BriefCam®

Architecture & Engineering Overview

August 2011

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1 Introduction

NO ONE can watch hours and hours on end of surveillance video. And yet CCTV deployment continues to grow exponentially worldwide, generating just that - hours and even days of surveillance video that goes largely unwatched. Consequently, there is growing need for technologies that can assist video surveillance operators in browsing ever increasing volumes of video footage, whether in real-time or in offline, post-event investigation scenarios.

Current video review methods typically involve "fast forwarding" through hours of taped surveillance records in search of the event of interest. This manual process results in valuable evidence often being overlooked or, in most cases, being discovered long after the event has been reported.

Case in point - the London bombings of July 2007, for example, generated a reported 80,000 video tapes – hundreds of thousands of hours that needed be pored over to pin down a precious few frames portraying a number of suspect men with backpacks standing near the entrance to the London Underground. The result –investigations lasted months. Similarly, the failed Times Square car bombing of 2010 had investigators combing through footage from a reported 82 cameras, and managing to review recordings from a mere 30 cameras by the end of the first day.

As challenging as video footage review may be for government, law enforcement and other organizations, the challenge becomes even more pronounced with SMB (Small to Medium Business) enterprise users and consumers. Much as these video surveillance users may regard watching over company or private property, household pets, children, elders and caretakers as critical, they simply do not possess the time or resources required to review large volumes of video footage.

This acute need for technology that can effectively help users overcome traditional video review challenges presents great business opportunity. Responding to this opportunity, BriefCam has developed BriefCam VS Enterprise and BriefCam VS Forensics. This uniquely powerful Video Synopsis™ offering is capable of compacting hours of video into "briefs" of mere minutes that concentrate and draw attention to critical events. Full context is retained in that these video briefs serve as easily accessible indexes into the original, full-length video.

A uniquely powerful yet fast and easy to install Total Video Review offering, BriefCam makes it possible for video surveillance operators to:

- Review hours and hours of video in a matter of minutes
- Manage and respond to critical events in real time
- Quickly conduct post-event investigations
- Make video review part of a daily routine

Document Objectives

This architecture and engineering overview introduces BriefCam's BriefCam VS Enterprise and BriefCam VS Forensics product offerings, while detailing their underlying architecture and the engineering considerations they reflect.

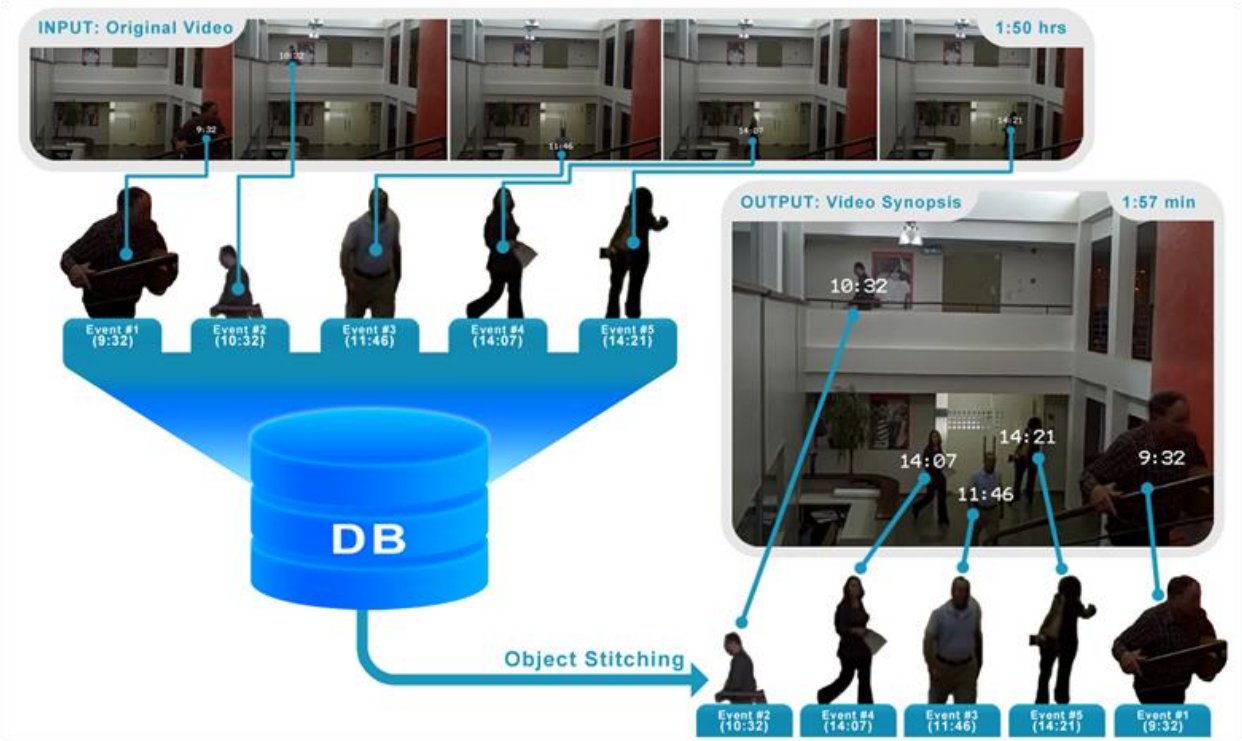
This document is primarily intended for the following key audiences:

- **System planners, architects and consultants** are likely to find the information provided useful for composing or responding to RFIs or RFQs for video surveillance and monitoring projects of any scale
- **System integrators and BriefCam channels** should find this document a valuable resource for prospecting, specifications definition, installation and support of BriefCam-based Video Synopsis solutions. Of particular usefulness is the information provided on how to quickly and easily deploy BriefCam alongside or embedded within existing CCTV and video management solutions
- **Technical partners** – typically Business Development executives, system engineers or CTOs – will find that this overview contains all of the information they and their technical staff require to determine just how readily BriefCam technology can be OEMed as an enhancement of their own in-house solutions

2 The BriefCam Video Synopsis Concept

BriefCam's key innovation lies in its Video Synopsis technology, proprietary image processing technology that essentially creates condensed summaries of original, full length video recordings, while preserving all objects and events of interest. These are presented either simultaneously or in rapid succession, regardless of the time point and sequence in which they occurred, effectively providing operators with a clear view of activities and enabling them to rapidly review and home in on events of interest.

