WHITE PAPER

Public address

IP-based paging systems with Axis products

August 2021

AXIS COMMUNICATIONS

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1 Summary

Public address (PA) systems enable the broadcasting of announcements and can greatly improve security, safety, and operational efficiency in public, institutional, and commercial premises. A PA system can be used to issue live, scheduled, or triggered messages, in regular daily operation as well as in an emergency. If you have many speakers on a site, you can divide the site into zones and play content in one or more zones. In a school, for example, you could make announcements to individual classrooms, several classrooms, or to the whole school.

There are several ways to build an IP-based PA system using Axis audio products, combining an audio input device with Axis IP speakers and management solutions. Unlike a traditional analog system where you need to rewire the system to add new speakers, Axis audio devices are network-connected, so when you need to add more devices to the system you just plug them into the network and add them in the software. This creates a very flexible system that is easy to use.

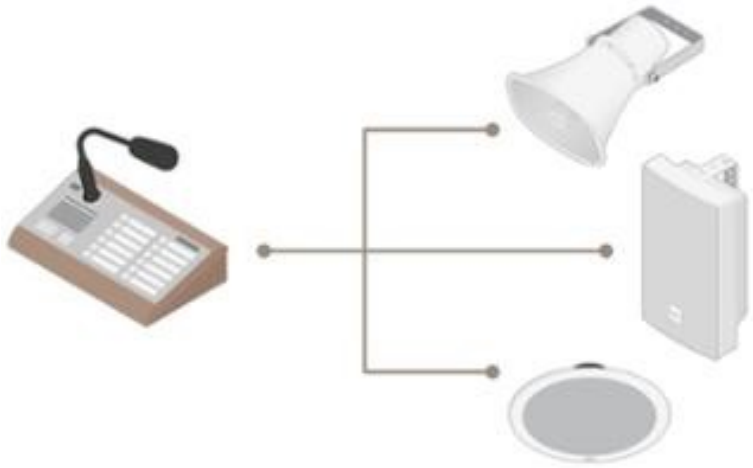
PA from Axis comes with built-in controls to ensure sound quality, device connectivity, and functionality. The active IP speakers contain both hardware and software and enable you to use predefined sound profiles and preconfigured digital sound processing to automatically optimize the sound quality in any environment. All devices can be monitored via the network, with remote health checks to keep you informed that the system is working, All these functionalities ensure that the PA system is fully functional and optimized when most needed; in an emergency or other unforeseen event you will know that the PA system is ready to help you.

Based on IP and open standards, Axis PA is easily integrated with third-party systems, such as alarm systems, video surveillance, access control, and telephony. This way, processes incorporating the two systems can be automated. Integrated with an earthquake detection or other early-warning system, the PA system can have a crucial role in informing the public as soon as possible. Integrated with video surveillance, it could allow operators to transmit verbal warnings when intruders are detected. The opportunity for integration creates a futureproof system where new possibilities and new use cases can always be introduced.

PA can also be used to play informative messages, updates, and audio commercials in retail environments. It can be used for paging, but also for background music. You can set up priorities so that the music can be interrupted by urgent messages.

Many types of devices can be used to provide the audio input, both Axis products and standard IT equipment. The output is handled by the Axis speaker model that best suits the location and use case. With the right audio management software, it is easy to control and update scheduling, zoning, and content, but also to manage user accesses and ensure that cybersecurity controls are in place.

2 Introduction



Public address (PA) systems enable the broadcasting of announcements in locations such as stadiums, schools, and shopping malls. Modern IP-based PA systems consist of IP audio devices, typically microphones and speakers, and audio management software which may be integrated in the devices. Announcements can be made live, played back according to a schedule, or triggered in response to specific events.

This white paper is intended to provide decision makers with an overview of how PA systems can be built with Axis network audio products, standard office equipment (such as IP telephones), and standard network cabling. The paper also gives an overview of benefits and features and concludes with describing some of the most central use cases of IP-based PA systems. This includes what a PA system can offer, which types of devices to use, and what to think about before deploying the system.

3 IP-based public address from Axis

Network audio systems offer a single, flexible solution for different kinds of needs, whether for protecting property, keeping people safe, or optimizing a business. The systems are futureproof, easy to use, and have built-in controls to ensure sound quality as well as device connectivity and functionality.

