Allied Telesis

IP Security and Surveillance

Video surveillance and security has moved to the forefront globally as a strategic tool in protecting corporate assets, the war against terrorism, crime prevention, and public safety. At the same time, video surveillance usage is increasing as a tool for traffic monitoring and local government security. The days of grainy and blurry analog CCTV systems have been replaced by advanced digital IP cameras and systems producing high-resolution, high-definition, real-time video. Along with that new technology, the high-speed IP networking infrastructure enabling it is critical.

Video Surveillance Technology Advancements

The new-generation IP-based video technologies displacing analog CCTV systems use high-definition, high-megapixel cameras and high-quality lenses to produce full-motion, real-time video. The requirement to have clear, high-resolution, real-time video demands high-speed IP to ensure uninterrupted quality. An IP video surveillance system consists of multiple cameras connected to video storage servers recording and processing video streams, and an operations center or hub where video is displayed and monitored on a real-time basis. Many IP security cameras feature 360-degree pan-and-tilt capabilities controlled remotely from an operations center. To support the IP video network and enable remote camera control and operation, a high-speed IP/Ethernet network is required with its design and functionality tailored to IP video applications.

IP security cameras are used in nearly every type of facility and application: on streets, on building exteriors, inside buildings and hallways, in parking lots, and so on. There are many types of fixed or adjustable cameras suited for many applications. They serve the needs of military, government, utilities, corporate, medical, retail, hospitality, transportation, and education and more. To serve the wide variety of needs and applications, whether indoors or out, a reliable high-speed IP network is needed to connect cameras, servers, and the operations center where monitoring occurs, whether inside a building or atop a roof or traffic light. The range of applications, environments, and even the types of cameras used, all dictate the need for adaptive IP/Ethernet networking infrastructure scalable to and optimized for the specific requirement. A "one solution fits all" approach lacks the robustness and economic efficiency to solve the range of applications required of IP video surveillance.

Allied Telesis Provides the IP Connection

Allied Telesis was founded in 1987 as an IP/Ethernet technology company, and has been pioneering IP access edge solutions for enterprise and carrier markets globally for more than 20 years. As a result, Allied Telesis brings to the market a diverse family of more than 1,000 IP/Ethernet products including media converters, PC NICs, Layer 2 and 3 Ethernet switches, routers, integrated Multiservice Access Platforms (iMAP™), and intelligent Multiservice Gateways (iMG).

Allied Telesis has been a leading innovator in IP video, designing advanced Ethernet switches, multiservice gateways, and carrier access products to be IP video-enabled and -capable. In fact, the first commercial deployments of IPTV services in the world used Allied Telesis as the platform. Allied Telesis brings both the video expertise and complete range of IP functionality necessary to deliver the highest-quality IP high-definition video possible.

IP video surveillance and security systems require network equipment at the camera sites, server/data center, as well as the monitoring center. Allied Telesis offers a range of products and technologies functionally and economically designed for each location to enable the creation of a complete end-to-end network solution. Product selections include units environmentally hardened for use in outdoor locations, as well as hub and aggregation equipment. In addition, Allied Telesis offers a unified management approach with its AlliedView™ NMS, allowing an operator to configure, monitor, diagnose, and manage every part of their security network with Allied Telesis intelligent devices.

Allied Telesis solutions encompass the connectivity needs required for a complete IP video surveillance network, from connecting cameras to backhauling video, to distribution via:

- Power over Ethernet (PoE)
- 10/100TX and BX
- Optical-to-Electrical (O/E) media conversion
- 100Mbps and Gigabit optical Ethernet
- Gigabit and 10 Gigabit fiber transport

The Importance of IP Video Functionality

IP Multicast (IGMP)

IP multicast is based on the Internet Group Management Protocol (IGMP), and is designed to allow one video source to broadcast video to multiple hosts as a single instance, thereby conserving bandwidth. IGMP uses a series of "join" and "leave" messages to allow clients to receive video and notify the host to broadcast it. IGMP operates with group IP addresses, using an address range specifically designated for video multicast. IGMP can be configured for either a Layer 2 bridging function (IGMP snooping) or Layer 3 routing using VLANs (IGMP proxy routing). Multicast is most often used between servers and clients, such as a NOC center.

Allied Telesis supports both IGMP Layer 2 snooping and Layer 3 proxy routing. Depending on the size of the IP security network and design, the systems can be configured for either a simple bridging approach or a more comprehensive routing approach. In most cases, routing is used at a video hub and aggregation point, with bridging used at subtending ends.

Real-Time Streaming Protocol (RTSP)

In many instances, real-time IP video is merely streamed from the source end to the host site rather than broadcast. Known as Unicast, RTSP protocol is used as the streaming mechanism Allied Telesis supports across its access platforms to deliver Unicast along with Multicast video traffic. Unicast is primarily used between cameras and servers as a point-to-point video stream.

IP Quality of Service

Allied Telesis places a high value on IP Quality of Service (QoS) as a requisite for video as well as multiservice Triple Play (voice, video and data). IP QoS is based on the use of VLANs, allowing the user to set priorities (IEEE 802.1Q) as well as classifications of service (IEEE 802.1p). If there is more than one service in a network (for example, IP video from a camera and traffic control for a signal on the same pole), a VLAN can be assigned to each service, each with its own classification and priority. This assures contention does not affect performance for one service over the other. Allied Telesis also supports enhanced functionality such as rate shaping, rate limiting and traffic policing through other IP functions like DiffServ.