Figure 1: Compacting Hours of Video to Mere Minutes



The main concept behind BriefCam's offering is that human operators remain very much "in the loop". BriefCam provides operators with everything they need to quickly spot anything suspicious, out of the ordinary or potentially criminal, even when they do not necessarily know in advance what they're looking for. The company's Video Synopsis technology enables them to set the speed and density of event playback, focus on specific areas of interest, and toggle time-stamping for detailed event tracking, yet it is ultimately up to operator intelligence, experience and human instincts to make sense of this raw video data.

Full indexing is supported, enabling operators to easily go back and review original video footage – in either real-time online feeds or offline archival video recordings — for on-the-spot event tracking and post-event forensics, as well as evidence discovery and export.

BriefCam's video synopsis is performed in three main stages:

- **Ingestion** - video is analyzed in online feeds – even as it is being recorded by the DVR/NVR (Digital Video Recorder or Network Video Recorder) – or in offline recordings. It is separated into backgrounds (which are required to be static) and foreground events (moving objects) via BriefCam's proprietary VMD (Video Motion Detection) algorithms, with events extracted, tagged and stored in a database.

- **Synopsis** – users specify a time period of interest (i.e. the last 24 hours), and all events (moving objects) detected within this specified period are extracted from the database and superimposed on relevant backgrounds to generate a synopsis video. This video is typically very short – a full day of original footage can be summarized in a few minutes – as events are shifted chronologically and presented simultaneously, regardless of the time at which they actually occurred. Placement of events on backgrounds is performed so as to avoid overlap and ensure full visibility, with context and chronological awareness maintained via time stamp captions.
- **Indexing** – operators select a specific event of interest, which points to the original video, allowing them to review and export this event in full length, as originally recorded.

BriefCam provides Video Synopsis technology to high-end DVR/NVR manufacturers in the security industry, and has formed technology partnerships with companies comprising the mainstream video software market, including Milestone Systems, Genetec and OnSSI. Additionally, the technology can easily be integrated with additional DVR/NVR and other technology partners on demand, and can enable system integrators to provide video synopsis as differentiating functionality in their product and solution offering.

Competing Solutions

While there are no direct competitors to BriefCam's Video Synopsis technology, the company's offering is often compared with VCA (Video Content Analytics) offerings claiming to address similar industry challenges.

Both these technologies utilize smart algorithms to manipulate video, generate meta data and summarize events, but there are substantial differences. First and foremost, VCA offerings require that operators know in advance what they're looking for. Additionally, VCA solutions are generally difficult to set up and expensive, and tend to produce false alarms, effectively desensitizing operators. And yet, the most notable differentiator between BriefCam and VCA offerings is that VCA exclusively utilizes rules-based technology to filter video and issue alerts, whereas BriefCam's offerings present all events in a visual format that is easily and quickly reviewed, leaving critical judgment calls up to arguably more capable human operators and eliminating false alarms.

BriefCam's Video Synopsis offering serves as a decision support system, making operators more efficient by an order of magnitude. It presents them with all events, allows them to quickly go back and forth between original video and synopsis, and ultimately enables them to quickly and accurately identify events of interest.

Given the above differences, BriefCam regards its offering as complementary to VCA, as a highly effective tool set to revolutionize video surveillance.

3 BriefCam Product Offering

BriefCam offers both offline and live video synopsis solutions. The company's VS Forensics product is an easy-to-use software application that accepts existing video recordings as input, while its VS Enterprise product is targeted at real-time as well as post event applications involving integration with high end DVR, NVR and VMS (Video Management System) environments.

BriefCam VS Forensics

BriefCam VS Forensics is an easy-to-use software application that enables users to review footage offline, then create, view and export summary video synopses for post-event investigative purposes.