3.1 Simple and scalable

With IP-based PA systems, you can use existing network cabling to connect the audio input and audio output devices. When you need to add more devices to the system you just plug them into the network.

This scalability means that you can easily meet changing needs and requirements by expanding or changing the system.

3.2 Sound you can trust

All the functionalities are integrated in the active IP speakers, which contain both hardware and software. Each speaker is in fact a complete sound system. You can use predefined sound profiles and preconfigured digital sound processing to automatically optimize the sound quality in any environment.

All devices can be monitored via the network. Remote health checks keep you informed that the system is working, with the possibility for remote troubleshooting if needed.

These functionalities ensure that the PA system is functional and optimized when needed the most, such as in an emergency or other unforeseen event.

3.3 Flexible zones and content

The IP speakers can be grouped in different zones independently of the physical cabling. This means that administration of speaker zones is simple and easy to change. Both zone management and content management are done in the software, which provides flexibility and allows you to broadcast the content you want, in the right location, at the right time.

The remote management means that whenever you need to make changes to zoning or content, there is no need for re-cabling, no downtime, and no need to send staff to physically visit the site.

3.4 Integrates with other systems

An important advantage of using an IP-based public address system is the power to integrate with systems such as access control, video surveillance, alarm systems, and telephony. The integration allows automated processes.

Similarly, PA systems integrated with video surveillance systems can help operators give verbal warnings if an intruder is detected. This works extremely well for perimeter protection because trespassers are often easily deterred if they are simply informed of the fact that they are being watched.

Integration is possible because IP-based PA systems are built on open standards. This creates a futureproof system where new possibilities and new use cases can always be introduced.

3.5 Multipurpose use

A PA system is versatile and suits many types of applications.

- **Safety**
  A PA system can be used to issue live or triggered announcements during an emergency. It can be especially effective if the PA system is connected to, for example, an earthquake detection system or other early-warning system, when it is crucial that the public is informed as soon as possible. A PA system can also be used as an addition to a fire alarm and broadcast instructions in all relevant zones, saving time and potentially lives.
- **Operational efficiency**
  In retail environments, the PA system can be used to play recorded or live informative messages, updates, and audio commercials. In schools or production facilities you might want to play bells or signals at specific hours, for example, for breaks. You can use the PA system to call someone to a specific area, such as a colleague to the checkout counter, or a student to the principal's office. There is also a possibility to play background music, for example, from a radio station or a commercial provider of background music. You can set up priorities so that the music can be interrupted by urgent messages.
- **Security**
  By integrating the PA system with video surveillance, you can set the systems up so that video events automatically also trigger audio clips, typically dogs barking or a voice message, to discourage unwelcome individuals.

4 Components of a public address system

Audio input, audio output, and audio management can all be set up using Axis products and standard IT equipment.