Low Latency

Allied Telesis uses chip and software designs to deliver extremely low latency for video traffic, as real-time digital video quality can suffer from latency or buffering. As one example, a number of Allied Telesis Ethernet switches and iMAP carrier access platforms support Ethernet Protection Switch Rings (EPSR) on the fiber uplink for redundancy in the transport network. Its EPSR technology provides sub-50 millisecond failover switch protection, delivering hitless protection for streaming video should a fiber cut or failure occur.

Layer 2 or Layer 3 Approach for IP Video

Whether to implement a more simple to configure Layer 2 IP video network or create a Layer 3 routed video network is somewhat dependent on the size of the network and application. Single switch and small-to-medium IP video surveillance installations typically require a less complex network using a Layer 2 approach without the more complex multicast routing capabilities.

In larger installations that spread across a large footprint, or when more than video may be transported in the network, a Layer 3 routing approach provides more control for services, as well as allows for video to be placed into various subnets. Typically, networks where multiple switches are used will benefit from the more robust performance and higher degree of management that Layer 3 affords.

Allied Telesis offers choices of Layer 2 and Layer 3 switches, or configuring a Layer 3 switch as a Layer 2 device, as needed. Its iMG gateway devices support both Layer 2 and 3 functions, as does the iMAP carrier access platform. The products serve as building blocks to create the right network at the right location, with the scalability and flexibility to deliver optimum performance and economics.

Allied Telesis IP Video Surveillance Partnerships

Allied Telesis has strategic partnerships with a number of major IP camera and systems vendors, distributors, and integrators to ensure customers benefit from a total solution. Allied Telesis works with partners to test and perform interoperability to ensure the system meets performance expectations and operates seamlessly. Allied Telesis and its solutions partners understand customers want an integrated solution, without having to arbitrate between multiple vendors. These partnerships result in the intelligence and expertise necessary to provide a fully featured, high-performance IP networking component as part of a complete IP surveillance solution.

Approaching IP video surveillance as a system through partnerships reduces complexity, and therefore time to install, test and tune video. It also assures end-to-end performance requirements are met. Allied Telesis IP video partnerships allow customers the flexibility to choose among industry-leading equipment suppliers, VARs, and integrators offering the best fit to their particular application, requirements, and budget. Allied Telesis welcomes customer requests to recommend or bring in a partner, or propose a complete turnkey solution.

Small Video Surveillance System: Single Switch Application

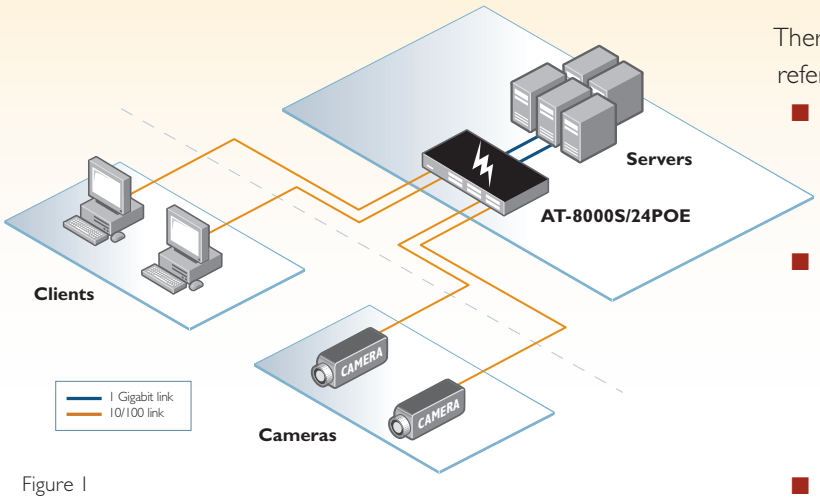

Figure 1

A facility may have IP cameras dispersed inside and outside the structure, with a security monitoring center located on the premises. This type of application is often found in a number of common locations:

- Office buildings
- State, local, or federal facilities
- R&D centers (secure)
- Hotels, entertainment and hospitality venues
- Banks and financial offices

A single 12-, 24- or 48-port Ethernet Switch can be used, depending on the number of IP cameras and clients that need to be connected. In most cases, Layer 2 IP functionality is used, including IGMP snooping, querying, and possibly filtering. Should other data and/or voice also be shared on the network, Layer 3 VLAN routing is an option. The ideal application uses Power over Ethernet (PoE) to distribute power from the switch to remote cameras.

From a port capacity and bandwidth perspective, the ideal switch choice is the AT-8000S/AT-8000GS family, due to its outstanding economic value and features. Figure 1 shows a simple IP security layout using a single 8000S Series switch with PoE, 24- or 48-port available.

There are several key features of the 8000S or 8000GS Series reference solution:

- The switch provides power to remote cameras (indoor as well as outdoor) using PoE. As required, the switch can implement access security (IEEE 802.1x or MAC-based authentication).
- Servers can be networked directly via Gigabit ports from the switch to provide high-speed throughput for real-time high definition video processing and storage. The 8000S/GS Series switch provides support for both multicast traffic and unicast feeds, and can also perform IGMP querying to intelligently forward multicast packets to hosts that have requested it.
- The 8000S/GS Series switch also sends IGMP queries to maintain client membership of IGMP groups and deliver traffic efficiently. This avoids the problem of dropped leaves creating unnecessary and unwanted multicast traffic that can congest the network.

Alternative Solutions

To avoid any chance of a single point of failure, substituting the 8000S/GS Series switch with either the AT-9424T/POE or AT-8624POE switches provides power-supply redundancy. Features and functionality are the same, including models with varying port densities, but they offer additional redundancy over the 8000S/GS Series.