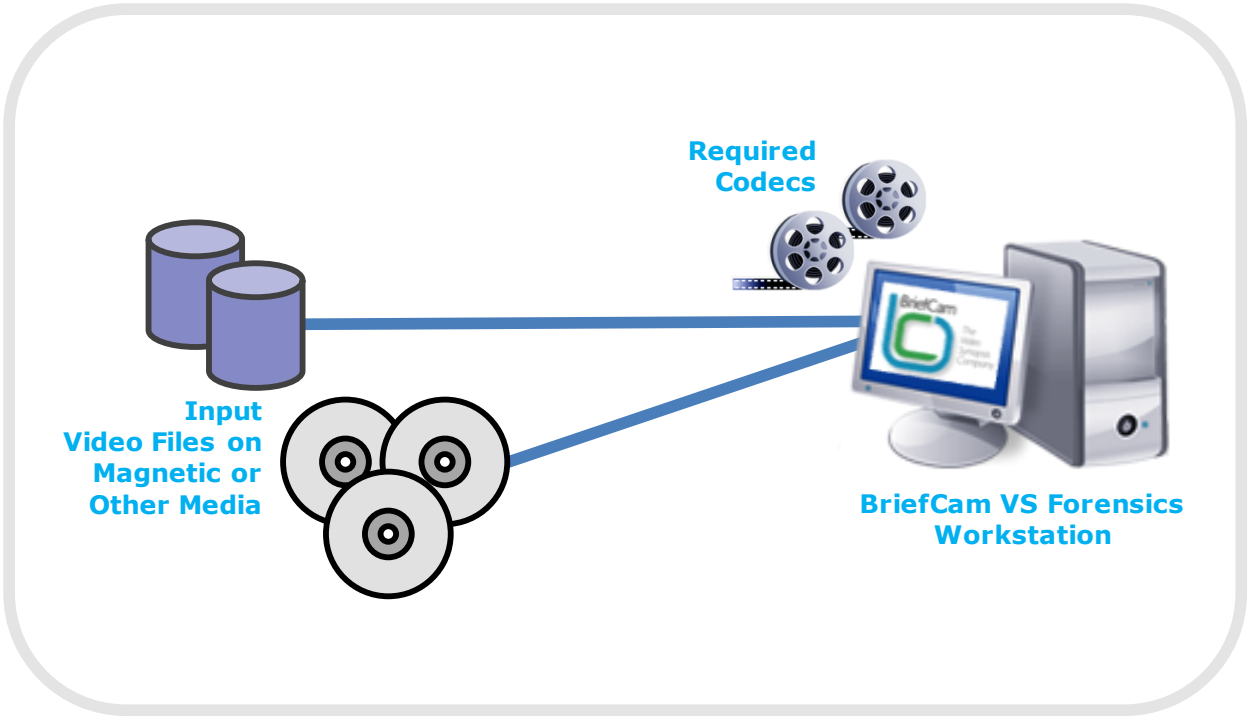
The application enables significant reduction in the amount of time and personnel required to review video footage, resulting in relatively low video storage and manpower costs.

A standalone product, VS Forensics does not require integration with a DVR/NVR, and can process and generate video synopses of up to four digital video files (i.e. AVI or MPEG-4) simultaneously.

VS Forensics can import and process video from industry standard systems commonly used by law enforcement, government agencies, educational facilities, municipalities and loss prevention organizations.

VS Forensics Product Architecture

Figure 2: VS Forensics Architecture



BriefCam VS Forensics accepts video files as input and processes them offline to create reduced length synopses. Processing time is typically 25% of the original video clip's length, so that an hour of video will require roughly 15 minutes of processing time.

To function properly, all required video codecs need be present on the BriefCam VS Forensics workstation. Any Microsoft DirectShow-compatible codec is fully supported, as are proprietary codecs, which may be added to the system as required.

BriefCam VS Forensics can be used to process an unlimited number of video files, with up to four such files processed in parallel at any given moment, depending on the hardware on which BriefCam software is installed. The software application ensures a high level of responsiveness, and even allows users to view synopsis clips of video that has only partially been processed.

Separate video clips may be concatenated into a single synopsis, an especially useful feature in motion detection-based scenarios where footage is shot in segments to reduce storage requirements.

For archival or evidence provision purposes, both video synopses and original video footage of events of choice may be exported to AVI.

BriefCam VS Enterprise

BriefCam VS Enterprise integrates with DVR/NVR and VMS environments to provide both On-Demand and Live functionality. It contains On-Demand channels which accept video synopsis processing requests and deliver the results following an elapsed time period, for post-event investigation. Add-on option from On-Demand to Live channels provides Live continuous processing in real-time of video feeds to assure instantaneous video synopsis availability, and is especially useful in cases where response time is critical.

With the use of On-Demand channels, which are extremely efficient in hardware resource utilization, VS Enterprise is a very cost effective video synopsis solution to cover all cameras on site and enables what BriefCam refers to as Total Video Review (TVR). It makes it easy for operators, Security Officers reviewing video in real time as well as Investigators reviewing video in-depth in search of post-event evidence, to quickly review massive amounts of video as part of their daily routine, thus benefiting from the existing large investment in cameras and recording systems, which is mostly never viewed.

The solution is compatible with a range of leading DVR/NVR offerings, and can easily and seamlessly be integrated with large-scale VMS ecosystems.