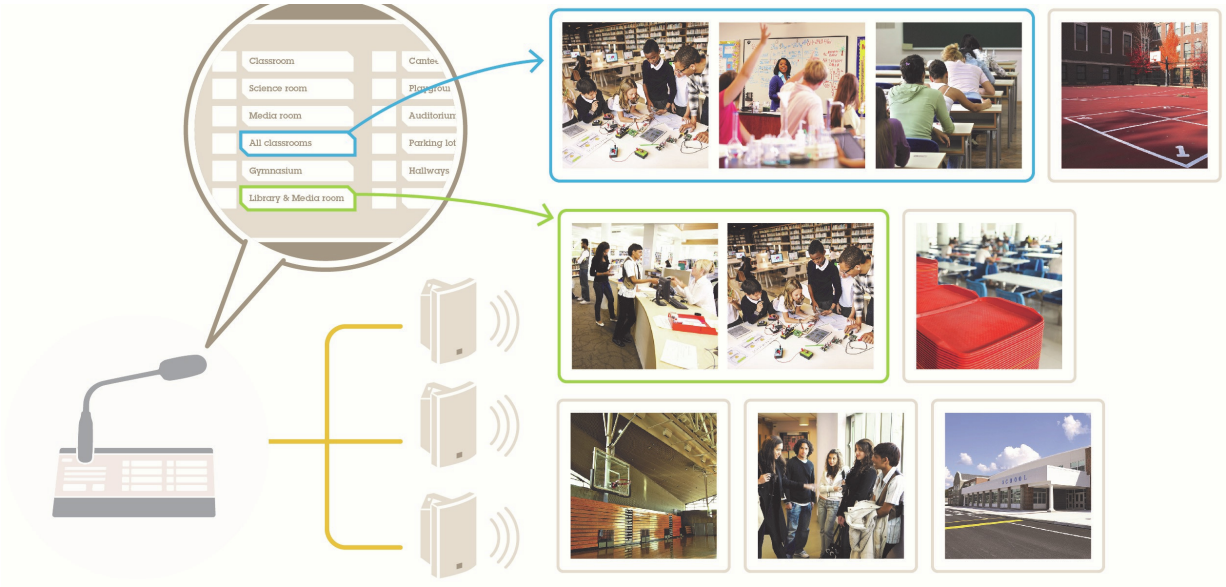
4.1 Audio input devices

Many types of devices can be used to provide the audio input: both Axis products and standard IT equipment. The choice of input device affects how zones, content, scheduling, and user access can be managed.

4.1.1 IP microphone as input device

The IP microphone 2N SIP Mic can communicate with Axis IP audio products in two ways – either via the Axis API (application program interface - code that enables communication between two software programs) *VAPIX*, or via the SIP protocol. SIP is the standard communication protocol in the telecommunications and unified communications industry. All Axis audio products are SIP-compatible.

2N SIP Mic has 12 buttons that can be used for live announcements or for triggering audio clips stored in the Axis IP audio products. If you need more than 12 buttons in your installation, you can install two or more 2N SIP Mics.



4.1.2 SIP telephone as input device

Most office telephones today are SIP-compatible. Any standard SIP telephone can be used to call the SIP address of an Axis IP audio device.

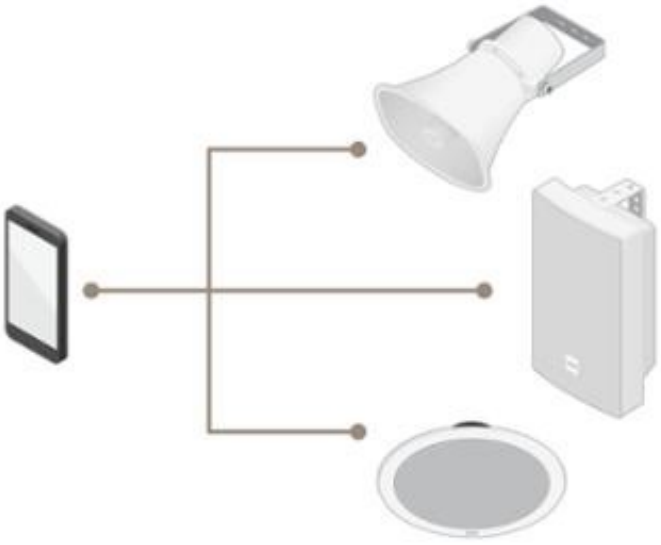
To facilitate daily operation, you can program a button, or a combination of buttons, on the phone to represent the SIP address of the audio device. You can then start a live announcement in your PA system simply by pressing that button on the phone. You can also program a button, or a combination of buttons, to trigger an audio clip on one of the audio devices.

4.1.3 SIP PBX as input device

A SIP PBX is a hub that works like a traditional switchboard. It can be hosted on an intranet or by a third-party service provider. SIP devices register with the SIP PBX and can contact each other through their phone number and extension number.

Axis devices can easily be connected by adding them as extensions to a PBX system. You can add single devices or connect AXIS Audio Manager Pro via SIP trunk. You can address any single unit or preconfigured groups just by dialing a number from your phonebook.

4.1.4 Smartphone with app as input device



There are third-party SIP apps that can be used for making announcements to Axis speakers. Most manufacturers of telephony and unified communications equipment also have their own apps for smartphones. If these apps are supporting the SIP protocol, they may also be compatible with Axis IP speakers. Axis does not test the compatibility of such apps so it would be up to you or your integrator to do that.

4.1.5 USB headset connected to a VMS client as input device

If you use a video management system from Axis or an Axis software partner, you can connect a USB headset to the VMS (video management system) client. Using the headset and a web button in the VMS client, you can make announcements to Axis IP speakers and trigger audio clips. This functionality is supported in AXIS Camera Station, AXIS Companion, and in many VMS solutions from Axis software partners.

