



# 360 Degrees of Coverage at the Client



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# Overview

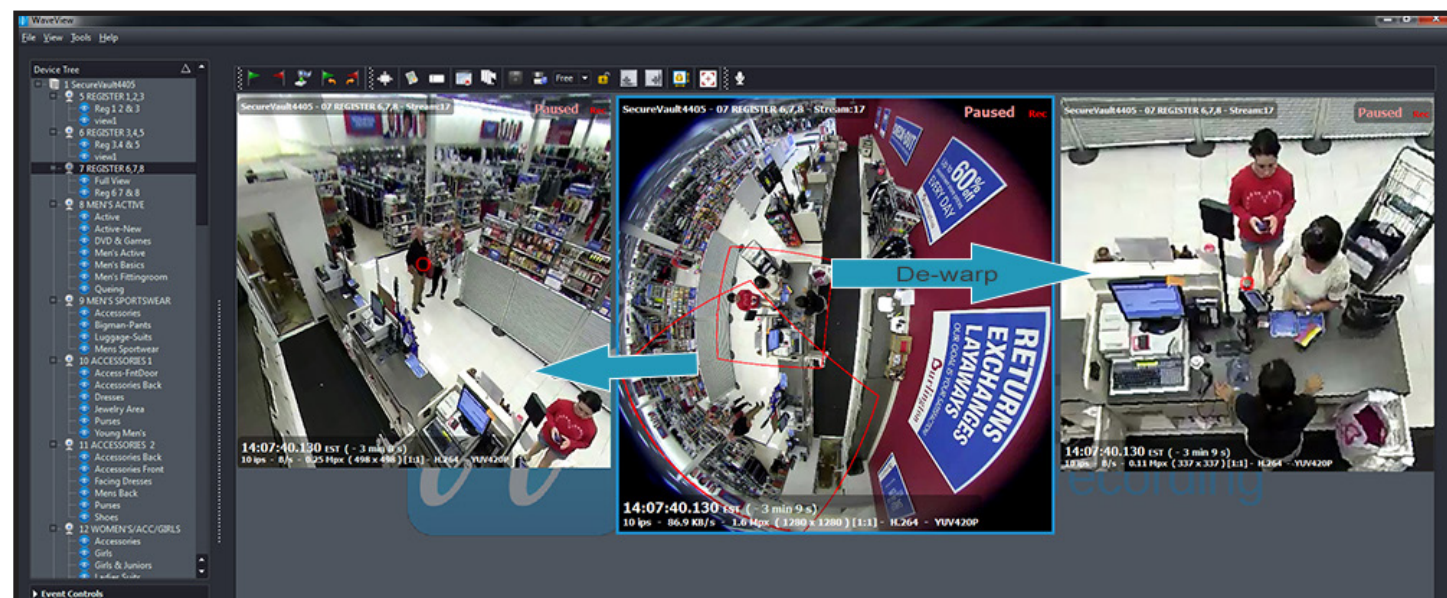
Retail surveillance, airport security, schools, public spaces and other similar applications are realising the extensive coverage and additional cost benefits of installing fisheye or panoramic cameras. Specifying 360/180 degree cameras is a growing trend in video surveillance due to their ability to continuously monitor and record an extremely wide area of view, coupled with the savings from requiring fewer cameras. The images from these cameras are distorted, however, and need dewarping technology to unbend the globe-like picture that the cameras produce. The round and distorted image is the result of capturing such an ultra-wide field of view. Dewarping is a processor intensive method that makes flat, rectangular images from the original images produced by all 180° and 360° video cameras. **To make the images usable,** the dewarping process takes place either at the client/server, where the client software handling the dewarping of the images resides, or at the camera itself. The purpose of this white paper is to discuss the benefit of dewarping at the client/server, utilizing the superior features found in Wavestore dewarping technology.