VS Enterprise Product Architecture

Figure 3: VS Enterprise Architecture

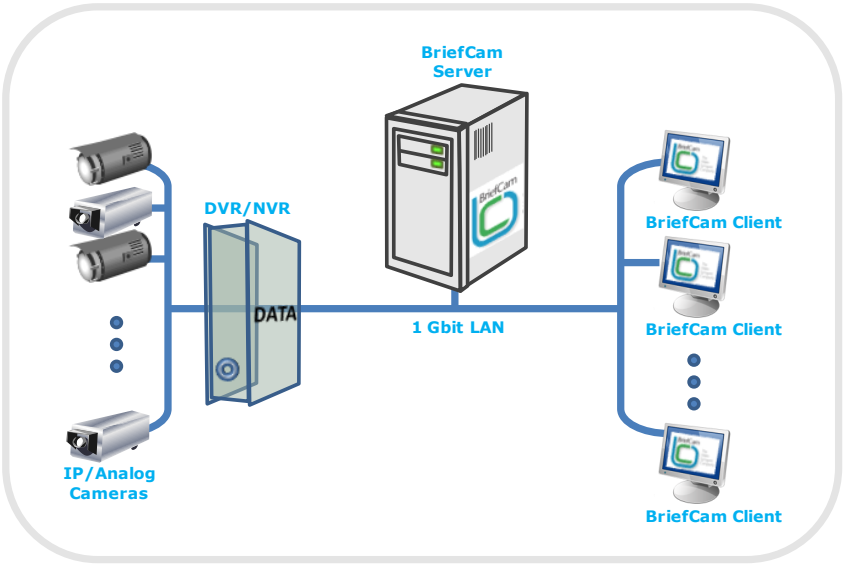
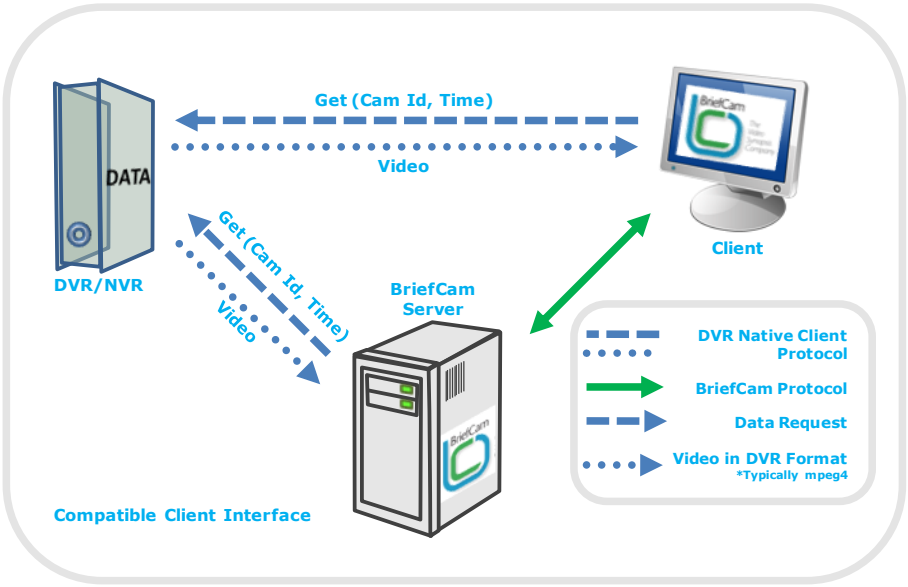


Figure 4: VS Enterprise Logical Components



4 Integration Options

While BriefCam VS Forensics is a standalone product, BriefCam VS Enterprise supports two integrated deployment modes.

One essentially involves side-by-side deployment alongside existing DVR/NVR or VMS environments, with BriefCam runing on a dedicated workstation and under its own proprietary user interface.

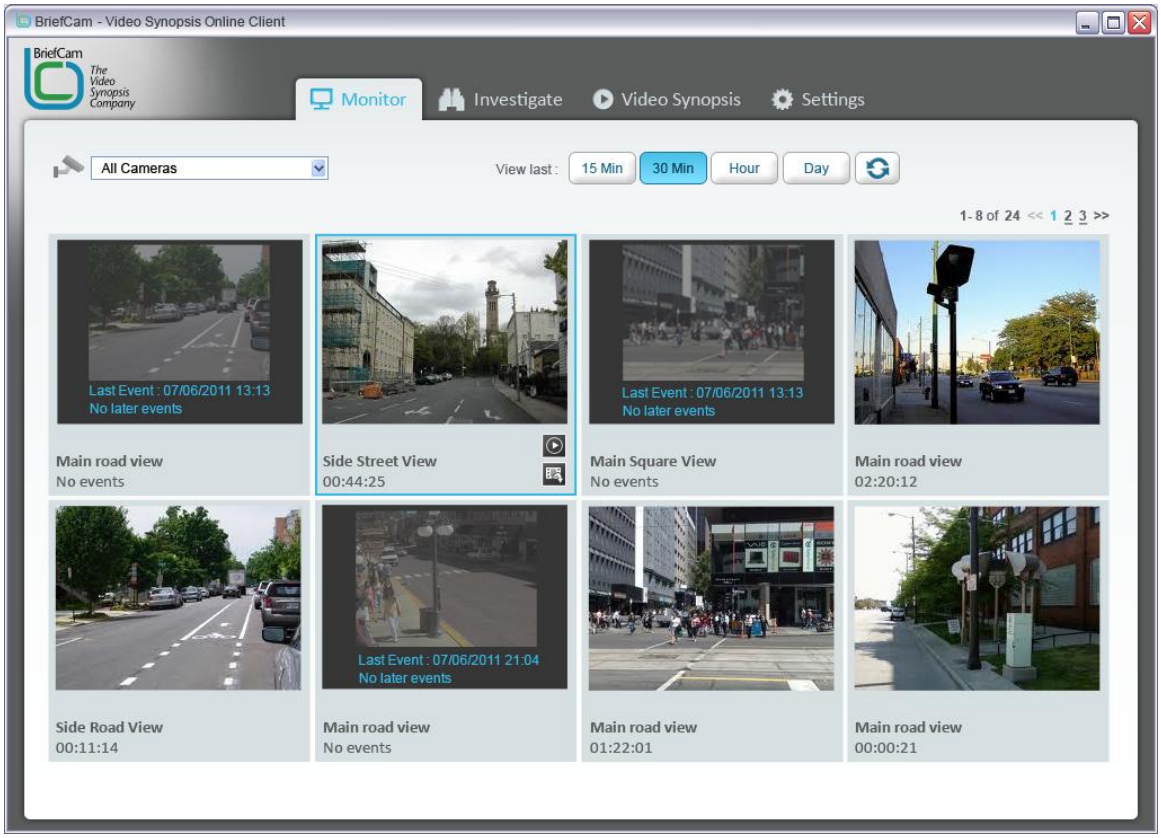
The other involves a high level of integration, with BriefCam seamlessly embedded in the DVR/NVR or VMS environment of choice, resulting in highly streamlined user experience.

