550 PoC radio through batch programming, upgrade, key management, permission control, Apps, and file push to PoC radio through WLAN and LTE, helping improve the overall productivity and efficiency of the hotel.

8 About the author

Chuan Chuan (Winter) Leng is an ICT specialist at Hytera with more than 18 years of professional experience. Chuan was at Lucent/Alcatel-Lucent/Nokia before joining Hytera. He has a wide range of experience in digital transformation and mission-critical communications across various sectors, including MNO mobile networks, public safety, physical security, manufacturing, oil & gas and transport, with a current focus on next-gen mission-critical communications.

As a network architect deeply familiar with multiple technologies, Chuan has also been designing and implementing many new ICT systems involving the convergence of PMR/LTE, ad-hoc tactical communications, 4G/5G private network and network security. He writes technical white papers and journal articles and leverages his technical expertise to provide consultancies to PMR professionals.

Chuan is a member of a number of professional bodies and has acquired a solid reputation in the industry from his many distinguished contributions, including his design of innovative solutions and promotion of higher industry standards.

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