# Demand for Dewarping Increases with Growing 360/180° Camera Usage

The dewarping function in Wavestore Video Storage and Management Systems eliminates distortion caused by wide-angle lenses in real time. When an event occurs, with Wavestore dewarping technology to flatten 360/180 degree camera images, security personnel can retrieve details that are important to the actual situation, while also having a variety of other viewing options available to access and review. The dewarping function records the original 360-degree or fisheye image from any panoramic camera and enables specific areas of interest to be dynamically selected and viewed as events demand. Present views can be set and saved.

The demand for 180/360 degree cameras continues to grow at a rapid pace, gaining market share in verticals such as retail, airports, schools, casinos, resorts and a variety of other public or private places, where monitoring wide areas is a key requirement of the video surveillance system. In these scenarios, field of view is an important aspect to consider when selecting surveillance cameras. To cover vast areas like warehouses, parking lots, hotel lobbies, stadiums or retail stores, the wider angle view from fisheye or panoramic cameras provides broader coverage.

For example, 360-cameras excel in a retail store where a single camera can observe all directions at the same time. The cameras are also successfully being deployed in settings like college lecture halls, casinos, office lobbies, hallway intersections and enclosed parking garages and more.

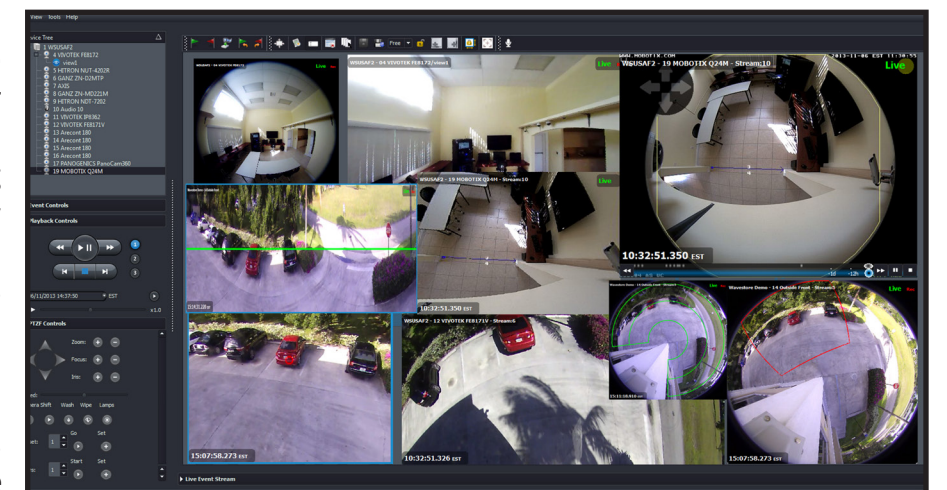


The dewarping technology built in to Wavestore Storage and Management Systems excels in a retail environment.

# Demand for Dewarping Increases with Growing 360/180° Camera Usage

Fixed cameras, by contrast, focus on one spot. Often used for entrances and exits, they do not provide the efficiency offered by fisheye or panoramic cameras. While traditional PTZ cameras can help negate the problem of focusing on one area and avoiding blind spots, they cannot provide an uninterrupted record of all events simultaneously and they may not be monitoring where an incident is occurring in the first place. A 360 degree camera exceeds the capabilities of a PTZ camera by recording activity over a wide area, in every direction at the same time. The ability of 360/180 degree cameras to capture images that could be missed by traditional fixed cameras or even pan-tilt-zoom camera models makes them critical for security applications where sweeping views are required.

A single 360-degree fisheye camera not only significantly reduces the number of cameras required to cover a particular area, additional capital expenditures are saved by needing less infrastructure and fewer security personnel to monitor that area. With no moving parts further savings can be achieved on installation and maintenance budgets as well.