There are occasional situations where only a few cameras and a single host is needed, as in the case of a small retail store or in those cases where distance requires the use of fiber. In these applications, Allied Telesis media converters and PoE injectors provide a scalable and cost effective solution. Examples of these products include the AT-6101G (PoE injector), AT-PC2002POE, and AT-PC232/POE (fiber-to-PoE media converters).

Additionally, Allied Telesis offers alternative solutions for IP security cameras that do not support PoE. Using a small, economically attractive AT-6102G PoE splitter to directly connect the camera allows power to be taken from the standard PoE line and supply the camera with user-selectable voltages between 5 and 12 V.

High Availability IP Switch Solutions for Smaller Installations

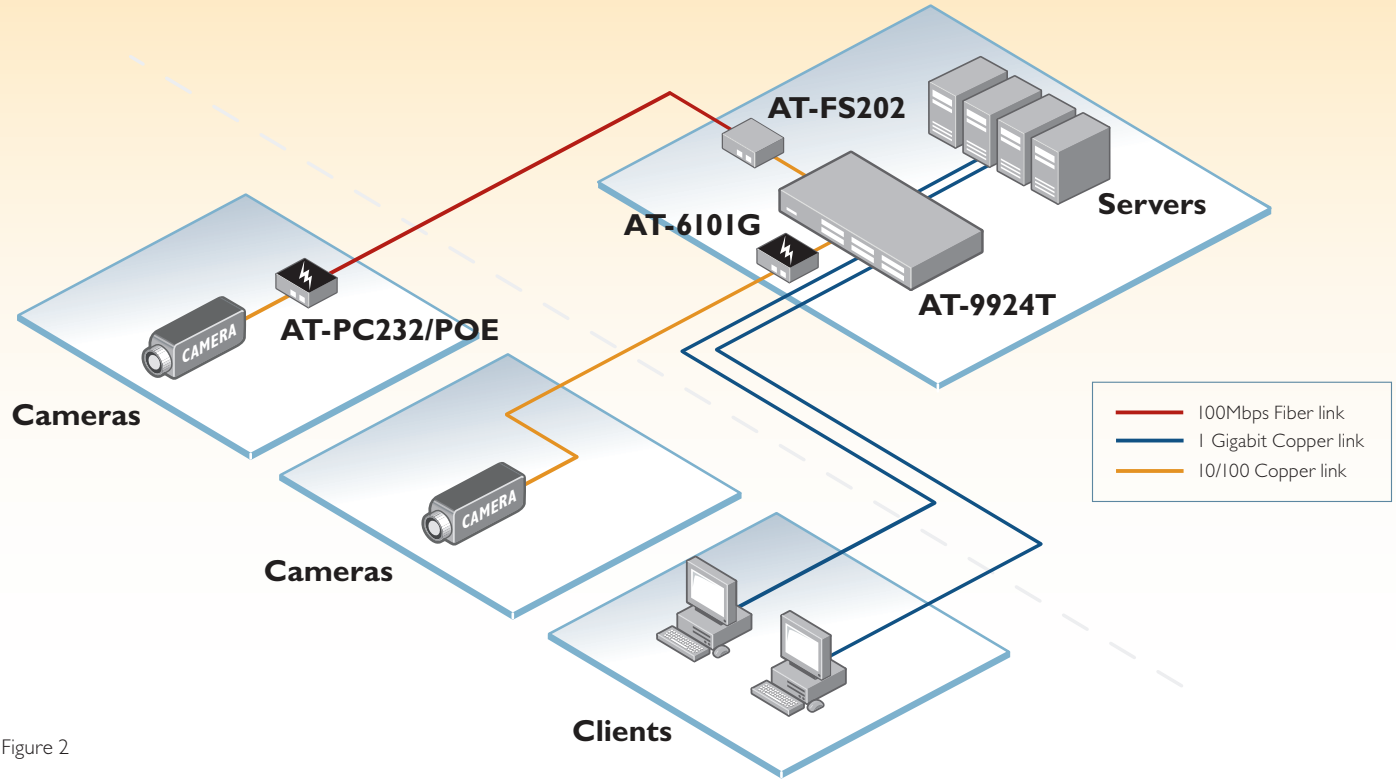

Figure 2

There are instances when, although the size of the IP security network is not large, the nature of the security application requires a higher level of redundancy as well as the ability to deliver high availability. Some examples of the applications include the following:

- Military and defense facilities
- Public utility facilities
- Secure labs
- Emergency service facilities

The Allied Telesis 9924 Series switch is the ideal solution based on both performance and value for a high-availability application. It is a fully featured Layer 3+ Ethernet switch, supporting extensive QoS, IP security, routing, and of course IGMP multicast functions. The 9924 Series switch offers hot swappable redundant power supplies for reliability.

Because the 9924 Series does not support PoE, however, the 6100 Series PoE injectors can be used to bring power to cameras using Ethernet cabling. The AT-PC232/POE media converters could be used, as well, for cameras located farther from the switch room if fiber is used. Figure 2 shows an example of an IP security network topology using the 9924 Series switch and peripheral PoE equipment in a typical application.

Alternative Solution

The x600 Series Layer 3+ Ethernet switch with PoE can be used to provide the necessary hardware redundancy with PoE functionality. The x600 Series switch can also be stacked to provide uplink and additional hardware redundancy using Allied Telesis VCStack™ technology. This removes a single point of failure by using two NICs bonded together into a Link Aggregation Group (LAG) to the servers, with one connected to each chassis in the stack.