Side-by-side Deployment (Server-side Integration)

In side-by-side deployment scenarios, BriefCam requires the video surveillance or management system vendor's server-side SDK, as the basis for limited integration. Following such integration, operators access cameras, configure and manage video recordings via the partner's traditional DVR/NVR or VMS client user interface, with a standalone BriefCam application (now residing alongside the partner's software interface) providing them access to full video synopsis capabilities.

A relatively short period of R&D, integration and testing is typically required to adapt BriefCam to the vendor's server SDK. These efforts result in the BriefCam software smoothly interfacing with the video surveillance or management system of choice, yet presented to the user via a separate, standalone desktop application and user interface.

Figure 5: Standalone BriefCam VS Enterprise Client Running Alongside Partner Client Application



Side-by-side deployments typically comprise the following:

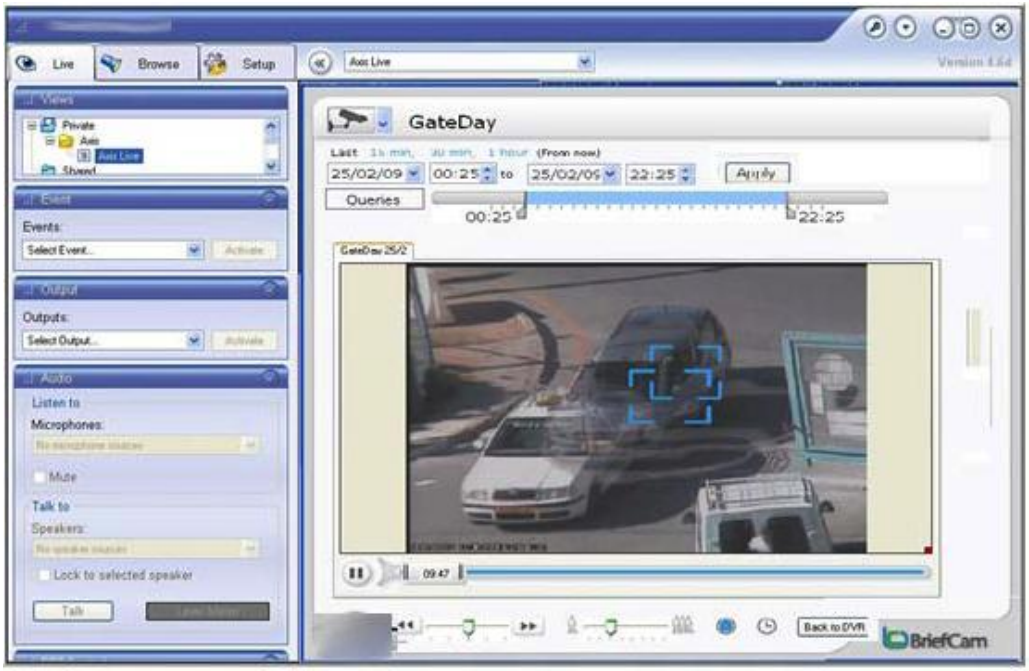
- The DVR/NVR/VMS partner's recording server
- The partner's own client application (recorded video data view)
- The BriefCam server
- The BriefCam client application (running on the same PC alongside the partner's client application)

Full (Server- and Client-side) Integration

In fully integrated configurations, both DVR/NVR or VMS vendor-supplied server-side SDK and BriefCam's own client-side SDK are utilized to seamlessly embed BriefCam software in the vendor's user environment.

Following moderate integration efforts leveraging both SDKs, BriefCam becomes inherent to the system it is embedded in. When users select cameras in the vendor's video data view, they are presented with BriefCam's full functionality – including the ability to generate video synopses and access indexed original video feeds on demand – embedded as an organic element of the video management system's own user interface. (see Figure 6).

Figure 6: BriefCam VS Enterprise Embedded in Vendor GUI



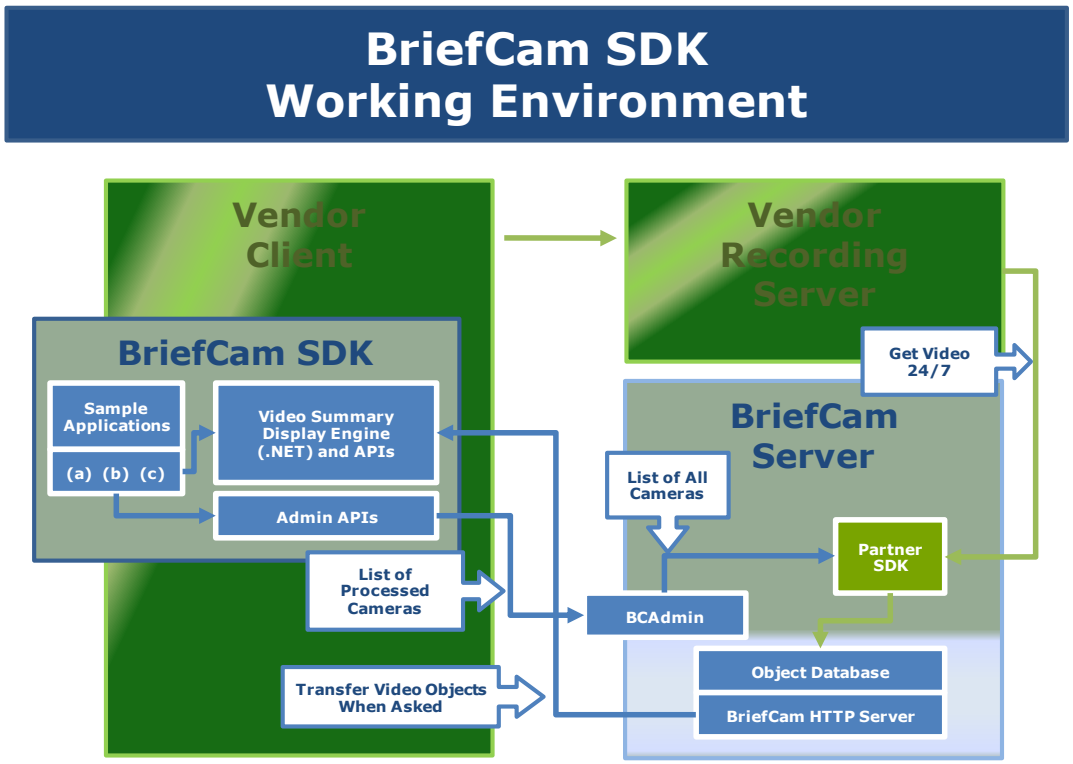
BriefCam's embedded video summary window allows video operators to view and freely manipulate summaries – they may play and pause video, increase or decrease the number of objects presented, select and move individual objects and more.