4.2 Audio output devices

4.2.1 Speakers

Axis network speakers are complete, high-quality audio systems in themselves, with integrated amplifier and digital signal processor. They are powered by Power over Ethernet (PoE) technology and connect to standard networks, and as such are well-suited for PA purposes.

Each speaker has built-in audio management software. They come with preconfigured sound and onboard memory for storing audio clips that can be played back as required. Each speaker also has an integrated microphone that can be used with the built-in test function to verify the functionality remotely.

Form factors, sound pressures, and mounting possibilities vary — some speaker types are optimal for conveying clear and audible announcements in noisy outdoor areas, while others work better in smaller areas.

- **Horn speaker.** An Axis network horn speaker has a high sound pressure level and maximizes the loudness of those frequencies to which the human ear is most sensitive. This means that a message can be conveyed as clearly as possible. Due to its shape, the speaker directs all the sound in one direction, which further enhances the sound pressure. A horn speaker can be used in noisy indoor areas like warehouses and industrial plants, or in outdoor installations. It can be mounted on a pole or a wall.
- **Cabinet speaker.** An Axis network cabinet speaker provides a medium sound pressure level and should be used in less noisy areas, such as hospitals, schools, retail outlets, or office buildings. It can be used both indoors and semi-outdoors, meaning that it can be mounted under a roof that protects it from heavy rain. It can be mounted horizontally or vertically, on a wall, in a ceiling, or with a pendant kit.
- **Ceiling speaker.** An Axis network ceiling speaker provides a medium sound pressure level and should be used in less noisy indoor areas, such as hospitals, schools, retail outlets, or office buildings. It can be mounted in a drop ceiling where it will be very discreet and physically well-integrated.
- **Mini speaker.** An Axis network mini speaker provides a low sound pressure level and should be used in quieter indoor areas, such as hospitals, schools, retail outlets, or office buildings. It is small and discreet and fits into small spaces. It also has wide audio coverage, which means you need fewer speakers. The mini speaker has a built in PIR sensor for motion detection, which can be set up so that the speaker automatically plays an audio message when someone approaches.

4.2.2 Audio system devices

Audio system devices make it possible to combine legacy equipment, such as analog speaker systems with or without amplifiers, with network audio equipment and gain the benefits of network audio without having to replace all the equipment at once. Axis offers both a network audio amplifier and a network audio bridge.

- **Network audio amplifier.** This is a small device for connecting one or more analog speakers. The amplifier and the speaker together will, in all relevant aspects, act as a network speaker. Passive speakers that are connected this way can be managed through an audio management system — both network speakers and passive speakers can be controlled and managed from one location and system health tests can be performed on the passive speakers as well. The network audio amplifier has a built-in amplifier and digital signal processor (DSP) and is powered by PoE.
- **Network audio bridge.** The network audio bridge connects and combines analog and network audio systems. It has ports for both analog and digital connections and enables network speakers to be used in an analog audio system, and analog audio sources to be used in an Axis network audio system. A single network audio bridge can be used for hundreds of speakers. The audio bridge can be powered by PoE but can also use a standard power supply.

4.3 Audio management systems

The management of devices and audio content is a crucial aspect of an audio system. With the right audio management software, it is easy to control and update scheduling, zoning, and content, but also manage user access and ensure that cybersecurity controls are in place.

Axis offers software for efficient management and control of network audio systems of any size and complexity:

- **AXIS Audio Manager Edge.** This management software is built into every network audio speaker from Axis. It makes each speaker a complete, all-in-one sound system with no need for a separate software management server. AXIS Audio Manager Edge is intended for low-complexity use cases on small to medium-sized sites. It can be used to manage up to 200 speakers in up to 20 zones.
- **AXIS Audio Manager Pro.** This management software is intended for larger and more advanced use cases. It can handle large numbers of zones and thousands of speakers in a single interface. It facilitates long-term scheduling and advanced priority settings.

The most important features of audio management software are summarized below.

4.3.1 Audio zone management

If you have many speakers on a site, you can divide the site into zones and play content in one or more zones. For example, a school with speakers in several classrooms could make a zone for each classroom. This would make it possible to make announcements to individual classrooms, several classrooms, or even the whole school. Adding new zones in an IP-based software does not involve any extra costs, as it would do in an analog system where you would need more wiring.