The Wavestore dewarping feature is the perfect choice for handling the images produced by these exceptional *Wavestore dewarping offers many viewing and backup options.* Not only does Wavestore dewarping integrate the 360 camera video streams but also handles the digital PTZ controls without any need of a third party Software Development Kit (SDK) integration. You can move throughout the 360 image simply by using a 3 axis mouse and have the option to overlap the whole image in the panoramic view. While reviewing recorded video, an operator can use a digital PTZ to investigate specific areas of interest without losing the whole picture.

Users can directly control the 360 degree camera from the Wavestore Graphical User Interface (GUI) as well as the other connected cameras using easy commands, visual indicators and icons. After an initial set up to choose the appropriate mounting, users can create new 360 degree camera virtual views quickly and easily while monitoring live cameras. Security personnel will not notice any difference in the layout of 360 degree camera virtual views since the control is similar to conventional PTZ operation.

## Advantages of Wavestore Client-Side Dewarping

Panoramic cameras are available with dewarping on the client application and on the camera. Industry evidence and experience shows that there is a significant advantage when the dewarping is performed on the client-side with an application such as Wavestore versus dewarping at the camera. Dewarp is built into all Wavestore Video Storage and Management Systems—no extra plugins or compacted configurations needed.

Wavestore offers a powerful and efficient dewarping algorithm that supports all ONVIF Profile S conformant video cameras. Wavestore leads the market in camera technology partners offering the largest list of close to 2000 compatible analog/IP camera integrations. Wavestore Video Storage and Management Systems give a seamless user experience with zero latency.

The Wavestore dewarping function enables the original fisheye image from a wide range of cameras to be recorded and specific areas of interest to be dynamically selected or viewed as events require. By dewarping the image captured by 360 and 180 degree cameras at the server/client, you can obtain multiple streams and video commonly seen from traditional video systems.

### *Wavestore Software Dewarps 360 Degree Cameras in the Best Way Possible*

The dewarping capability available within Wavestore Video Storage and Management Systems allows greater flexibility. It makes it possible to easily integrate 360-degree cameras into existing analog or IP surveillance systems. Wavestore dewarping facilitates the recording of the original fisheye images captured by a 360-degree camera and simultaneously displays the dewarped images from the same camera, as well as images from other network and analog cameras in a multi-image display.

The original images captured by the 360-degree cameras are stored unaltered so that, when required, specific video data can be copied and authenticated. With Wavestore client-side dewarping, you have the best forensic tool available on the market today.

Dewarping with a Wavestore Video Storage and Management System provides an immersive experience that allows you to go back in time and view the total scene in its original form. You can pan, tilt, or zoom within the 360-degree image just like you would on a live image view. If an incident or event occurs, you can play back the clip from the time just before, during and after the event took place and capture every detail of what happened across the entire scene as if you were there.

An additional advantage to dewarping on the client side is the ability for multiple users to view the same image, with different perspectives, concurrently which is usefulness for remote viewing by different operators at the

## Advantages of Wavestore Client-Side Dewarping

same time. Among the many benefits of the Wavestore dewarping software is that it can record the original fisheye image from any of the many 360° camera manufacturer models, and enable every user to dynamically dewarp and create independent linear images of selected areas, while making a minimal demand on the network bandwidth. There is no time slicing required as with traditional systems.

Wavestore technology utilizes Software Development Kits (SDKs) for multiple platforms that can be integrated into any client-side application. The user interface is simple to learn and intuitive to operate with all of the relevant functions available from the main display screen.

Dewarping on the client-side allows for retrospective viewing, which enables the user to go back in time to view the total scene in its original form and then pan, tilt, and/or zoom within the 360-degree image as desired. Wavestore dewarping technology gives a seamless user experience with zero latency. Wavestore dewarping technology eliminates blind spots. Windows can be moved using PTZ commands over the network, and then have latency similar to what is currently associated with mechanical PTZ cameras.

Dewarping at the camera, by contrast, does not allow the ability to retrospectively view the 360-degree image, which is one of the biggest advantages of using 360-degree cameras. In addition, dewarping at the camera does not allow all users to view the same image at the same time or request a time slice to control the camera, severely limiting its usefulness for remote viewing by different operators at the same time.