Please refer to BriefCam's Client-side Integration SDK for further details on the SDK BriefCam provides to implement high integration deployment scenarios.

BriefCam's Client-side Integration SDK

BriefCam client-side integration SDK is a .NET control with APIs that allow embedding of video summaries in different vendors' video data views.

Figure 7: BriefCam Client-side SDK Working Environment

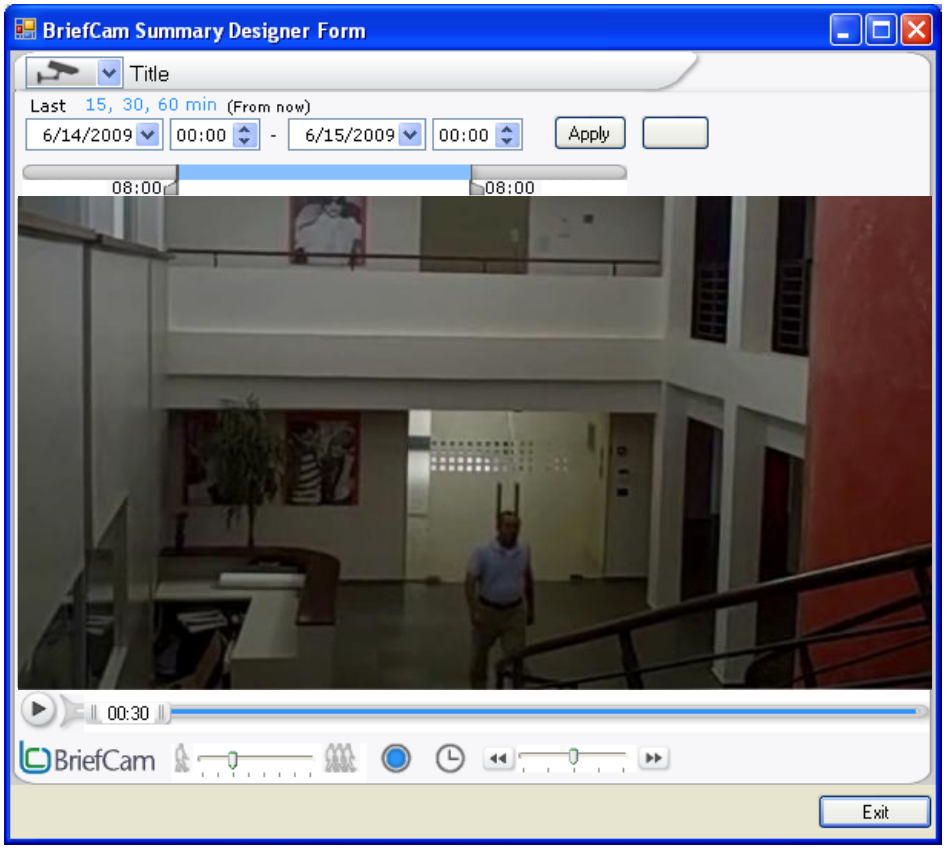


The SDK features the following:

- APIs
- Sample applications
- Documentation (a concise programmer's manual)

The SDK's APIs are implemented as a DLL with a .NET control that implements video summary visualization for a single camera, an executable (.EXE) file for the server, and an interface for definition of select cameras.

Figure 8: Sample SDK-based Application with Full Video Control



The client-side integration SDK essentially enables implementation of video summary control interfaces featuring the following functionality:

- Summary play/pause
- Fast/slow playback
- Display speed control
- Summary object density control
- Object display toggling (highlights detected objects)
- Time display toggling (overlays event start times)
- Summary speed slowdown on mouse motion
- Keyboard-based object tracking
- Start/end time control
- New summary generation (as per timeframe and camera specified)
- Generation of summary covering the last 15/30/60 minutes and 8 hours
- Camera selection

Additionally, the following client functions can be activated via external command:

- Activate
- Fast/slow summary playback/pause
- Set/get start/end time
- Set/get camera

External commands can also activate the following server functions:

- Set DVR parameters
- Set/get supported camera list
- Set/get BriefCam user password

DVR/NVR/VMS Vendor Integration Compatibility

BriefCam's Video Synopsis offering can be seamlessly integrated with a broad range of leading DVRs, NVRs and video management systems. The following table provides specific, per-vendor compatibility details.