There are different alternatives for how and where to administrate audio zones:

- **Integrated in Axis network audio products.** Each Axis network audio product has integrated basic functionality for audio zone administration. Speakers can be addressed individually, in separate groups or all at once. In AXIS Audio Manager Edge, you can administer zones by their physical location or by content. This gives an opportunity to make endless zone consultations.

- **Integrated in AXIS Audio Manager Pro.** If you need zone management for more than 20 zones on one site, you should consider using AXIS Audio Manager Pro. This management software supports more than 100 audio zones.
- **Integrated in PBX/telephony systems.** If you integrate your Axis IP speakers in a PBX environment, you can do the zone management in your PBX management platform. All Axis network audio products are SIP-compatible and can therefore be considered SIP telephone clients from a PBX point of view. You only need to set up one call group in your PBX server for each audio zone. Then you add the SIP address of the leader speaker in each zone to the corresponding call group. This can be a solution if you want to, for example, make an announcement to several remote locations at the same time. Simply group them into one call group and make a call to that group.
- **Zone management with third-party solutions.** Several Axis partners can provide management solutions.

4.3.2 Content management

The audio management system allows you to create content zones with great flexibility. You can combine physical zones, content zones, and devices, to be in full control of what is played and where.

In PA systems, you typically make live announcements, or you play back prerecorded messages, according to a schedule or when triggered. You can also play background music from, for example, a radio station or a commercial provider of background music.

4.3.3 Scheduling

You can set up schedules for when and where to play specific content. Announcements with important information to guide people can be scheduled at strategic intervals. If, for example, you want to play a clip of a bell to signal a break at a school or a production facility, you can schedule the clip to be played using the integrated scheduling functionality. If you want to play an audio commercial in a retail environment, you can schedule this as an audio clip as well.

Audio management systems may allow advanced scheduling, including advanced exception handling and fallback scheduling.

4.3.4 Prioritization of content

You can prioritize content and ensure that urgent messages interrupt schedules. You have the flexibility to prioritize between scheduled content (such as announcements, ads, or background music) and triggered messages. You can also prioritize between different audio sources (line-in, paging, intercom), so that, for example, paging is always prioritized over content from other sources.

4.3.5 Health monitoring

In case of system errors, these can be detected remotely. You can check device status, system status, and streaming status through the management system dashboard, or receive alerts when something is wrong. This way, you will know that the firmware and hardware are functioning as expected, and that no device has been disconnected. Speakers can be tested through automatic speaker tests, which can also be scheduled.

4.3.6 User management and access control

An audio management system lets you create groups, users, and roles to control who has access to what features. Each user has a unique name and password and can be added to multiple groups. You can select which apps the users in the group should have access to. There are separate access rights for administrators, content managers, and other users, which means you control who should have access to what, by only assigning the necessary permissions.

4.3.7 IT security

Axis network audio uses encrypted connections to protect the network from attacks. Axis speakers support IEEE 802.1X, which protects a network against connections from unauthorized devices. IEEE 802.1X is important in network audio applications since network speakers are often located in public spaces where an openly accessible network socket can pose a security risk.

Axis audio devices can communicate over HTTPS (hypertext transfer protocol secure), which means that the HTTP connection and the data itself are encrypted.

You should ensure that your devices use up-to-date firmware versions. This will give you access to new features and improvements, but also mitigate common risks for devices, because the latest firmware versions include security patches for newly discovered vulnerabilities. The *signed firmware* feature ensures that the firmware you install has not been tampered with.

For account access, you should use a principle of least privileged accounts. This means that user access privileges are limited to the resources needed to perform their specific tasks.

5 Deployment use cases

The flexibility of public address from Axis allows many use cases. This final chapter provides examples of typical deployments.

5.1 Education

In a school, the PA system can be used for a wide range of purposes, from informing students about new regulations, to making sure they remain safe during a lockdown or evacuation situation. A school environment can be complex with its many requirements:

- Multiple zone consultations
- Multiple audio sources
- Both scheduled and unscheduled content
- Information triggered by other systems or devices
- Simultaneous playback of messages with different content (internal vs external)

Keep in mind:

Be clear about your main use case. Is it to protect, inform and guide, or utilize audio in multiple ways? Designing the system depends on your needs and requirements.