Similar stacking options can be provided using Allied Telesis SwitchBlade® x908 or x900 Series switches.

Medium-sized IP Security Solution: Switch Network

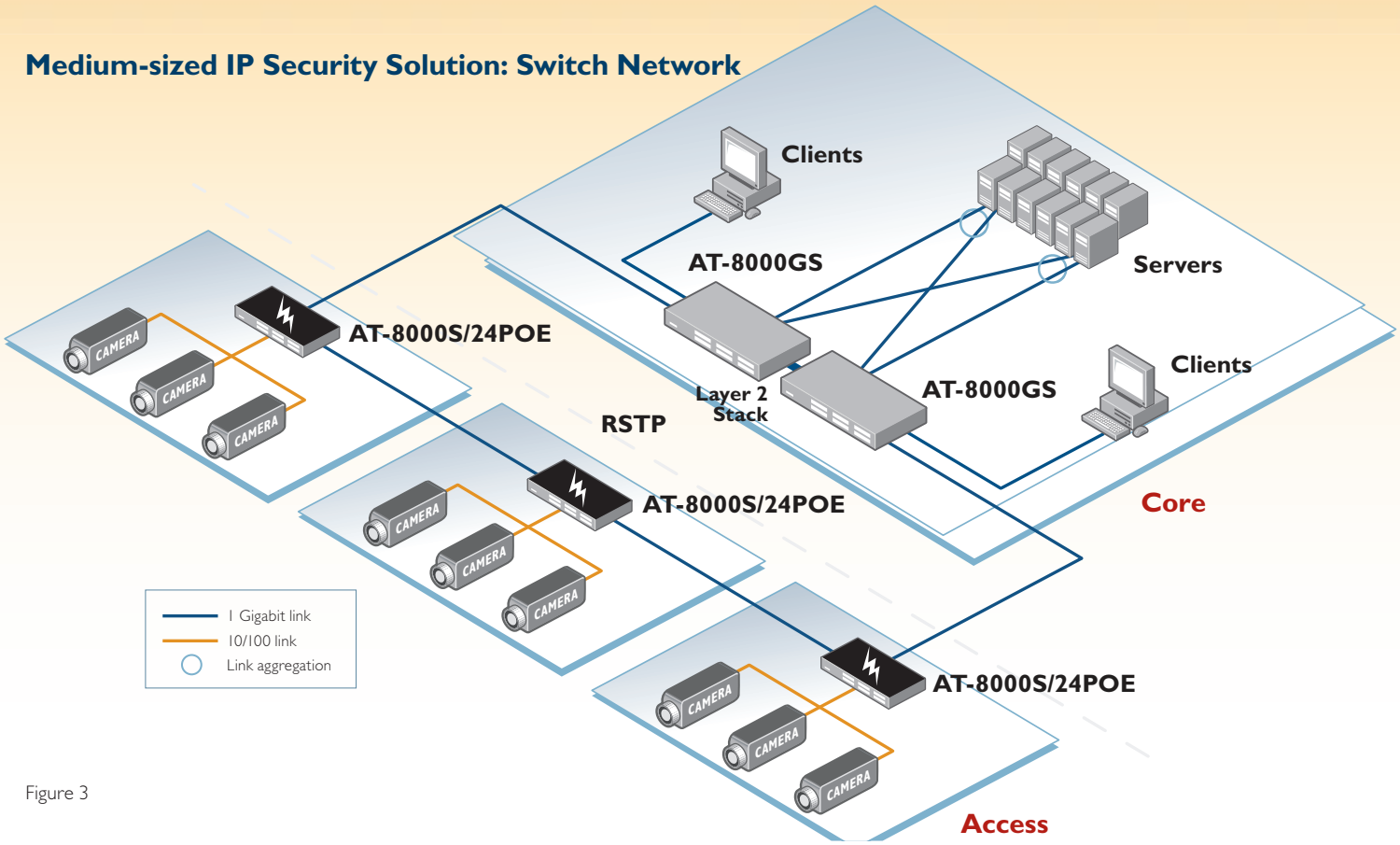

Figure 3

Many IP security situations encompass multiple cameras inside and outside in multiple building clusters. In this distributed architecture, a switch is needed within each building that connects to a network switch in the central site where servers and the main control center resides. Some typical applications for a medium-sized application such as this include the following:

- Medical/hospital facilities
- Business/corporate facilities
- Medium-sized retail shopping centers
- Medium-sized educational institutions
- MDUs (apartments, condominiums or hotels)

The distribution switches are generally Layer 2, with port capacities scaled to the number of cameras and/or clients needed to connect at each location. The network switch is generally Layer 3, providing Gigabit fiber connectivity to the distribution switches, and Gigabit fiber connections to the servers. For resiliency, the network must offer link redundancy with failover protection, allowing restoration of the connection within an acceptable timeframe for continual operation.

In a distributed environment like this, the network is divided into core and access layers. The overall network topology between the core and access switches is a ring with link failover capability using Rapid Spanning Tree Protocol (RSTP).

The access switches connect to the IP cameras, and need to provide PoE power as required. Other requirements for these switches include IGMP snooping for intelligent forwarding of multicast traffic, IGMP filtering in case additional control of IGMP signaling is required, and RSTP to add link/node failure tolerance to the network. The access switches are connected to each other and the two core switches using a ring topology.