Table 1: BriefCam Video Synopsis Primary Vendor Compatibility

Vendor	Product	Models	Versions	Notes
Milestone	XProtect	Enterprise	6.5, 7.0, 8.0*	
		Professional	6.5, 7.0	
		Corporate	2.0**, 3.0**, 3.1, 4.0	
Genetec	Omnicast		4.6, 4.7	Federation not supported
OnSSI	Ocularis		1.1	
	NetGuard	NDVS, NETDVMS	4.6f	
	NetDVR		6.5c	

(*) Under evaluation (**) To be discontinued in upcoming release

5 Product Specifications

BriefCam VS Forensics Specifications

Licensing Terms

BriefCam VS Forensics is offered under a single-user license with a 12-month warranty, and enables processing of an unlimited number of video files.

Hardware Requirements

BriefCam VS Forensics requires the following minimum hardware configuration:

- **Operating system:** Windows XP or Windows 7 with .NET 4.0
- **CPU:** a quad-core CPU for parallel processing of up to 2 video clips;
  Core-i7 for parallel processing of 3 to 4 clips
- **Memory:** 2 GB of RAM
- **Hard disk:** 1 TB of available disk space

Languages Supported

BriefCam VS Forensics supports English, Japanese, Simplified Chinese, Traditional Chinese and Korean in both BriefCam user interface and Windows operating systems.

BriefCam VS Enterprise Specifications

Licensing Terms

BriefCam VS Enterprise supports two types of channels: On-Demand and Live, each with different license terms. On-Demand channels are fixed licenses, must be assigned to a particular camera, and cannot be moved following the installation from one camera to another. Live channels, are per-site floating licenses add-on to On-demand channels (assigned to a particular camera, but may be moved between cameras with On-Demand license – subject to the number of concurrent cameras licensed under the agreement). VS Enterprise is backed by a 12 months of warranty.

Server licenses may be installed on any PC on the network. Base licenses cover either 30 On-demand channels (i.e. On-Demand functionality for 30 individual cameras with no Live channels functionality), or a combination of 10 On-Demand channels and 10 Live add-on channels (i.e. On-Demand functionality for 10 individual cameras with Live channels add-on functionality for the same 10 cameras) with expansion priced as per each additional On-Demand/Live channel.

Hardware Requirements

To implement a BriefCam VS Enterprise deployment, a server component is installed on a server PC for central processing, and client components are installed on PCs enabling video summary review. Upto 3 clients are allowed, only one concurrent client using the On-Demand channels (Investigate Screen) and upto two clients running Live channels (Monitor Screen) can run simoultaneousely.

The solution can be configured to process up to 32 Live cameras and practically unlimited number of On-Demand cameras (per server) monitoring normal activity and stored for a duration of up to 21 days. Normal activity involves an average of 2 to 5 objects (people, cars, etc.) moving at a given moment in time. While response time of Live channels is immediate, actual response time of On-Demand channels will depend on PC performance and its load.

Minimum BriefCam Server PC Requirements (up to 16 4CIF Live Channels per Server)

- **Operating system:** Windows XP Professional or Windows 7 Ultimate with .NET 4.0
- **CPU:** a quad-core processor
- **Memory:** 2 GB of RAM
- **Hard disk:** 1 TB of available disk space
- **Network:** a 1 Gigabit Ethernet LAN adapter

Minimum BriefCam Server PC Requirements (up to 32 4CIF Live Channels per Server)

- **Operating system:** Windows Server 2008 with SP2 and .NET 4.0
- **CPU:** dual quad-core (Xeon or equivalent) processors
- **Memory:** 16 GB of RAM
- **Hard disk:** 2 TB of available disk space
- **Network:** a 1 Gigabit Ethernet LAN adapter

Note: projects incorporating more than 32 4CIF Live channels will require custom deployment of multiple BriefCam servers. Please contact BriefCam's technical support team for further information.

Minimum Client PC Requirements

- **Operating system:** Windows XP Professional or Windows 7 with .NET 4.0
- **CPU:** a dual-core processor
- **Memory:** 2 GB of RAM
- **Display:** XGA (1,024 x 768 resolution)

Languages Supported

BriefCam VS Enterprise supports English only.

Processing and Other Impact Factors

Integrating BriefCam with a DVR, NVR or VMS environment is likely to bear a certain impact in terms of processing load.

The following table provides details on the exact processing impact incurred by BriefCam on specific vendor systems.

Table 2: Per-vendor BriefCam Processing Impact

Vendor	Product	Impact
Milestone		Every BriefCam channel may impose an increase of up to 1% in CPU processing load. 100 channels and up will therefore require the vendor to utilize a multiple server architecture
Genetec		BriefCAm deployment will require a Genetec DFS license for each individual channel and and two Genetec SDK licenses for each BriefCam client
OnSSI		

Impact on Network Load

In most cases, BriefCam integration will roughly double the load on network throughput.

For example, if BriefCam is configured to process 50% of the channels (camera feeds) connected to a VMS system, it will add approximately 50% to overall network load.

Additional Implementation Considerations

Frame Rates

Standard cameras normally record video at 25 or 30 frames per second.

BriefCam's processing algorithm adapts to input video frame rates as follows:

- **25 or 30 fps** - BriefCam processes alternating frames, effectively reducing the number of frames to be processed by half (i.e. 30 frames per second are processed as 15 frames per second, and 25 frames per second as 12.5)
- **Reduced frame rates (due to network or other load) ranging from 20 to 30 fps** – video processed normally, at half the frame rate (i.e. BriefCam processes alternating frames)
- **10 to 20 fps** – video processed as is, at the input frame rate (i.e. each individual frame is processed, as opposed to alternating frames)
- **Frame rates lower than 10 fps** – video processed as is, with performance degradation (i.e. reduced event detection rate and potential misses) to be expected
- **5 fps or lower** – not handled

Detection Performance

Detection of objects is subject to the following criteria:

- **Minimal time duration** – any object spanning a time period longer than one second is detected
- **Minimal object size** – the minimal size of objects that can be detected depends on the contrast between specific objects and the background. Typical minimal object size is approximately 9 × 9 pixels
- **Minimal contrast** – the minimal contrast of objects that can be detected depends on the size of specific objects. Typical minimal object contrast is of approximately 15 grey levels
- **Illumination effects** – illumination is ocassionally detected as an object

Camera Placement and Additional Detection Considerations

BriefCam supports static cameras only. PTZ (Pan/Tilt/Zoom) cameras can be supported, assuming they are in a fixed position when video is recorded.