Take ambient sound levels (noise) into account when planning device installation. Ensure good coverage in large and small rooms, halls, and corridors.

Solution:

Axis audio manager, together with Axis network speakers, Axis network audio bridge, and 2N SIP Mic can form a smart audio system to cover all the requirements in this school use case.

AXIS Audio Manager Pro enables:

- **Zone management.** You can group your speakers into different zones. Whether you need several zones in a single building, or in multiple buildings on the same campus, everything is set up in the software. It is especially useful that one speaker can belong to several zones, giving you the possibility to create several layers of zones.
- **Audio content management.** Live announcements and prerecorded messages are easily managed and set up. With 2N SIP Mic, you can play multiple prerecorded messages in multiple zones, but also handle announcements and local music and streaming content – all at hand's reach, for all your zones.
- **Scheduling.** You can do long-term planning for your announcements and bell schedule. You can even create rules for your scheduling. This gives you flexibility and the possibility to tailor your audio well in advance.
- **Prioritize between audio content.** You can make sure that an important live announcement from the principal or an emergency-triggered announcement overwrites all the scheduled outputs simply by giving it a higher priority.

All of this is done from a single user interface at one location.

5.2 Cities

PA can be used in many ways in a city depending on its needs. Where crime or vandalism are an issue, PA has great potential to help avert incidents immediately upon detection. Cities that face environmental threats can use PA to evacuate and keep people informed about a situation. Cities that experience heavy traffic during festivals or holidays can use PA to guide people and manage traffic flows.

Typical requirements may be:

- Emergency notifications
- Deterrence
- Informative notifications
- Sound detection

Keep in mind:

Consider the network infrastructure and how it affects the placement of speakers. Utilize poles that already have cameras installed. You may also need to integrate PA with third-party systems.

Solution:

- Axis horn speakers: outdoor speakers with built-in I/Os and two-way communication capabilities
- Axis paging microphone(s)
- Axis cameras with analytics
- AXIS Audio Manager Pro or third-party mass notification system
- Video management software (VMS)

With these devices, applications, and software you can set up both monitored and unmonitored installations with prerecorded messages and/or live announcements. The built-in I/Os can be triggered by sensors or other devices to play voice messages to warn, instruct, and guide. A situation can be closely monitored with the speaker's built-in microphone, which provides the possibility to listen in.

5.3 Critical infrastructure

A PA system can help protect critical infrastructure by ensuring uninterrupted operations and secure sites. Typical requirements may be:

- Perimeter protection
- Restricted access
- Emergency notifications
- Safety reminders
- Information and guides

Keep in mind:

Take ambient noise into account when planning installations. Ensure good coverage and strategic placement of speakers. You may need to integrate PA with third-party systems.

Solution:

- Axis paging microphone(s)
- Axis cameras with analytics
- Axis horn speakers: outdoor speakers with built-in I/Os and two-way communication capabilities
- Audio management for the triggering of audio clips, live and scheduled announcements, zone-based content management, and user management.
- AXIS Audio Manager Pro or third-party mass notification system
- Video management software (VMS)

5.4 Retail

In retail environments, typical use cases of a PA system include improving operational efficiency by playing live or scheduled promotional content or customer information. But there are also benefits related to security. For example, it could enable staff to call for assistance. The system can also be used for playing background music, with possibilities to stream from internet radio, line-in, SD card, or third-party systems.

Keep in mind:

Plan the speaker placement for an even sound throughout the premises and ensure good volume control for a pleasant customer experience.

Solution:

- Use the device-integrated management system AXIS Audio Manager Edge for zoning, volume control, scheduled announcements and advertisements, and user management.
- Get design help with AXIS Site Designer.
- Axis paging microphones
- Integrations with SIP PBX and VMS
- Use ACAP applications such as AXIS People Counter and AXIS Occupancy Estimator.

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About Axis Communications

Axis enables a smarter and safer world by creating solutions for improving security and business performance. As a network technology company and industry leader, Axis offers solutions in video surveillance, access control, intercom, and audio systems. They are enhanced by intelligent analytics applications and supported by high-quality training.

Axis has around 4,000 dedicated employees in over 50 countries and collaborates with technology and system integration partners worldwide to deliver customer solutions. Axis was founded in 1984, and the headquarters are in Lund, Sweden