The core switches provide connectivity to servers and client PCs. They receive the IP camera video feeds from the access switches and forward this traffic to the servers. In turn, they receive multicast traffic from the servers and deliver it to interested clients. The core switches must provide enough bandwidth for this high-traffic volume, IGMP snooping and querying capability, as well as support RSTP.

Recommended switches for this solution include the following:

- Access: AT-8000S/24POE or AT-8000S/48POE
- Core: Stacked AT-9924 or SwitchBlade® x908

This solution offers a good level of reliability, as the core switches are redundant. RSTP recalculates the network topology to re-establish connectivity with all the nodes in the network. Depending on the location of the break, traffic flow can be restored in under a second using the RSTP rapid-transition mechanism. At most, RSTP will restore connectivity in 5-15 seconds, as all the links are point-to-point. In this solution, it is not only necessary to restore connectivity, but also to re-establish correct multicast forwarding through the switches. This requires the IGMP query source to induce a refresh of the switches' IGMP forwarding entries. Using Allied Telesis IGMP query solicitation (SwitchBlade x908, x900 and 9924 Series), the multicast path can be re-established within a second or two after RSTP re-convergence. This feature allows the switch to force an immediate general query when an RSTP topology change is detected.

Access node failure will result in all the cameras connected to that node being unavailable. As described above, connectivity of the rest of the cameras to the servers is quickly restored. Core switch failure does not result in lost server connectivity, as link aggregation via teamed NICs provides connection to both core switches. If client devices are not employing NIC teaming, then clients connected to the failed core switch will be unavailable. After RSTP re-convergence and IGMP signaling update, all the camera feeds will be available.

Alternative Products and Accessories

Other Allied Telesis switches available to build a network with similar features include the following:

- Core switches: SwitchBlade x908, x900 and x600 Series
- Access switches: AT-9424T/POE and AT-8624POE

In a medium-size network, legacy switches can be reused—even if they do not have PoE support—with the option of an inexpensive Allied Telesis PoE injector (AT-6101G).

Media converters with PoE can also be used for connecting IP cameras over a long-reach fiber strand.

Medium-sized High Availability IP Security Solution: Switch Network

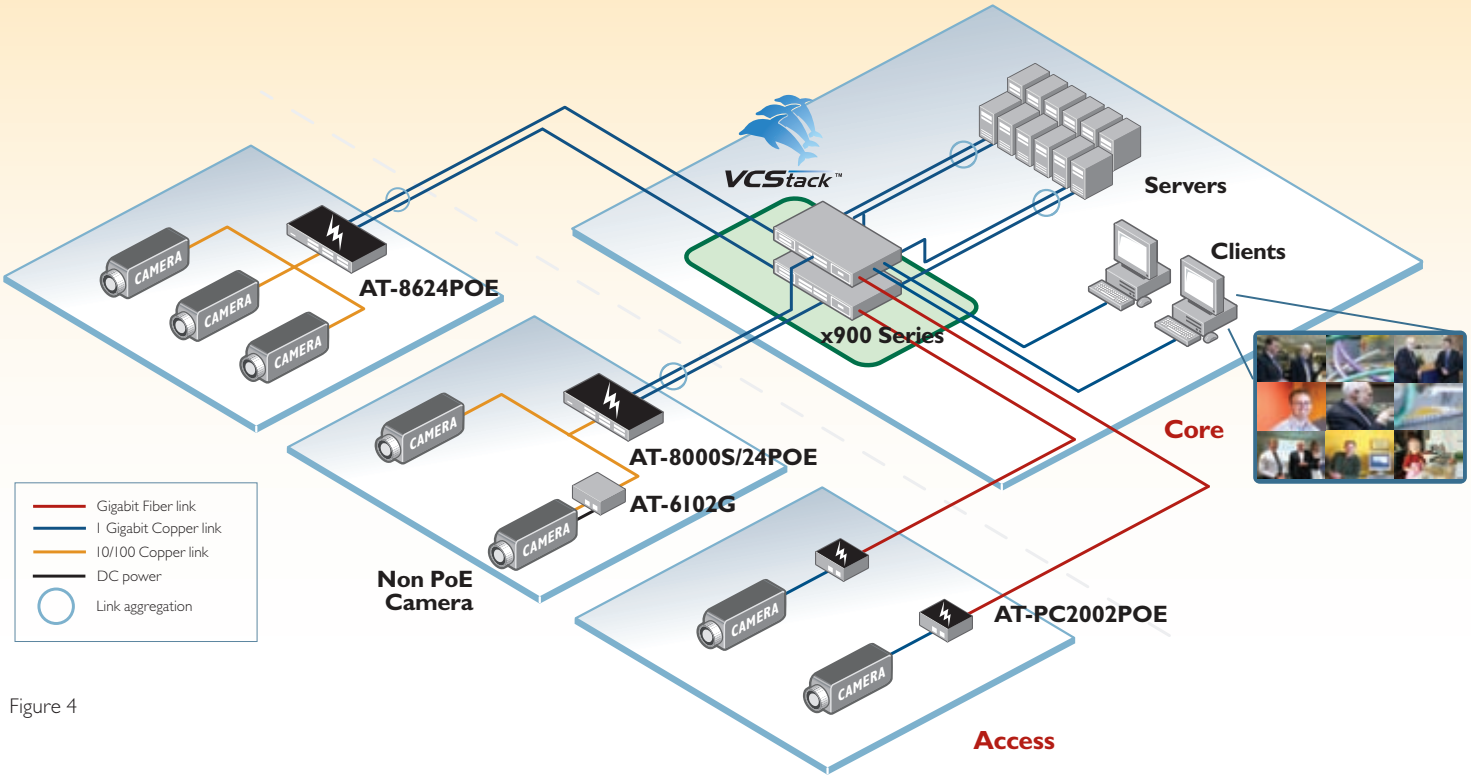

Figure 4

This solution is similar to the previous one, with the exception that no service downtime is allowed. As real-time video is sensitive to latency and buffering, the goal in a situation where high availability is required is to limit failover protection (switch protection) to a range of 50 milliseconds. High availability is typically required for several types of applications:

- Military and defense
- Secure facilities (for example, prisons)
- Airports and other facilities where terrorism concerns exist
- Secure labs and research facilities

The Allied Telesis virtual chassis stacking solution (VCStack), together with link aggregation, can be used when high availability is required. This approach allows a simpler network topology and configuration as well as more efficient use of bandwidth.