With the Wavestore client-side dewarping technology built into all Wavestore Video Storage and Management Systems, you get superb image quality with greater view angles, distortion correction in real-time and better resolution uniformity over the entire image.

### *Wavestore Beats the Competition with Built In Dewarping Technology*

To recap, 360/180 degree cameras can either dewarp at the camera or on the client/server application. Statistics show that there is a significant advantage when the dewarping is performed on the client-side (host dewarping) versus doing the dewarping at the camera (edge dewarping). Edge dewarping is not flexible and does not provide any expansion possibilities. Whenever possible, host dewarping should always be chosen as the preferred solution.

## Advantages of Wavestore Client-Side Dewarping

- Even if fixed cameras are carefully installed blind areas can still occur, which in a retail environment, for example, could be an open invitation to would be shoplifters. While PTZ cameras can help negate this problem, they cannot provide an uninterrupted record of all events simultaneously and may not, of course, be monitoring where an incident is taking place.
- Using Wavestore dewarping technology, a 360 degree camera exceeds the capabilities of a PTZ camera by recording activity over a wide area, in every direction at the same time. While reviewing recorded video an operator can use a digital PTZ to investigate specific areas of interest without losing the whole picture.
- The use of 360 degree cameras can significantly reduce the quantity of cameras, infrastructure and security personnel needed to monitor a large area. In applications such as retail surveillance, airport security, manufacturing processes or public spaces, the benefit of installing these cameras is that a single device is able to monitor an entire area continuously.
- In addition, the Wavestore dewarping function enables the original fisheye image from a wide range of cameras to be recorded and specific areas of interest to be dynamically selected and viewed as events require.
- The Wavestore dewarping feature not only integrates the 360 camera video streams but also handles the digital PTZ controls without any need of third party SDK integration. You can move throughout the 360 image simply by using a 3 axis mouse and have the option to overlap the whole image in the panoramic view.
- Users can directly control the 360 degree camera from the Wavestore GUI as well as the other connected cameras using easy commands, visual indicators and icons. After an initial set up to choose the appropriate mounting, users can create new 360 degree camera virtual views quickly and easily while monitoring live cameras. Security personnel will not notice any difference in the layout of 360 degree camera virtual views since the control is similar to conventional PTZ operation.
- With the latest Wavestore video management software it is now possible to integrate 360 degree cameras into existing and new surveillance systems. Wavestore Video Storage and Management Systems with built in dewarping facilitate the recording of the original fisheye images captured by a 360 degree camera and simultaneously displays the dewarped images from the same camera, as well as images from other network and analog cameras, in a multi-image display. The original images captured by the 360 degree cameras are stored unaltered so that, if required, specific video data can be presented and verified in a court of law.

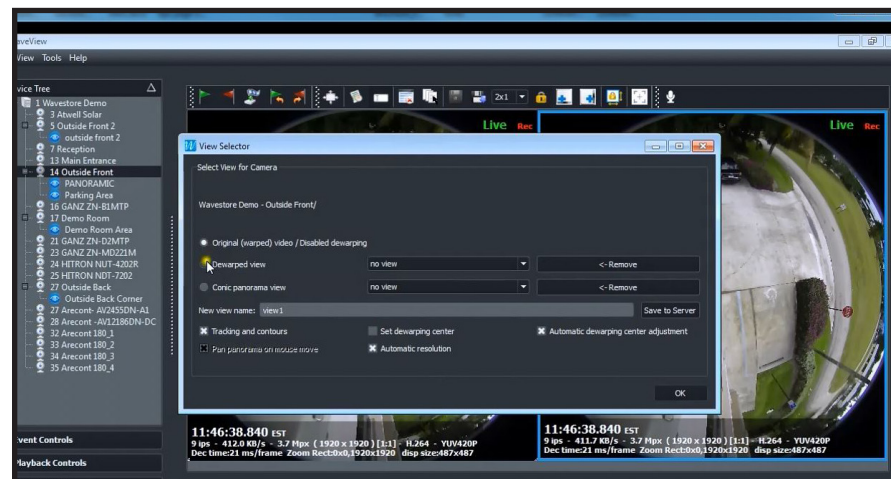
## Wavestore Superior Built In Dewarping Functions