Changes in background (for example, when transitioning from daylight to night-time) may result in video artefacts or visual quality degredation.

Very crowded scenes may result in longer video summaries. Conversely, summary duration is reduced in less crowded scenarios.

Typical Synopsis Video Length

In a detailed field study, during which BriefCam analyzed data from more than 1,500 hours of video recorded by four different cameras during a three week period, it was discovered that, on average, BriefCam can compact a full hour of captured video reflecting medium activity to a synopsis of just 60 seconds.

Average synopsis video length can be cut down further – to approximately 20 seconds per hour of video – using BriefCam's AOI (Area of Interest) or AOE (Area of Exclusion) features. AOI/AOE are able to effectively filter out undesired visual "noise", such as wind-induced tree movement, as well as such background motion as distant roadway traffic.

Even in worst case scenarios, 90% of the summaries produced during the course of the field study were of a duration of no more than 10 minutes per one hour of video.

Supported Resolutions

BriefCam VS Forensics

The BriefCam server has successfully been tested with cameras featuring 5 Megapixel resolution, and supports a range of export video resolutions.

Exported video exceeding 1 Megapixel resolution is downsampled to dimensions supported by the BriefCam encoder, as per Table 3 below.

Table 3: VS Forensics Original Video/Export Resolution Downsampling

Resolution	Dimensions	Original AVI Export Resolution
Lower than CIF		Lower than CIF
CIF (PAL)	352 x 288 x 12.5 fps	CIF (PAL)
CIF (NTSC)	320 x 240 x 15 fps	CIF (NTSC)
PAL	720 x 576 x 25 fps 704 x 576 x 25 fps	4CIF (704 x 576)
NTSC	640 x 480 x 30 fps	4CIF (640 x 480)
1 Megapixel	1,024 x 1,024 x [] fps	4CIF (704 x 576)
1 to 5 Megapixels		4CIF (704 x 576)

BriefCam VS Enterprise

The BriefCam server supports cameras of resolutions ranging up to 1 Megapixel. Feeds from cameras recording at a resolution higher than 4CIF may result in performance degradation, with resolutions higher than 1 Megapixel completely rejected.

Exported original video may be resized to dimensions supported by the BriefCam encoder, as per Table 4 below.

Table 4: VS Enterprise Original Video/Export Resolution Downsampling

Resolution	Dimensions	Original AVI Export Resolution
Lower than CIF		Lower than CIF
CIF (PAL)	352 x 288 x 12.5 fps	CIF (PAL)
CIF (NTSC)	320 x 240 x 15 fps	CIF (NTSC)
PAL	720 x 576 x 25 fps 704 x 576 x 25 fps	4CIF (704 x 576)
NTSC	640 x 480 x 30 fps	4CIF (640 x 480)
1 Megapixel	1,024 x 1,024 x [] fps	4CIF (704 x 576), may impact server performance
More than 1 Megapixel		Blocked

6 Site Survey Template

Detailed site surveys are used to record essential information and specific technical aspects of customer sites in advance of BriefCam VS Enterprise deployment.

This section features a typical BriefCam site survey document template.

Contact Details:

Contact person: _____

Title: _____

Phone number: _____

E-mail: _____

Company: _____

Technical person name: _____

Technical person Tel.: _____

Technical person e-mail: _____

Integrator Details:

Integrator name: _____

Title: _____

Phone number: _____

E-mail: _____

Company: _____

Site Information

Video Recorder information

Vendor type: _____ Server version: _____

Number of recording servers: _____

Number of management servers: _____

Master/slave configuration: Yes/No

Backup server: Yes/No

Server License Information (for Genetec Installations)

Number of SDK connections: _____

Number of uncompressed video filters: _____

Note: please provide snapshot of license information if available

Devices Connected to Recording Servers

Encoders

Encoder Type	Model

Cameras

Camera Type	Model

Total number of cameras: _____

Recording Profile

FPS (1-30): _____

Bit rate (1 Mbps – 4 Mbps): _____

Resolution (CIF, 2CIF, 4CIF): _____

Stream type (MP4, h264, MJpeg): _____

Recording performed: (24/7)/on motion

Viewing Profile

FPS (1-30): _____

Bit rate (1 Mbps – 4 Mbps): _____

Resolution (CIF, 2CIF, 4CIF): _____

Stream type (MP4, h264, MJpeg): _____

Storage Requirements

Number of days to store channel information: _____

Recording System Clients

Number of concurrent clients connected to the recording system: _____

Number of remote locations where clients are installed: _____

Operating system model client machines for BriefCam Client installation
(XP, Vista, Windows 7, 32 bit – 64 bit): _____

Network Information

Type of network (LAN/Wireless): _____

Speed (100 Mbps – 1 GB): _____

External Internet access available on site: Yes/No

Site Diagram

7 CSI 2004 Specifications

The following sections provide CSI 2004 compliant BriefCam VS Forensics and BriefCam VS Enterprise specifications.

BriefCam VS Forensics CSI 2004 Specifications

BriefCam VS Enterprise CSI 2004 Specifications

Contact Information

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