Two x900 switches form the "virtual" network core. Each access switch is connected to the core switches with two aggregated links, one to each member of the stack. The use of link aggregation is made possible because the two core switches are a single virtual chassis. Such a topology creates a loop-free network with link and core switch redundancy. Application servers (and optionally clients) can be equipped with two or more NICs and use NIC bonding to provide resilient connections to the core. A clear benefit of this configuration is that no single point of failure exists in the critical part of the network and there is no service downtime in case of link failure.

Alternative Products and Accessories

Allied Telesis alternative products supporting VCStack include the SwitchBlade x908 and x600 Series. In a medium-size network, legacy switches can be reused even if they do not have PoE support with the option of a PoE injector (AT-6101G).

Media converters with PoE support can also be used to connect IP cameras over a long-reach fiber strand.

Large-scale Distributed IP Security Network: Switch Network

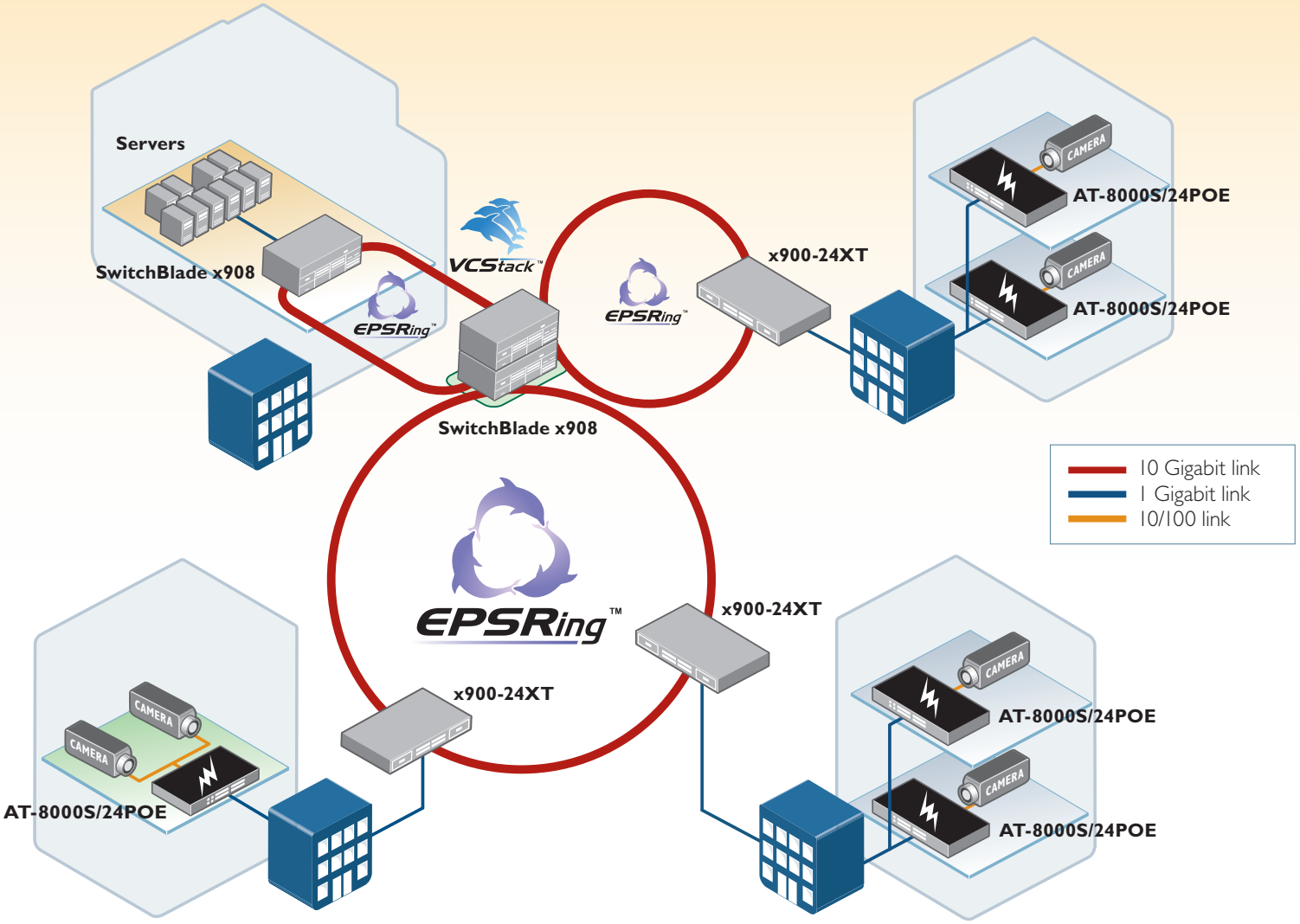

Figure 5

In a large campus network, or metro-area network, the video surveillance system is typically overlaid on an infrastructure that has been designed to carry multiple applications and services. Such a network, supporting a significant number of end-users, needs to be very reliable, manageable, and scalable. Such applications are often found in several facilities:

- City or municipal street and public surveillance networks
- City or municipal traffic monitoring networks
- Transportation, transit line networks
- Large education campuses (college, university)
- Large business parks
- Large retail malls
- Military bases

There are often other data connections, even other video such as conferencing, and possibly IP voice, within the same network. These requirements are best met by a network design in which different services are partitioned into separate VLANs, and transported over resilient rings protected by an extremely fast failover mechanism.