All Wavestore Video Storage and Management Systems feature built in dewarping. The dewarping process ensures minimal resolution loss on the dewarped images. Wavestore 360/180 degree camera dewarping software provides a host of industry leading functions including the following:

- Easily configured to display both the fisheye and the dewarped images of the area covered.
- The distorted hemispherical image of the fisheye camera is converted into a conventional rectilinear projection.
- The original image is recorded by Wavestore and can include Authentication, where evidence is required.
- The original image can be displayed together with one or more “fixed virtual views” simultaneously (highlighted in red bounded area, if required).
- The original image can be displayed together with one or more “PTZ virtual views” simultaneously (highlighted in green bounded area, if required).
- Identical images from the same 360 degree camera view can be displayed simultaneously (live and archived).
- The horizon can be set according to the application (useful for video conferencing where the faces are faithfully reproduced).
- Set up routines are provided to display images from the camera if 360 degree cameras are wall, ceiling or desk mounted.
- A configurable user layout provides for each image size, position and aspect ratio to be individually set and saved as one of many “unique user views.”
- An option to display the full panoramic (dewarped) image is provided, which can be presented as a “letter-box” image.
- Multiple data streams can be configured dynamically.

# Wavestore Superior Built In Dewarping Functions

- No need to use specific end to end video management packages.
- Dewarp process is smooth and fast.
- Images are better quality while using lower CPU consumption. The 360° viewing functionality uses advanced dewarping algorithms to generate images with accurate and realistic perspective.
- Offers savings on bandwidth and storage usage.
- Feature rich and highly customizable. Different customizable and multi-platform views and projections are provided.
- Growing list of close to 2000 compatible cameras. Wavestore leads the market with excellent camera compatibility and analog/IP camera integration.









The View Selector window is simple to navigate.

- Allows panoramic views in addition to dewarp. Dewarping algorithms allows immersive navigation inside any live or recorded 360° Conic panorama view showing a flat image of the entire captured area. Immersive navigation is also possible on multiple independent panoramic views of all 360 degree cameras.
- Able to enhance the image quality in certain zones of interest. The 360° viewing functionality uses advanced dewarping algorithms to generate images with accurate and realistic perspective. Able to produce still shots and snapshots of events.
- Easily adapts to any client server, personal computer, web browser or embedded hardware.
- Detailed analytics, documentation and reports.

# Wavestore 360 Degree Camera Testing Program

Wavestore Video Storage and Management Systems integrate with thousands of video surveillance cameras which are extensively pre-tested with the Wavestore dewarping feature. The ongoing testing program at Wavestore is updated on a regular basis. Below is a listing of the top cameras most recently tested.