The Allied Telesis fast-failover ring protection solution is the Ethernet Protected Switching Ring (EPSR). This is an extremely reliable, high-performance ring protection protocol that can restore connectivity within 50ms of a link failure being detected. Services such as video surveillance can each be provisioned with one or more VLANs running over the EPSR rings, with data on Layer 2 or Layer 3 switched between the rings and the central-site facility.

A reliable, scalable design is achieved by subtending multiple rings off multiple SwitchBlade® x908s with VCStack™ providing the gateway between the rings and central site. For ease of management, control, and troubleshooting, a different video-surveillance VLAN runs in each ring, and the SwitchBlade x908 VCStack Layer 3 switches the video streams from the rings to the server and client devices at the central site.

This network design is very scalable, potentially providing extremely reliable network services to thousands of end users, and hundreds of surveillance cameras. When multiple services share the same network infrastructure, it is necessary to ensure each experiences the Quality of Service expected, ensuring timely delivery of traffic and access to applications when required. Bandwidth usage must be controlled, so no one service can starve the others of bandwidth. Moreover, for loss and jitter-sensitive applications like video, it is extremely important to be able to deliver the data streams in a smooth, lossless fashion.

The Allied Telesis SwitchBlade x908 and x900 Series switches are extremely feature-rich Quality of Service offerings that can manage the characteristics of over 1,000 separate data streams simultaneously, thereby making them ideal for the provisioning of shared-service networks involving real-time applications.

A link failure in any ring results in EPSR recovering in as few as 50 milliseconds, usually undetected even by users of real-time services like video or voice. A failure of a unit within the SwitchBlade x908 VCStack will automatically recover with minimal disruption.