	<p><b>Samsung SNF-8010VM</b></p> <p>Samsung's <b>SNF-8010VM</b> 360° fisheye camera features 5MP @ 20 fps which captures smooth video at a higher frame rate with true day and night function. Bi-directional audio allows greater situational awareness. Rated to IP66/IK10 (SNF-8010VM), it can work effectively in more demanding environments that are prone to severe or varying weather conditions as well as tampering or physical attack.</p>
	<p><b>Mobotix Q25M</b></p> <p>The <b>Mobotix Q25M</b> 360° ultra-compact weatherproof camera features 5 MP @ 30 fps and a 360° all-round view to capture an entire room, a panorama function and a quad view to show images from four different angles simultaneously. Robust and low maintenance with no moving parts, the Q25 offers optimized image quality and reduced motion blur for perfect exposure and reduced image noise even in poor lighting conditions.</p>
	<p><b>VIVOTEK FE8172</b></p> <p>The <b>VIVOTEK FE8172</b> fisheye fixed dome network camera features a 5-Megapixel CMOS Sensor and 30 fps @ 1080p full HD. Equipped with a fisheye lens for 180° panoramic view (wall mount) or 360° surround view (ceiling/floor/table mount) without blind spots, the camera offers various display layouts. In addition, the FE8172 features a removable IR-cut filter, maintaining clear images 24 hours a day.</p>
	<p><b>Sentry 360 IS-IP10K</b></p> <p>The <b>Sentry 360 IS-IP10K</b> is a professional-grade multi-megapixel network security and surveillance camera. With an active resolution more than 32x that of traditional CCTV cameras, the IS-IP10K is a great choice in applications requiring the highest forensic detail. Measuring 1.38" x 2.52" x 3.27", the camera is equipped with a 10.0 Megapixel CMOS sensor and includes motion detection and day/night options, among other features.</p>

	<p><b>AXIS M 3007 – P</b></p> <p>The <b>AXIS M 3007 - P</b> fixed mini dome network camera offers 360° / 180° panoramic view and resolution up to 5 MP. A totally inconspicuous impact-resistant design, it blends easily into walls and ceiling s. The affordable AXIS M3007-P camera comes pre-focused out of the box, saving on installation time. The AXIS M3007-P allows for a variety of views including the whole view of 360°, Panorama, Double Panorama, Distortion Correction and Quad views.</p>
	<p><b>Panasonic WV-SF438</b></p> <p>The <b>Panasonic WV-SF438</b> dome network camera features 360° monitoring with a variety of transmission modes: Panorama, Double Panorama, Quad PTZ, Single PTZ, and Quad streams. Offering 1080p full HD images up to 30 fps, multiple H.264 streams and JPEG streams ensure simultaneous real time monitoring and high resolution recording. The WV-SF438 also offers smooth PTZ operation and built-in distortion correction function among other features.</p>
	<p><b>Brickstream LIVE By Nomi</b></p> <p><b>Brickstream LIVE</b> combines behavior and security in a single platform, using stereo vision analytics to accurately and anonymously detect people and their movements. Designed for retailers, malls, entertainment venues, transportation, healthcare facilities, among other verticals, the compact camera offers high definition video streams, multiple areas of interest, and easy integration.</p>
	<p><b>GeoVision GV-FE420/GV-FE421</b></p> <p>The <b>GeoVision GV-FE420/GV-FE421</b> fisheye camera allows you to monitor all angles of a location with just one camera. In addition, the 4MP progressive scan CMOS 360 degree camera features electronic day-night function, auto pan function, privacy mask, visual automation, tampering alarm, built-in microphone and speaker, one sensor input and alarm output, and micro SD/SDHC Card Slot.</p>
	<p><b>AMG Panogenics PanoCam360</b></p> <p>The <b>AMG Panogenics PanoCam360</b> 5MP network camera provides up to fourteen simultaneous electronic-Pan-Tilt-Zoom and panoramic video streams which may be recorded or viewed live. The PanoCam 360 features 185° Fisheye Lens, 10 Preset positions and 10 Privacy zones, Alarm in / out, 12.5 Frames Per Second, 5 Watt PoE or 12Vdc and Indoor, Outdoor, Surface or Flushmount, Vandal Resistant and Low Profile housing options.</p>
	<p><b>Oncam Evolution 05 Indoor Camera</b></p> <p>The <b>Oncam Evolution 05 Indoor Camera</b> features 5MP @ 30 fps and no moving parts. The camera can provide 3 simultaneous H.264 and MJPEG video streams, with resolutions from 528x480 (¼ MP), up to 2144x1944 (4MP). Available in either black or white finish, the Evolution Indoor Camera is a convenient surface-mounting enclosure that fully supports Power-over-Ethernet standard for installation convenience.</p>