Outdoor Traffic and Security IP Surveillance Applications: Extended Temperature

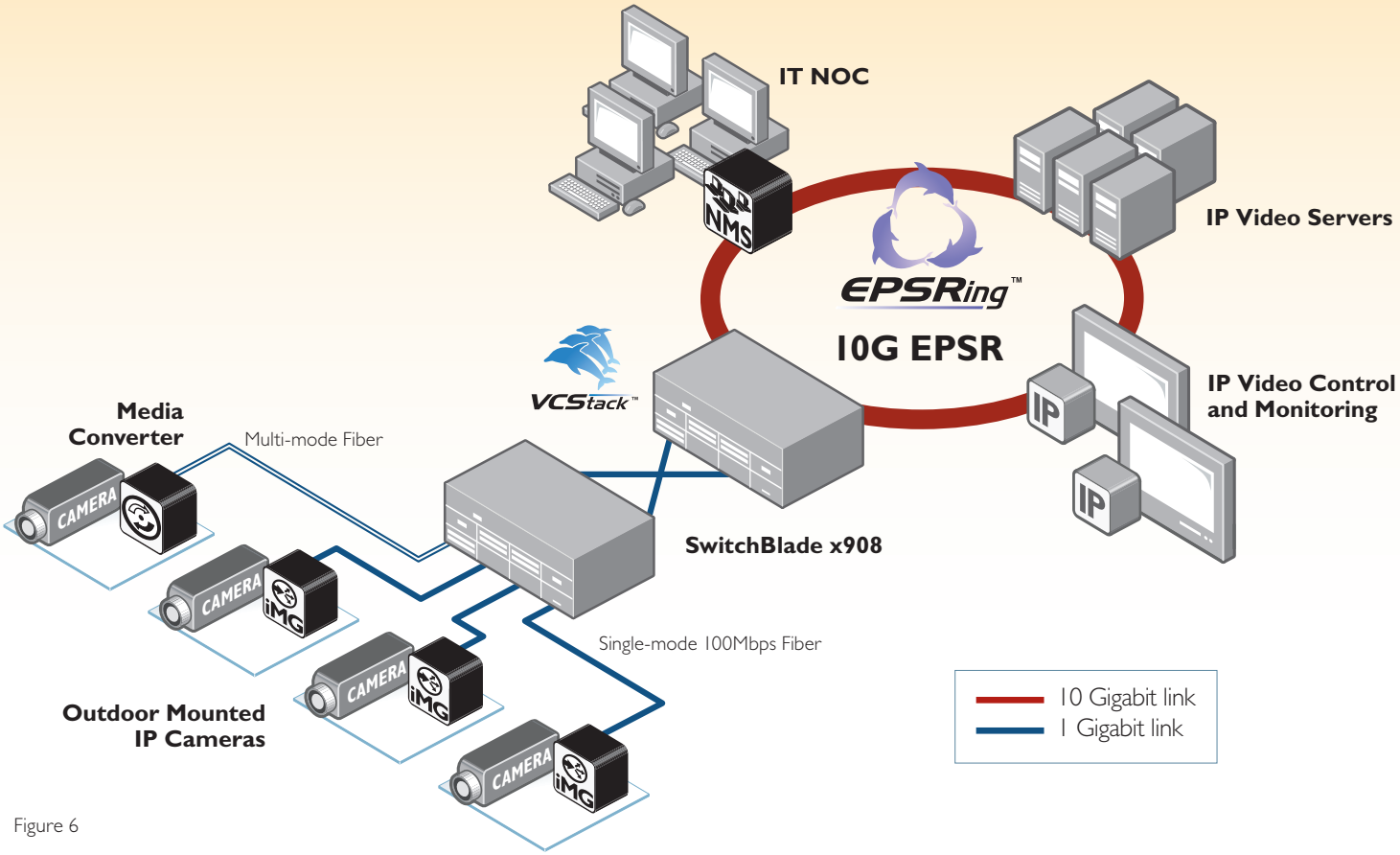

Figure 6

It is common to mount IP security cameras on poles, traffic lights, or even on buildings outdoors. Additionally, there are numerous cameras dispersed over a wide area. It becomes economically impractical to put a switch at each location, and it is further compounded by the need to have electronics capable of withstanding the rigors of non-environmentally controlled locations. Although NEMA-rated cabinets are often present to provide power, they do not provide adequate protection against extreme heat or cold.

Reference Solution

Allied Telesis offers a carrier-class fiber ONT, the iMG 7x6MOD Series, designed for FTTH and use on residential exteriors. The iMG 7x6MOD is an extended-temperature product in a sealed enclosure with a fiber and electronics tray designed to NEBS level 3 environmental specifications.

Using the iMG 7x6MOD, fiber is run from a centralized switch to the pole, traffic light, or similar outdoor location, allowing up to a 20-kilometer distance between a switch and the IP security camera. Each iMG 7x6MOD has six 10/100TX Ethernet ports, allowing the ability to connect up to six cameras in a location — on the same pole or even adjacent poles, or buildings within the distance that Cat 5e Ethernet cable permits. The iMG 7x6MOD uses one 100Mbps active Ethernet point-to-point single-mode fiber connection between it and the switch.

Since most IP cameras in traffic or street surveillance applications have access to and use local power, PoE becomes much less of a requirement. The iMG 7x6MOD can be mounted inside a NEMA cabinet at the base of a pole and powered from there, or on the side of a building and AC-powered from the building. Figure 6 shows the use of an iMG 7x6MOD extending from a central fiber configured switch for outdoor applications.

Alternative Solution

The alternative solution is the use of an FS232x Series media converter to convert from Ethernet over fiber to copper at the camera location. It is also applicable when multi-mode fiber is used, since the iMG 7x6MOD is strictly a single-mode fiber device. As a simple optical-to-electrical media converter, this allows a single IP camera to connect to a single fiber from the switch (options of single-mode or multi-mode type fiber supported). The FS232x Series media converters provide an unmanaged solution. However, this is generally not an issue at remote camera sites. Media converters, though, are not designed to the same hardened temperature specification of the iMG 7x6MOD. They are best suited for use in NEMA-rated cabinets, which afford a maximum degree of protection against outside temperature, moisture, and humidity.

IP Video Security Technology Solutions

An overview of the products referenced in the application section is listed here with models and features. More detailed information is available, including datasheets, at **alliedtelesis.com/products**.

Stackable Layer 3 Ethernet Switches

x600 Series
Intelligent Gigabit Layer 3+ Switches

SwitchBlade® x908
Advanced Layer 3 Modular Switch

8600 Series
Layer 3 Fast Ethernet Switches and PoE (8624)

x900-12X and 24X
Advanced Gigabit Layer 3+ Expandable Switches

Stackable or Standalone Layer 2-4 Ethernet Switches

8000GS Series
Managed Stackable Gigabit Ethernet Edge Switches

9400 Series
Gigabit Ethernet Layer 3 Switches

8000S Series
Managed Fast Ethernet Switches and PoE

9924 Series
Multi-layer IPv4 and IPv6 Gigabit Switches

Media Conversion and PoE Injection Devices

AT-FS202 and AT-FS232
Two-port Fast Ethernet Speed/Media Converter

AT-PC232/POE
Two-port Fast Ethernet Speed/Media Converting Switch with Power over Ethernet

AT-PC2002POE
Two-port Gigabit Speed/ Media Converting Switch with PoE

AT-6101G
IEEE 802.3af Single-Port Gigabit Ethernet PoE Injector

AT-6102G
IEEE 802.3af Single-Port Gigabit Ethernet PoE Splitter

iMG Fiber Outdoor Gateways

iMG 7x6MOD Series Outdoor ONT
Gigabit or Active Ethernet single-mode fiber uplink, 6 x 10/100TX and 2 or 4 FXS ports in NEBS 3 enclosure

iMG 726 Electronics Tray
Without outdoor enclosure, for cabinet or rack mounting

About Allied Telesis, Inc.

Allied Telesis is a world class leader in delivering IP/Ethernet network solutions to the global marketplace. We create innovative, standards-based IP networks that seamlessly connect you with voice, video and data services.

Enterprise customers can build complete end-to-end networking solutions through a single vendor, with core-to-edge technologies ranging from powerful 10 Gigabit Layer 3 switches right through to media converters.

Allied Telesis also offers a wide range of access, aggregation and backbone solutions for Service Providers. Our products range from industry leading media gateways which allow voice, video and data services to be delivered to the home and business, right through to high-end chassis-based platforms providing significant network infrastructure.

Allied Telesis flexible service and support programs are tailored to meet a wide range of needs, and are designed to protect your Allied Telesis investment well into the future.

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